Conference Abstract

2022 IEEE 22nd International Conference on Communication Technology (22nd IEEE ICCT)

November 11-14, 2022
Nanjing, China

Organizers / 主办单位

IEEE 江苏省信息技术应用学会 JIANGSU INFORMATION TECHNOLOGY APPLICATION SOCIETY

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JEIT 电子与信息学报 JOURNAL OF ELECTRONICS & INFORMATION TECHNOLOGY

SIE 四川省電子學會 Sichuan Institute of Electronics

重庆市电子学会 Chongqing Institute of Electronics

IEEE Singapore Section Education Chapter

IEEE Sensors, Systems and China Councils Joint Chapter

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Wei Wei, Xi’an Unviersity of Technology, China

On behalf of the conference committee, it is our great honor and pleasure to welcome you to the 2022 IEEE 22nd International Conference on Communication Technology (ICCT 2022), which will be held during Nov. 11-14 in Nanjing. ICCT 2022 is organized jointly by IEEE and Jiangsu Information Technology Application Society; and co-organized by University of Electronic Science and Technology of China and Science and Technology on Communication Networks Laboratory. It is sponsored by Xidian University, UESTCYDRI, Beijing University of Posts and Telecommunications, Guangxi University, Chongqing University, Science and Technology on Communication Information Security Control Laboratory, and the Communication Society of Chinese Institute of Electronics; technically supported by Southeast University, Digital Communications and Networks, Journal of Electronics & Information Technology (JEIT), Sichuan Institute of Electronics, Chongqing Institute of Electronics, and IEEE Singapore Section Education Chapter.

Due to the COVID-19 pandemic, ICCT 2022 will be held virtually this year. It is a pity that we cannot gather together in person. However, we work at our best to provide you with a high-quality conference as always, and your strong and full support is greatly appreciated. Many thanks!

This year, we have received a good number of high-quality submissions from both academia and industry. All submitted papers have been carefully peer-reviewed and the quality of ICCT 2022 is therefore guaranteed. We are honored to have invited excellent world-class keynote speakers. They are all leading experts in the research areas close to our conference theme. We are sure that all the attendees will be inspired and benefitted by their keynotes. We are also confident that ICCT 2022 will be a thought-provoking forum for attendees from both academia and industry to share ideas, exchange experiences, discuss challenges, and report the state-of-the-art works. Research progresses in the key aspects of communication technology will make ICCT 2022 very valuable for all attendees.

On behalf of the organizing committee, we thank the authors very much for submitting their works to the conference and allowing us to build a program of high quality. Our heartfelt appreciation goes to everybody supporting ICCT 2022 including the keynote speakers, invited speakers, session chairs, committee members, staffs for their great efforts and contributions. Without them, ICCT 2022 will not be such a great success. We truly hope that you will find the conference program enjoyable and stimulating!

General Chair
Zaichen Zhang, Southeast University

ZOOM Download Link: https://zoom.us/download

ICCT 2022 Kits: http://www.ieee-icct.org/ICCT2022Kits.rar

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Rename screen name before entering the room	Examples
Authors: Paper ID-Name	NA10001-San Zhang
Listener: Listener- Name	Listener-San Zhang
Keynote Speaker: Keynote-Name	Keynote-San Zhang
Invited Speaker: IS-Name	IS-San Zhang
Committee Member: Committee-Name	Committee-San Zhang

Subscribe“电子与信息学报” official account on wechat to watch the opening ceremony and keynote speeches in the morning of Nov. 12 and 13.

Materials Prepared by the Presenters

✧ **Oral Presentation:**

PowerPoint or PDF files

PowerPoint Background Template: http://www.ieee-icct.org/ICCT-PPT%20Template.jpg

✧ **Poster Presentation**:

Poster: 80cm*180cm (height>width), Portrait Format

Poster Background Template: http://www.ieee-icct.org/ICCT-Poster%20Template.jpg

Duration of Each Presentation

✧ Keynote Speech: 40 Minutes of Presentation including Q&A.

✧ Invited Speech: 25 Minutes of Presentation including Q&A.

✧ Regular Oral Presentation: 15 Minutes of Presentation including Q&A.

✧ Poster Presentation: 5 Minutes of Presentation including Q&A.

Note

✧ The regular oral presentation time arrangement is for reference only. In case any absence or some presentations are less than 15 minutes, please join your session before it starts.

✧ An excellent presentation will be selected from each session which will be announced and awarded an excellent presentation certificate.

Pretest Tips:

- ✧ Please get your presentation file ready for the pretest.
- ✧ Please unmute audio and start video while your presentation.
- ✧ It's suggested to use headset with microphone or earphone with microphone.

Pretest 1

Nov. 9, Wednesday, 10:00-11:00, Beijing Time, GMT+8

- **Zoom Link: https://us02web.zoom.us/j/89249045417 / Password: 111114**

NA11035, NA11083, NA11051, NA11038, NA11065, NA11059, NA11078, NA11060, NA11054, NA11012, NA11031, NA11081, NA11061, NA11073, NA11057, NA11001, NA11104, NA11040, NA11066, NA11108, NA11088, NA11070, NA11091, NA11090, NA11017, NA11045, NA11071, NA11074, NA11020, NA11030, NA11019, NA11013, NA11089, NA11003, NA11052, NA11101, NA11077, NA11107, NA11109, NA11039

Pretest 2

Nov. 9, Wednesday, 10:00-11:00, Beijing Time, GMT+8

- **Zoom Link: https://us02web.zoom.us/j/84736236843 / Password: 111114**

NA11084, NA11023, NA11015, NA11080, NA11048, NA21052, NA21074, NA21053, NA11007, NA21049, NA21015, NA21038, NA21044, NA11097, NA21032, NA11062, NA11063, NA21085, NA21023, NA21066, NA21067, NA21031, NA21075, NA21069, NA21072, NA21042, NA21019, NA21039, NA21089, NA21057, NA21029, NA21034, NA21059, NA21062, NA21060, NA21054, NA21076, NA21073, NA21040, NA21043

Pretest 3

Nov. 9, Wednesday, 10:00-11:00, Beijing Time, GMT+8

- **Zoom Link: https://us02web.zoom.us/j/82118500729 / Password: 111114**

NA21036, NA30274, NA21022, NA21033, NA21064, NA21037, NA21020, NA21083, NA21045, NA21084, NA21078, NA21068, NA21047, NA21028, NA21056, NA21016, NA21017, NA30242, NA30252, NA30225, NA21041, NA30247, NA31091, NA30264, NA30227, NA30283, NA21030, NA30287, NA30248, NA30228, NA30237, NA30297, NA30268, NA30233, NA30229, NA30239, NA30206, NA30290, NA40339, NA40374

Pretest 4

Nov. 9, Wednesday, 14:00-15:00, Beijing Time, GMT+8

- **Zoom Link: https://us02web.zoom.us/j/89249045417 / Password: 111114**

NA40337, NA30257, NA30226, NA30319, NA30267, NA30255, NA30211, NA30214, NA40409, NA40384, NA30200, NA40333, NA30295, NA40416, NA30236, NA30203, NA31094, NA30273, NA40340, NA30202, NA30254, NA30217, NA30216, NA40330, NA31099, NA30258, NA30269, NA30282, NA30223, NA30277, NA40342, NA40410, NA30313, NA31098, NA30265, NA30261, NA40423, NA30246, NA40366, NA40381

Pretest 5

Nov. 9, Wednesday, 14:00-15:00, Beijing Time, GMT+8

- **Zoom Link: https://us02web.zoom.us/j/84736236843 / Password: 111114**

NA30205, NA30279, NA31092, NA40349, NA30256, NA40387, NA40403, NA40418, NA30294, NA40361, NA30285, NA40373, NA40371, NA40356, NA30280, NA30289, NA40336, NA30253, NA30230, NA30238, NA21035, NA40344, NA40411, NA31096, NA30288, NA30292, NA30286, NA40379, NA30207, NA30281, NA40341, NA30300, NA30260, NA30251, NA40348, NA21081, NA30308, NA30234, NA30301, NA40334

Pretest 6

Nov. 9, Wednesday, 14:00-15:00, Beijing Time, GMT+8

- **Zoom Link: https://us02web.zoom.us/j/82118500729 / Password: 111114**

NA40420, NA40432, NA30215, NA40325, NA40321, NA40386, NA40414, NA30284, NA40383, NA40327, NA40378, NA40345, NA40406, NA40400, NA40360, NA40367, NA30221, NA40385, NA30299, NA40382, NA40335, NA30201, NA40407, NA40438, NA30307, NA40422, NA40431, NA40424, NA40404, NA40328, NA40394, NA21082, NA21080, NA21077, NA40436, NA30306, NA30249, NA30291, NA30293, NA30272

Pretest 7

Nov. 9, Wednesday, 15:30-16:30, Beijing Time, GMT+8

- **Zoom Link: https://us02web.zoom.us/j/89249045417 / Password: 111114**

NA40395, NA30259, NA40396, NA40392, NA40437, NA30310, NA40435, NA40408, NA30302, NA40359, NA40429, NA40331, NA30296, NA30276, NA40393, NA40372, NA40425, NA40369, NA40428, NA40338, NA40376, NA40375, NA30209, NA00007, NA40405, NA30309, NA00020, NA40413, NA40377, NA40433, NA30278, NA30316, NA31093, NA30244, NA40354, NA30318, NA30314, NA40352, NA40415, NA21058, NA31097, NA21051, NA00025, NA00010, NA40427, NA00008

Poster Pretest

Nov. 9, Wednesday, 15:30-16:30, Beijing Time, GMT+8

- **Zoom Link: https://us02web.zoom.us/j/84736236843 / Password: 111114**

NA11033, NA11034, NA11053, NA11014, NA11068, NA11100, NA11111, NA11110, NA11002, NA11075, NA11072, NA11064, NA11042, NA11106, NA11098, NA11085, NA21061, NA21024, NA21013, NA21055, NA21088, NA21070, NA21079, NA30250, NA30210, NA30240, NA40397, NA40324, NA40351, NA40346, NA30303, NA40370, NA40326, NA30262, NA30317, NA30275, NA30270, NA40355, NA40362, NA40323, NA30231, NA30271, NA40434, NA30311, NA40391, NA40350, NA21021

Invited Speaker Pretest 1

Nov. 11, Friday, 10:00-11:00, Beijing Time, GMT+8

- **Zoom Link: https://us02web.zoom.us/j/84231845366 / Password: 111114**

NA11026, NA11058, NA11028, NA11056, NA11036, NA11105, NA11082, NA11010-A, NA11011-A, NA11095, NA11055, NA11103, NA11043, NA11093, NA11018, NA55001, NA21012, NA55002, NA55003, NA40419-A, NA55005, NA40329-A, NA55007, NA55008, NA55010, NA55011, NA55012, NA30235, NA40332-A, NA55013, NA40364, NA31090

Invited Speaker Pretest 2

Nov. 11, Friday, 14:00-15:00, Beijing Time, GMT+8

- **Zoom Link: https://us02web.zoom.us/j/84231845366 / Password: 111114**

NA55014, NA30263, NA55015, NA55016, NA40353, NA30243, NA55017, NA55018, NA40412-A, NA55019, NA40399, NA55020, NA55021, NA55022, NA55023, NA55024, NA21018, NA40439, NA00015, NA55025, NA55026, NA11021-A, NA55027, NA55028, NA55029, NA55030, NA55032, NA55033, NA55035, NA55036, NA55031, NA55037

Session Chair Pretest

Nov. 11, Friday, 15:30-18:00, Beijing Time, GMT+8

- **Zoom Link: https://us02web.zoom.us/j/84231845366 / Password: 111114**

Keynote Speaker & Committee Member Pretest

Nov. 11, Friday, 10:00-18:00, Beijing Time, GMT+8

- **Zoom Link: https://us02web.zoom.us/j/81069396768 / Password: 111114**

Nov. 12, Saturday, 9:15-9:55, Beijing Time, GMT+8

ZOOM Link: https://us02web.zoom.us/j/84231845366

Password: 111114

Prof. Tiejun Cui

Southeast University, China

Academician of the Chinese Academy of Sciences

IEEE Fellow

Speech Title: RIS and Information Metasurfaces

Abstract: Information metasurfaces are described by digital elements 0 and 1 with the opposite electromagnetic (EM) responses (e.g. anti-phases). By designing different coding states of the digital elements, the EM waves can be controlled in real time and in the desired way. The information metasurfaces set up a bridge between the physical world and digital world. Due to their powerful capabilities in controlling the wireless environment in real time and programmable way, the information metasurfaces are good platforms of reconfigurable intelligent surfaces (RIS) that have been popularly investigated in the community of wireless communications. Beyond functioning as RIS, the information metasurfaces can play more important roles in wireless communications, including the new architectures of transmitter systems, intelligent sensing, imaging and recognition, and programmable AI computing.

Bio: Tie Jun Cui is the Chief Professor of Southeast University, Nanjing, China. He proposed the concepts of digital coding and programmable metamaterials and realized their first prototypes, based on which he further proposed information metamaterials to bridge the physical world and digital world, and developed the new architecture information systems. Dr. Cui has published over 600 peer-review journal papers, which have been cited by more than 50000 times (H-Factor 113), and licensed over 100 patents. Dr. Cui received the Natural Science Award (first class) from the Ministry of Education, China, in 2011, the National Natural Science Awards of China (second class, twice), in 2014 and 2018, and the Highly Cited Researcher Awards from Web of Science (top 1%), in 2019-2021, respectively. His researches have been widely reported by Nature News, MIT Technology Review, Scientific American, Discover, New Scientists, etc.

Dr. Cui is the Academician of Chinese Academy of Science and IEEE Fellow. He served as Associate Editor of IEEE Transactions on Geoscience and Remote Sensing, and Guest Editors of Science China - Information Sciences, Science Bulletin, IEEE JETCAS, and Research. Currently he is the Chief Editor of Metamaterial Short Books in Cambridge University Press, the Editor of Materials Today Electronics, Associate Editor of Research, and the Editorial Board Members of eLight, PhotoniX, Advanced Optical Materials, Small Structure, and Advanced Photonics Research. He presented more than 100 Keynote and Plenary Talks in Academic Conferences, Symposiums, or Workshops.

Nov. 12, Saturday, 9:55-10:35, Beijing Time, GMT+8

ZOOM Link: https://us02web.zoom.us/j/84231845366

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Prof. Yiran Chen

Duke University, USA

IEEE Fellow, ACM Fellow

Speech Title: Scalable, Heterogeneity-Aware and Efficient Federated Learning

Abstract: Federated learning has become a popular distributed machine learning paradigm for on-device AI applications. However, the data residing across devices is intrinsically statistically heterogeneous (i.e., non-IID data distribution) and mobile devices usually have limited communication bandwidth to transfer local updates. In addition, the hardware resource heterogeneity across the devices also reduces the efficiency of the FL system. Such systematic heterogeneity and communication limitation are two major bottlenecks that hinder applying federated learning in practice. In this talk, we will present our recent works on novel federated learning frameworks to address the scalability and heterogeneity issues simultaneously.

Bio: Yiran Chen received B.S (1998) and M.S. (2001) from Tsinghua University and Ph.D. (2005) from Purdue University. After five years in industry, he joined University of Pittsburgh in 2010 as Assistant Professor and then was promoted to Associate Professor with tenure in 2014, holding Bicentennial Alumni Faculty Fellow. He is now the Professor of the Department of Electrical and Computer Engineering at Duke University and serving as the director of the NSF AI Institute for Edge Computing Leveraging the Next-generation Networks (Athena), the NSF Industry–University Cooperative Research Center (IUCRC) for Alternative Sustainable and Intelligent Computing (ASIC), and the co-director of Duke Center for Computational Evolutionary Intelligence (DCEI). His group focuses on the research of new memory and storage systems, machine learning and neuromorphic computing, and mobile computing systems. Dr. Chen has published 1 book and about 500 technical publications and has been granted 96 US patents. He has served as the associate editor of more than a dozen international academic periodicals and served on the technical and organization committees of more than 60 international conferences. He is now serving as the Editor-in-Chief of the IEEE Circuits and Systems Magazine. He received eight best paper awards, one best poster award, and fourteen best paper nominations from reputable international conferences and workshops such as MICRO, KDD, DATE, SEC, etc. He received numerous awards for his technical contributions and professional services such as IEEE Computer Society Edward J. McCluskey Technical Achievement Award, ACM SIGDA Service Award, etc. He is a Fellow of the ACM and IEEE and now serves as the chair of ACM SIGDA.

Nov. 12, Saturday, 10:45-11:25, Beijing Time, GMT+8

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Password: 111114

Prof. Wei Zhang

The University of New South Wales, Australia

Vice President of IEEE Communications Society

IEEE Fellow

IEEE ComSoc Distinguished Lecturer

Speech Title：Cybertwin – A Pathway to 6G Cloud Native Network

Abstract: With the fast development of Internet-of-Everything and its applications, the ever increasing mobile Internet traffic and services bring unprecedented challenges, including scalability, mobility, availability, and security. In this talk, a cybertwin based 6G network architecture is proposed to accommodate the evolution from end-to-end connection to cloud-to-end connection in the future network. As a digital representation of humans or things in the cyberspace, cybertwin serves in multiple capacities, such as communications assistant, network behaviour logger, and digital asset owner. We advocate a new cloud network operating system which can work in a distributed way through a real-time multi-agent trading platform to allocate 3C (computing, caching, communication) resources. Finally, 6G use cases and future research topics of cybertwin based cloud native network are discussed.

Bio: Wei Zhang is Vice President of IEEE Communications Society (2022-2023). He received the Ph.D. degree from The Chinese University of Hong Kong in 2005. Currently, he is a Professor at the School of Electrical Engineering and Telecommunications, the University of New South Wales, Sydney, Australia. His current research interests include 5G and beyond. He has been an IEEE Fellow since 2015 and was an IEEE ComSoc Distinguished Lecturer in 2016-2017.

Within the IEEE ComSoc, he has taken many leadership positions including Chair of Wireless Communications Technical Committee (2019-2020), Vice Director of Asia Pacific Board (2016-2021), Editor-in-Chief of IEEE Wireless Communications Letters (2016-2019), Member-at-Large on the Board of Governors (2018-2020), Technical Program Committee Chair of APCC 2017 and ICCC 2019, Award Committee Chair of Asia Pacific Board and Award Committee Chair of Technical Committee on Cognitive Networks.

In addition, he has served as a member in various ComSoc boards/standing committees, including Journals Board, Technical Committee Recertification Committee, Finance Standing Committee, Information Technology Committee, Steering Committee of IEEE Transactions on Green Communications and Networking and Steering Committee of IEEE Networking Letters. Currently, he serves as an Area Editor of the IEEE Transactions on Wireless Communications and the Editor-in-Chief of Journal of Communications and Information Networks. Previously, he served as Editor of IEEE Transactions on Communications, IEEE Transactions on Wireless Communications, IEEE Transactions on Cognitive Communications and Networking, and IEEE Journal on Selected Areas in Communications – Cognitive Radio Series.

Nov. 12, Saturday, 11:25-12:05, Beijing Time, GMT+8

ZOOM Link: https://us02web.zoom.us/j/84231845366

Password: 111114

Prof. Nan Chi

Fudan University, China

OSA Fellow

Speech Title: Visible Light Communication Toward 6G

Abstract: Visible light communication (VLC) is a high-speed communication technique with an unlicensed frequency range of 400–800 THz that can be adopted as an alternative approach in 6G. In this report, the prospects and challenges of VLC in 6G are presented in conjunction with its advances in high-speed transmissions. Recent hot research interests, including new materials and devices, advanced modulation, underwater visible light communication, and signal processing based on machine learning, are also discussed.

Bio: Professor Nan Chi is with School of Information Science and Engineering, Fudan University, China. She received the BS degree and PhD degree in electrical engineering from Beijing University of Posts and Telecommunications, China. She is the author or co-author of more than 300 papers and has been cited more than 9000 times. She has been awarded as The National Science Fund for Distinguished Young Scholars, the New Century Excellent Talents Awards from the Education Ministry of China, Shanghai Shu Guang scholarship. Her current research interests include advanced modulation format, optical packet/label switching, optical fiber communication and visible light communication. She is a fellow of the OSA.

Nov. 13, Sunday, 9:05-9:45, Beijing Time, GMT+8

ZOOM Link: https://us02web.zoom.us/j/84231845366

Password: 111114

Prof. Kin K. Leung

Imperial College London, United Kingdom

Fellow of the Royal Academy of Engineering

IEEE Fellow, IET Fellow

Speech Title: Optimization by Machine Learning for Communication and Computer Infrastructures

Abstract: Optimization techniques are widely used to allocate and share limited resources to competing demands in communication and computer infrastructures. The speaker will start by showing the well-known Transport Control Protocol (TCP) as a distributed solution to achieve the optimal allocation of network bandwidth. Unfortunately, factors such as multiple grades of service quality, variable transmission power, and tradeoffs between communication and computation often make the optimization problem for resource allocation non-convex. New distributed solution techniques are needed to solve these problems.

As an illustrative example, the speaker will consider in-network data processing in sensor networks where data are aggregated (fused) along the way they are transferred toward the end user. Finding the optimal solution for the distributed processing problem is NP-hard, but for specific settings, the problem can lead to a distributed framework for achieving the optimal tradeoff between communications and computation costs.

As discussed above, gradient-based iterative algorithms are commonly used to solve the optimization problems. Much research focuses on improving the iteration convergence. However, when the system parameters change, it requires a new solution from the iterative methods. The speaker will present a new machine-learning method by using two Coupled Long Short-Term Memory (CLSTM) networks to quickly and robustly produce the optimal or near-optimal solutions to constrained optimization problems over a range of system parameters

Bio: Kin K. Leung received his B.S. degree from the Chinese University of Hong Kong, and his M.S. and Ph.D. degrees from University of California, Los Angeles. He joined AT&T Bell Labs in New Jersey in 1986 and worked at its successor companies until 2004. Since then, he has been the Tanaka Chair Professor in the Electrical and Electronic Engineering (EEE), and Computing Departments at Imperial College in London. He serves as the Head of Communications and Signal Processing Group in the EEE Department at Imperial. His current research focuses on optimization and machine-learning techniques for system design and control of large-scale communications, computer and sensor networks. He also works on multi-antenna and cross-layer designs for wireless networks.

He is a Fellow of the Royal Academy of Engineering (2022), IEEE Fellow (2001), IET Fellow (2022), and member of Academia Europaea (2012). He received the Distinguished Member of Technical Staff Award from AT&T Bell Labs (1994) and the Royal Society Wolfson Research Merits Award (2004-09). Jointly with his collaborators, he received the IEEE Communications Society (ComSoc) Leonard G. Abraham Prize (2021), the IEEE ComSoc Best Survey Paper Award (2022), the U.S.–UK Science and Technology Stocktake Award (2021), the Lanchester Prize Honorable Mention Award (1997), and several best conference paper awards. He currently serves as the IEEE ComSoc Distinguished Lecturer (2022-23). He was a member (2009-11) and the chairman (2012-15) of the IEEE Fellow Evaluation Committee for the ComSoc. He has served as guest editor and editor for 10 IEEE and ACM journals. Currently, he chairs the Steering Committee for the IEEE Transactions on Mobile Computing, and is an editor for the ACM Computing Survey and International Journal on Sensor Networks.

Nov. 13, Sunday, 9:45-10:25, Beijing Time, GMT+8

ZOOM Link: https://us02web.zoom.us/j/84231845366

Password: 111114

Prof. Shiwen Mao

Auburn University, USA

IEEE Fellow, AAIA Fellow

Speech Title: Indoor Radio Map Construction and Location Estimation with a Deep Gaussian Process Approach

Abstract: With the increasing demand for location-based service, WiFi-based localization has become one of the most popular methods due to the wide deployment of WiFi and its relatively low cost. In this talk, we present a deep Gaussian process based indoor radio map construction and location estimation system. Received signal strength (RSS) samples, as well earth magnetic field readings, are used to generate accurate and fine-grained radio maps with confidence intervals using deep Gaussian process, while the model parameters are optimized with an offline Bayesian training method. Utilizing the maps, an LSTM based location prediction model is pre-trained with the artificial trajectory data and then fine-tuned with the signal measurements collected by the mobile device to be localized. Our extensive experiments demonstrate the excellent performance of the proposed system.

Bio: SHIWEN MAO is a professor and Earle C. Williams Eminent Scholar Chair, and Director of the Wireless Engineering Research and Education Center (WEREC) at Auburn University. His research interest includes wireless networks, multimedia communications, and smart grid. He is a Distinguished Lecturer of IEEE Communications Society and the IEEE Council of RFID, and is on the Editorial Board of IEEE TWC, IEEE TNSE, IEEE TMC, IEEE IoT, IEEE TCCN, IEEE OJ-ComSoc, IEEE/CIC China Communications, IEEE Multimedia, IEEE Network, IEEE Networking Letters, and ACM GetMobile. He received the IEEE ComSoc TC-CSR Distinguished Technical Achievement Award in 2019 and NSF CAREER Award in 2010. He is a co-recipient of the 2021 Best Paper Award of Elsevier/KeAi Digital Communications and Networks Journal, the 2021 IEEE Communications Society Outstanding Paper Award, the IEEE Vehicular Technology Society 2020 Jack Neubauer Memorial Award, the 2004 IEEE Communications Society Leonard G. Abraham Prize in the Field of Communications Systems, and several conference best paper/demo awards. He is a Fellow of the IEEE.

Nov. 13, Sunday, 10:45-11:25, Beijing Time, GMT+8

ZOOM Link: https://us02web.zoom.us/j/84231845366

Password: 111114

Prof. Lajos Hanzo

University of Southampton, United Kingdom

FREng, FIEEE, FIET, EURASIP Fellow

Speech Title: Space, Air, Ground Integrated Networking from Single- to Multi-component Pareto Optimization

Abstract: Thanks to the spectacular advances in signal processing and nano-technology, five wireless generations have been conceived over the past five decades. Indeed, near-capacity operation at an infinitesimally low error-rate has become feasible and flawless multimedia communications is supported in areas of high traffic-density, but how do we fill the huge coverage holes existing across the globe?

As a promising system-architecture, an integrated terrestrial, UAV-aided, airplane-assisted as well as satellitebased global coverage-solution will be highlighted to pave the way for seamless next-generation service provision. However, these links exhibit strongly heterogeneous properties, hence requiring different enabling techniques.

The joint optimization of the associated conflicting performance metrics of throughput, transmit power, latency, error probability, hand-over probability and link-lifetime poses an extremely challenging problem. Explicitly, sophisticated multi-component system optimization is required for finding the Pareto-front of all optimal solutions, where none of the above-mentioned metric can be improved without degrading at least one of the others.

Bio: Lajos Hanzo (http://www-mobile.ecs.soton.ac.uk, https://en.wikipedia.org/wiki/Lajos_Hanzo) (FIEEE'04) received his Master degree and Doctorate in 1976 and 1983, respectively from the Technical University (TU) of Budapest. He was also awarded the Doctor of Sciences (DSc) degree by the University of Southampton (2004) and Honorary Doctorates by the TU of Budapest (2009) and by the University of Edinburgh (2015). He is a Foreign Member of the Hungarian Academy of Sciences and a former Editor-in-Chief of the IEEE Press. He has served several terms as Governor of both IEEE ComSoc and of VTS. He has published 2000+ contributions at IEEE Xplore

https://ieeexplore.ieee.org/search/searchresult.jsp?action=search&newsearch=true&matchBoolean=true&queryText=(%22All%20Metadata%22:hanzo) , 19 Wiley-IEEE Press books and has helped the fast-track career of 123 PhD students. Over 40 of them are Professors at various stages of their careers in academia and many of them are leading scientists in the wireless industry. He is also a Fellow of the Royal Academy of Engineering (FREng), of the IET and of EURASIP. His citations can be found at https://scholar.google.com/citations?user=p0jnEW0AAAAJ

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Beijing University of Posts and Telecommunications, China

Shaolin Liao

Sun Yat-sen University, China

Hongzhi Wang

Harbin Institute of Technology, China

Zesong Fei

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Shenzhen Institute for Advanced Study, University of Electronic Science and Technology of China, China

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Xiaoying Tang

The Chinese University of Hong Kong (Shenzhen), and the Shenzhen Institute of Artificial Intelligence and Robotics for Society, China

Yao Sun

University of Glasgow, UK

Wei Yang

Beijing University of Posts and Telecommunications, China

Day 1, Nov. 11, 2022, Friday, GMT+8, Beijing Time

Time	Schedule
10:00-12:00	PRETEST (Click to Visit Page 12)
14:00-18:00	Purple Mountain Laboratories Virtual Visit and Recruitment (Click to Visit Page 176)

Day 2, Nov. 12, 2022, Saturday, GMT+8, Beijing Time

- *ZOOM Link: https://us02web.zoom.us/j/84231845366 Password: 111114*

Time	Schedule
9:00-9:15	**Opening Ceremony** **Welcome Message** Shaodong Feng, Jiangsu Association for Science and Technology, China **Opening Remarks** Prof. Zaichen Zhang, Southeast University, China **TPC Address** Prof. Supeng Leng, University of Electronic Science and Technology of China, China
9:15-9:55	**Keynote Speech 1** Prof. Tiejun Cui, Southeast University, China - *Speech Title: RIS and Information Metasurfaces*
9:55-10:35	**Keynote Speech 2** Prof. Yiran Chen, Duke University, USA - *Speech Title: Scalable, Heterogeneity-Aware and Efficient Federated Learning*
10:35-10:45	**Break Time**
10:45-11:25	**Keynote Speech 3** Prof. Wei Zhang, The University of New South Wales, Australia - *Speech Title: Cybertwin – A Pathway to 6G Cloud Native Network*
11:25-12:05	**Keynote Speech 4** Prof. Nan Chi, Fudan University, China - *Speech Title: Visible Light Communication Toward 6G*

12:05-13:30	**Lunch Time**
13:30-15:35	**Session 1: Satellite Communication Network and Signal Transmission** NA40419-A(Invited Speech), NA11058(Invited Speech), NA21082, NA11071, NA40348, NA30229, NA21077 - *ZOOM Link: https://us02web.zoom.us/j/84231845366 Password: 111114*
13:30-15:35	**Session 2: Sensors and Wireless Sensor Networks** NA55005(Invited Speech), NA40329-A(Invited Speech), NA40429, NA00020, NA40349, NA40344, NA30258 - *ZOOM Link: https://us02web.zoom.us/j/81069396768 Password: 111114*
13:30-15:50	**Session 3: Massive MIMO System and Key Technologies** NA00015(Invited Speech), NA30235(Invited Speech), NA11078, NA11031, NA11090, NA21031, NA21069, NA11077 - *ZOOM Link: https://us02web.zoom.us/j/81673586285 Password: 111114*
13:30-15:50	**Session 4: Electronics and Communication Engineering** NA11021-A(Invited Speech), NA40412-A(Invited Speech), NA31097, NA11104, NA21075, NA21073, NA40385, NA30310 - *ZOOM Link: https://us02web.zoom.us/j/89549029505 Password: 111114*
13:30-15:55	**Session 5: Communication and Signal System** NA30263(Invited Speech), NA21080, NA11040, NA11048, NA40415, NA11084, NA30309, NA21047, NA40354 - *Zoom Link: https://us02web.zoom.us/j/86088803609 Password: 111114*
13:30-16:00	**Session 6: 5G/6G and Future Communication Technology** NA40364(Invited Speech), NA40399(Invited Speech), NA55021(Invited Speech), NA11003, NA11035, NA31093, NA21083, NA30280 - *Zoom Link: https://us02web.zoom.us/j/86924134522 Password: 111114*
13:30-16:40	**Session 7: Optical Communication and Wireless Location Technology** NA55019(Invited Speech), NA55025(Invited Speech), NA55032(Invited Speech), NA55031(Invited Speech), NA21019, NA11051, NA30215, NA40414, NA40333, NA21039 - *Zoom Link: https://us02web.zoom.us/j/86108605540 Password: 111114*
15:50-18:25	**Session 8: Performance Analysis of Wireless Communication System and Network** NA55017(Invited Speech), NA40439(Invited Speech), NA11065, NA21045, NA21023, NA11039, NA21044, NA30277, NA40321 - *ZOOM Link: https://us02web.zoom.us/j/84231845366 Password: 111114*

15:50-18:25	**Session 9: Communication Network Security** NA55012(Invited Speech), NA55002(Invited Speech), NA11070, NA30286, NA40377, NA30300, NA21084, NA40386, NA21041 - *ZOOM Link: https://us02web.zoom.us/j/81069396768 Password: 111114*
16:05-18:45	**Session 10: Photonics and Optical Communication** NA11010-A(Invited Speech), NA11011-A(Invited Speech), NA55003(Invited Speech), NA55018(Invited Speech), NA11062, NA30225, NA11063, NA30227 - *ZOOM Link: https://us02web.zoom.us/j/81673586285 Password: 111114*
16:05-18:30	**Session 11: Digital Communication System and Function Optimization** NA11105(Invited Speech), NA21022, NA21034, NA21017, NA11023, NA30259, NA21035, NA21056, NA00010 - *Zoom Link: https://us02web.zoom.us/j/89549029505 Password: 111114*
16:10-18:35	**Session 12: Network Authentication and Security** NA11103(Invited Speech), NA40376, NA40337, NA40371, NA40372, NA11091, NA40416, NA30236, NA40375 - *Zoom Link: https://us02web.zoom.us/j/86088803609 Password: 111114*
16:15-18:40	**Session 13: Massive MIMO System and Key Technologies** NA55022(Invited Speech), NA30200, NA40356, NA11080, NA30252, NA31098, NA30257, NA30278, NA30205 - *Zoom Link: https://us02web.zoom.us/j/86924134522 Password: 111114*
16:55-18:20	**3rd International Workshop on Intelligent Internet of Vehicles** NA55037(Invited Speech), NA30283, NA11066, NA30209, NA40423 - Zoom Link: https://us02web.zoom.us/j/86108605540 Password: 111114
13:30-15:05	**Poster Session 1: Computer Information Network, Digital Image and Multimedia Technology** NA40434, NA11034, NA40351, NA40326, NA11033, NA40355, NA30271, NA21021, NA11042, NA40323, NA11064, NA30250, NA40370, NA11072, NA11075, NA11053, NA11014, NA11110, NA40324 - *ZOOM Link: https://us06web.zoom.us/j/89327674351 Password: 111114*
15:20-17:25	**Poster Session 2: Intelligent Communication System, Simulation and Performance Optimization Calculation** NA21055, NA11100, NA11111, NA11085, NA11068, NA21061, NA21070, NA30240, NA30262, NA21088, NA11002, NA21079, NA30231, NA21024, NA40391, NA40350, NA21013, NA30303, NA30317, NA11106, NA30270, NA11098, NA30275, NA30210, NA30319 - *ZOOM Link: https://us06web.zoom.us/j/89327674351 Password: 111114*
17:40-18:20	**Special Session 2: Geometric Signal Processing and Information Geometry** NA21068, NA40408, NA40346(Poster), NA40397(Poster) - *ZOOM Link: https://us06web.zoom.us/j/89327674351 Password: 111114*

Day 3, Nov. 13, 2022, Sunday, GMT+8, Beijing Time

- *ZOOM Link: https://us02web.zoom.us/j/84231845366 Password: 111114*

Time	Schedule
9:00-9:05	**Opening**
9:05-9:45	**Keynote Speech 5** **Prof. Kin K. Leung, Imperial College London, United Kingdom** - *Speech Title: Optimization by Machine Learning for Communication and Computer Infrastructures*
9:45-10:25	**Keynote Speech 6** **Prof. Shiwen Mao, Auburn University, USA** - *Speech Title: Indoor Radio Map Construction and Location Estimation with a Deep Gaussian Process Approach*
10:25-10:45	**Break Time**
10:40-11:25	**Keynote Speech 7** **Prof. Lajos Hanzo, University of Southampton, United Kingdom** - *Speech Title: Space, Air, Ground Integrated Networking from Single- to Multi-component Pareto Optimization*
11:25-13:30	**Lunch Time**

13:30-15:50	**Session 14: Signal Acquisition and Generation Method** NA55007(Invited Speech), NA11095(Invited Speech), NA21053, NA11061, NA21032, NA30206, NA40381, NA21074 - *ZOOM Link: https://us02web.zoom.us/j/84231845366 / Password: 111114*
13:30-16:10	**Special Session 3-Recent Advancement in Radar and Sonar Signal Processing** NA40403, NA30217, NA30291, NA40393, NA30242, NA30216, NA30293, NA30294, NA40413, NA40437, NA40362(Poster), NA30311(Poster) - *ZOOM Link:* https://us02web.zoom.us/j/81069396768 / *Password: 111114*
13:30-16:15	**Session 15: UAV Cooperative Communication and System** NA30243(Invited Speech), NA11055(Invited Speech), NA55008(Invited Speech), NA40438, NA30226, NA40378, NA00025, NA40422, NA30234 - *ZOOM Link:* https://us02web.zoom.us/j/81673586285 / *Password: 111114*

13:30-16:40	**Special Session 1-Electromagnetics Modeling, Simulation, Optimization and Experiment** NA21018(Invited Speech), NA31091, NA30313, NA40331, NA21060, NA30316, NA30237, NA21085, NA40342, NA40352, NA40338, NA30314 - *ZOOM Link:* https://us02web.zoom.us/j/89549029505 / *Password: 111114*
13:30-15:45	**Session 16: Image and Multimedia Technology** NA30302, NA11054, NA11017, NA21038, NA30255, NA30289, NA40395, NA30295, NA40420 - *ZOOM Link:* https://us02web.zoom.us/j/86088803609 / *Password: 111114*
13:30-16:10	**Session 17: Channel Detection and Estimation** NA55023(Invited Speech), NA11083, NA11081, NA30247, NA30287, NA30273, NA30281, NA40432, NA40327, NA40427 - *ZOOM Link:* https://us02web.zoom.us/j/86924134522 / *Password: 111114*
13:30-16:05	**Session 18: Resource Management and Allocation in Communication Networks** NA11018(Invited Speech), NA55010(Invited Speech), NA21036, NA30238, NA40334, NA40325, NA21015, NA40436, NA30272 - *ZOOM Link:* https://us06web.zoom.us/j/89327674351 / *Password: 111114*
16:05-18:20	**Session 19: Power Communication Technology in Smart Grid** NA21029, NA30203, NA40328, NA11038, NA31099, NA30288, NA30207, NA40400, NA40367 - *ZOOM Link:* https://us02web.zoom.us/j/84231845366 / *Password: 111114*
16:25-18:25	**Session 20: Electronics and Communication Engineering** NA11045, NA21037, NA21016, NA30230, NA30249, NA21051, NA30223, NA21052 - *ZOOM Link:* https://us02web.zoom.us/j/81069396768 / *Password: 111114*
16:30-18:45	**Session 21: Intelligent Image Detection and Application** NA40392, NA11052, NA30211, NA31094, NA40410, NA40411, NA30308, NA40396, NA40428 - *ZOOM Link:* https://us02web.zoom.us/j/81673586285 / *Password: 111114*
16:00-18:05	**Session 22: Speech Communication and Speech Recognition** NA55024(Invited Speech), NA11028(Invited Speech), NA11007, NA21066, NA30260, NA30284, NA30276 - *ZOOM Link:* https://us02web.zoom.us/j/86088803609 / *Password: 111114*
16:25-18:25	**Session 23: Communication Protocol Design and Standards** NA21067, NA30214, NA30296, NA40387, NA11107, NA21081, NA11108, NA11109 - *ZOOM Link:* https://us02web.zoom.us/j/86924134522 / *Password: 111114*

16:20-18:20	**Session 24: Coding and Modulation Technology** NA11101, NA21089, NA21033, NA30256, NA30301, NA30221, NA40366, NA30282 - *ZOOM Link:* https://us06web.zoom.us/j/89327674351 / *Password: 111114*

Day 4, Nov. 14, 2022, Monday, GMT+8, Beijing Time

9:00-11:20	**Session 25: Electromagnetic Theory and Antenna Design** NA55020(Invited Speech), NA40353(Invited Speech), NA21058, NA21030, NA30268, NA30285, NA30253, NA40405 - *ZOOM Link:* https://us02web.zoom.us/j/84231845366 / *Password: 111114*
9:00-12:10	**Session 26: Artificial Intelligence Algorithm and Data Model** NA11056(Invited Speech), NA11093(Invited Speech), NA11082(Invited Speech), NA55030(Invited Speech), NA40406, NA21078, NA40345, NA40382, NA11097, NA00008 - *Zoom Link:* https://us02web.zoom.us/j/81069396768 / *Password: 111114*
9:00-11:20	**Session 27: Communication Aware Computing in Wireless Systems** NA55015(Invited Speech), NA55014(Invited Speech), NA30307, NA21076, NA30279, NA40374, NA40431, NA11060 - *Zoom Link:* https://us02web.zoom.us/j/81673586285 / *Password: 111114*
9:00-11:25	**Session 28: Intelligent Communication Equipment and System** NA11043(Invited Speech), NA11059, NA31096, NA21043, NA30239, NA40336, NA30251, NA40394, NA40341 - *Zoom Link:* https://us02web.zoom.us/j/89549029505 / *Password: 111114*
9:00-11:40	**Session 29: Energy Management in Internet of Things and Wireless Communication System** NA11026(Invited Speech), NA31090(Invited Speech), NA55026(Invited Speech), NA55033(Invited Speech), NA40435, NA30318, NA30269, NA40424 - *Zoom Link:* https://us02web.zoom.us/j/86088803609 / *Password: 111114*
9:00-11:35	**Session 30: Satellite Communication Network and Space Communication** NA11036(Invited Speech), NA55028(Invited Speech), NA40335, NA11088, NA31092, NA30264, NA30254, NA40330, NA40433 - *Zoom Link:* https://us02web.zoom.us/j/86924134522 / *Password: 111114*
9:00-11:20	**Session 31: Cognitive Radio and Wireless Sensor Networks** NA55001(Invited Speech), NA55035(Invited Speech), NA40409, NA11001, NA21049, NA40384, NA11073, NA30292 - *Zoom Link:* https://us06web.zoom.us/j/89327674351 / *Password: 111114*

13:30-15:40	**Session 32: Modern Cryptography and Encryption Technology** NA55036(Invited Speech), NA11012, NA11015, NA30228, NA40339, NA40379, NA40383, NA30306 - *Zoom Link:* https://us02web.zoom.us/j/84231845366 / *Password: 111114*
13:30-15:40	**Session 33: Performance Analysis of Wireless Communication System and Network** NA55027(Invited Speech), NA11013, NA21064, NA21020, NA21028, NA30290, NA40404, NA21040 - *Zoom Link:* https://us02web.zoom.us/j/81069396768 / *Password: 111114*
13:30-15:40	**Session 34: Next Generation Communication Network Technology and Future Development** NA40332-A(Invited Speech), NA40361, NA11074, NA21042, NA30261, NA30246, NA40360, NA30244 - *Zoom Link:* https://us02web.zoom.us/j/81673586285 / *Password: 111114*
13:30-15:40	**Session 35: Network Attack and Security** NA55029(Invited Speech), NA11019, NA21057, NA30265, NA21054, NA30233, NA40340, NA21062 - *Zoom Link:* https://us02web.zoom.us/j/89549029505 / *Password: 111114*
13:30-15:40	**Session 36: Computer Network Model and Data Transmission** NA55011(Invited Speech), NA21059, NA30274, NA30202, NA30248, NA40418, NA40407, NA30201 - *Zoom Link:* https://us02web.zoom.us/j/86088803609 / *Password: 111114*
13:30-15:40	**Session 37: Image Recognition and Segmentation** NA21012(Invited Speech), NA40359, NA11057, NA40425, NA30267, NA40373, NA40369, NA00007 - *Zoom Link:* https://us02web.zoom.us/j/86924134522 / *Password: 111114*
13:30-15:50	**Session 38: Development of Electronic Equipment Based on AI** NA55016(Invited Speech), NA55013(Invited Speech), NA11020, NA21072, NA30297, NA30299, NA11089, NA11030 - *Zoom Link:* https://us06web.zoom.us/j/89327674351 / *Password: 111114*
20:00-20:20	**Closing Ceremony** - *Zoom Link:* https://us02web.zoom.us/j/84231845366 / *Password: 111114*

SESSION 1

Topic: Satellite Communication Network and Signal Transmission
Time: 13:30-15:35, Nov. 12, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/84231845366 Password: 111114

- **Session Chair: Assoc. Prof. Pu Miao, Qingdao University, China**

NA40419-A

Invited Speech

13:30-13:55

Title: Guarantee for Wireless Communication Security: Covert Communication
Invited Speaker: Assoc. Prof. Shu Fu and Graduate Student Yi Su, Chongqing University, China

Abstract: With the development of wireless communication, the widely used wireless communication increases people's concerns about communication security. In order to guarantee wireless communication security at the transmission level, covert communication has been proposed. Different from protecting communication content, covert communication provides a strong guarantee for wireless communication security by masking the transmission process under noise and interference. Covert communication has received extensive attention in various application scenarios such as the internet of things (IoT) and unmanned air vehicle (UAV) networks. Among them, UAV-aided covert communication can greatly enhance the security performance of non-terrestrial networks. The flexible deployment of UAV can effectively reduce the detection probability and improve the covert transmission rate. In addition, as one of the core technologies for 6G, reconfigurable intelligent surface (RIS) also shows its unique advantages in wireless communication security. In the scenario with RIS, by reasonably configuring the phase matrix, the received signal can be effectively enhanced, which provides higher gain for covert communication.

NA11058

Invited Speech

13:55-14:20

Title: Analysis of the Absorption Attenuation and Phase Shift of Terahertz Wireless Propagation
Invited Speaker: Assoc. Prof. Lu Zhang, Zhejiang University, China

Abstract: Terahertz (THz) technology is recognized as an important solution for future high-capacity wireless access, which is expected to support a flexible and broadband wireless backhaul network. However, the THz links would suffer from severe loss and distortions due to the atmospheric effects at the earth-ground, including absorption attenuation and phase shift. In this paper, we analyze the attenuation of the line-by-line absorption with the Van Vleck-Weisskopf (VVW) and the Lorentz theories, and investigate the continuum absorption using the millimeter-wave propagation (MPM) model, where the line-by-line and continuum absorption form the THz atmospheric attenuation. In addition, the phase shift of the THz signals induced by wireless propagation is also analyzed.

NA21082

14:20-14:35

Title: Robust Random Access Preamble Detection Scheme for 5G Integrated LEO Satellites Communication Systems
Authors: Zuxiang Zheng, DongDong Wang, Lizhe Liu, Bin Wang, and Chenhua Sun
Presenter: Zuxiang Zheng, Academy for Network & Communications of CETC, China

Abstract: In this paper, we propose a robust random access preamble detection scheme for 5G integrated low-earth-orbit(LEO) satellites. By converting the traditional frequency domain detection to time domain detection and adjusting the starting time and interval of the time domain detection window according to the large round-trip delay differences of LEO satellite systems, this scheme can directly adopt the preamble format of terrestrial 5G, and achieve the correct preamble detection and the accurate TA(Timing Advance) estimation without relying on the navigation and positioning systems, which are used to provide necessary information for TA pre-compensation based LEO satellite preamble detection scheme. In addition, the optimal detection threshold expression, which is applicable to all preamble formats, is derived from a group of threshold coefficient curves which is acquired from the estimated value of detection threshold and noise power. Simulation results show that, compared with the TA pre-compensation LEO satellite

preamble detection scheme, the proposed scheme shows 1dB performance improvement at the same detection success rate under different condition of normalized carrier frequency offset(NCFO) without the help of navigation and positioning systems.

NA11071

14:35-14:50

Title: Interference Analysis for Mobile Cellular and LEO Satellites Co-existence

Authors: Zixi Fang, Guoyan Li, Jixin Zheng, Tengjiao Feng
Presenter: Zixi Fang, Academy for Network & Communications of CETC; Science and Technology on Communication Networks Laboratory, Shijiazhuang, China

Abstract: Aiming at the problem that 5G uplink signal interferes with satellite earth station in satellite-terrestrial integrated networks, this paper proposes interference modeling and performance analysis methods based on stochastic geometry. The successful communication probability (SCP) of satellite-terrestrial is defined as the performance metrics of satellite downlink in the interference environment. The closed-form solutions of SCP are derived using Lutz channel model. Combined with the actual parameters, the proposed methods are numerically simulated, and the factors affecting the receiver performance have been quantified. The simulation results show that the density of interferers and the SINR threshold are two key factors restricting the performance. The research results of this paper provide a theoretical basis for the engineering and application of interference coordination in satellite-terrestrial integrated networks.

NA40348

14:50-15:05

Title: Distance Characteristics of Paths with the Minimum Inter-satellite Hops in LEO Satellite Networks

Authors: Quan Chen, Lei Yang, Guanglei Song, Zhenglong Yin, Huaguo Yang and Yong Zhao
Presenter: Quan Chen, National University of Defense Technology, China

Abstract: Satellites in low-Earth orbit (LEO) networks can be connected by multi-hop inter-satellite paths. In most LEO network scenarios, the shortest distance path (SDP) is also within the minimum hop path (MHP) set. The distance differences between SDP and various MHPs are less studied. This paper proposes approaches to calculate the SDP and the longest distance path (LDP) in the MHP set. Then the distance of SDP, LDP, and randomly generated MHPs are compared and analyzed based on the Starlink scenario. The path difference is mainly caused by the distance of interplane inter-satellite links (ISLs) and is also affected by the required interplane and intraplane hops. The results show that when the source and destination satellites are far away, the path distance differences between MHPs are significant and should be considered in path selection.

NA30229

15:05-15:20

Title: Task allocation method for UAV swarm ground attack based on IPSO

Authors: Zhong Yun, Huang Song-Hua, Zhang Jie-Yong, Zhao Liang
Presenter: Huang Song-Hua, Key Lab of Information System Engineering, The 28th Research Institute of CETC, China

Abstract: The ground attack task allocation of unmanned aerial vehicle (UAV) swarm is the key and difficult problem in the UAV ground attack mission planning. In response to this problem, the mathematical model is designed, in which the objective function is to maximize the target attack gain and minimize the target attack cost, and the target coverage, the target damage effect, the UAV attack threshold and the UAV range constraints are taken into account. And an improved particle swarm optimization (IPSO) including encoding and decoding rules, constraint handling rules and particle update rules are designed to solve the model. The simulation results show that, the proposed algorithm can effectively solve the task allocation model, and compared with other algorithms, the proposed algorithm has certain advantages.

NA21077

15:20-15:35

Title: A Frequency Offset Independent Timing Synchronization Method for 5G Integrated LEO Satellite Communication System

Authors: Zijian Zhang, Dongdong Wang, Lizhe Liu, Bin Wang, Chenhua Sun
Presenter: Zijian Zhang, Academy for Network & Communications of CETC Science and Technology on Communication Networks Laboratory, China

Abstract: In this paper, a frequency offset independent timing synchronization method is proposed to solve the large frequency offset problem for the 5G integrated low-earth-orbits (LEO) satellite communication (SatCom) system. Firstly, a frequency offset independent timing metric is designed. Without changing the frame structure of NR and based on the conjugate symmetry of the primary synchronization signal (PSS) time-domain sequence, the received PSS sequence times its time-inverse sequence to construct a product sequence, each element of which has the same phase. And the phase can be canceled by the absolute value operation. Secondly, a delay-superposition method is used to improve the performance of the designed timing metric. The detection threshold can be improved further by accumulating the correlation peak value of each PSS in the SSB burst, and the number of superposition can be selected flexibly to adapt the link-budget of the LEO SatCom system. The simulation results show that the proposed method maintains a high detection probability with increasing of the frequency offset. Compared with the M-part PSS cross-correlation algorithm, the proposed method can improve 49% detection probability at -6dB when the frequency offset is as large as 600kHz.

SESSION 2

Topic: Sensors and Wireless Sensor Networks
Time: 13:30-15:35, Nov. 12, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/81069396768 Password: 111114

- **Session Chair: Prof. Hesham Elbadawy, NTI, Egypt**

NA55005

Invited Speech

13:30-13:55

Title: Integrate Sensing and Communication Based on Pervasive Cameras
Invited Speaker: Assoc. Prof. Yanbing Yang, Sichuan University, China

Abstract: Optical camera communication (OCC) enabled by LED and embedded cameras has attracted extensive attention, thanks to its rich spectrum availability and ready deployability. However, the close interactions between OCC and the indoor spaces have created two major challenges. On one hand, the stripe pattern incurred by OCC may greatly damage the accuracy of image-based object recognition (OR). On the other hand, the patterns inherent to indoor spaces can significantly degrade the decoding performance of reflected OCC. To this end, we propose CORE-Lens as a pipeline to make the mutual interference transparent to existing OR and OCC algorithms. Essentially, CORE-Lens treats the two challenges as two sides of a signal mixture issue: the signals transmitted by OCC get mixed with background images so well that their features become entangled. Consequently, CORE-Lens exploits the idea of disentangled representation learning to separate the mixed signals in the feature space: while the GAN-reconstructed clean background images are used to perform object recognition, OCC decoding is conducted on the residual of the original image after subtracting the reconstructed background. Our extensive experiments on evaluating the real-life performance of CORE-Lens evidently demonstrate its superiority over conventional approaches.

NA40329-A

Invited Speech

13:55-14:20

Title: Fiber-membrane composite devices for acoustic sensing
Invited Speaker: Assoc. Prof. Wenjun Ni, South-Central Minzu University, China

Abstract: Fiber optic broadband acoustic sensors have great potential applications in many civil and military fields, such as oil and gas pipeline leakage monitoring, high-precision photoacoustic spectrum detection, seismic wave monitoring and anti-submarine monitoring. Compared with the traditional electronic acoustic sensor, optical fiber acoustic sensor has the advantages of high sensitivity, resistant to strong electromagnetic interference, light weight, small size, resistant to corrosion and other irreplaceable advantages. The research of broadband acoustic sensor based on fiber-membrane composite devices structure has been conducted to achieve the goal of high sensitivity, high precision, fast response, ultra-wideband and small size of the acoustic sensor. Four different broadband acoustic sensors based on fiber-membrane composite devices have been designed. It can be divided into two categories: the one broadband acoustic sensor is based on the transmission-type special optical fiber device combined with membrane, and the other ultra-wideband acoustic sensor is based on the reflective EFPI structure combined with the membrane.

NA40429

14:20-14:35

Title: Research on Coverage Reinforcement Strategy in Ocean Surveillance Wireless Sensor Networks
Authors: Duan Chaofan, Luo Yingguang, Fu Guobin, Feng Jing and Chang Haotian
Presenter: Duan Chaofan, National University of Defense Technology, China

Abstract: Ocean surveillance wireless sensor networks are easily affected by environmental factors such as ocean currents and waves, causing the passive movement of sensors, resulting in coverage holes in the monitoring area. Due to the relative positions between sensors and the information interaction of neighboring nodes, a coverage reinforcement control strategy in ocean surveillance wireless sensor networks is proposed. This strategy first constructs the Voronoi diagrams of the deployed sensors, and detects coverage holes according to the distance between sensor nodes and the

Voronoi vertexes. Then, the number of coverage holes as well as the elements of each hole circle can be obtained by mathematical calculation. Furthermore, the sensors′ deployment positions are calculated by the position of the nodes and the Voronoi edges, which maximize the coverage rate of the area. Finally, the coverage holes are healed by incremental deployment. The simulation results show that the proposed strategy is able to calculate the number and size of the holes accurately, and increase the coverage rate of the target area with a small computational complexity by incremental deployment, which achieves the reinforcement of the networks.

NA00020

14:35-14:50

Title: Curvature-sensitivity-enhanced Fiber-optic Sensor Based On Bragg Hollow Core Fiber

Authors: Sixiang Ran, Zhongke Zhao, Wenjun Ni and Chunyong Yang
Presenter: Sixiang Ran, South-Central Minzu University, China

Abstract: We proposed a novel curvature-sensitivity-enhanced optical fiber sensor realized by Bragg hollow core fiber (BHCF). The suspended hollow core fiber (SHCF) and the BHCF were connected between two single-mode fibers forming the sensor. The special construction of a four-bilayer Bragg structure provides a well-defined period interference envelope in the transmission spectrum for sensing external perturbations. Because of the different sensitivities of the interference dips, the proposed BHCF-SHCF-based sensor is able to simultaneously measure the parameter of curvature and temperature by monitoring the intensity fluctuation and wavelength shift, respectively. The highest curvature sensitivity of the proposed sensor is measured to be 0.36 dB/m-1 in the range of 1.283-3.247 m-1 with the adjusted R square value of 0.9895. Besides, the experiment of the temperature is also conducted, the results indicate the two measurands without crosstalk attributing to the different demodulation method.

NA40349

14:50-15:05

Title: DOA-TDOA hybrid location based on Weighted Least Squares with Observation Station Position Errors

Authors: Linqiang Jiang, Tao Tang, Paihang Zhao and Ziqiang Zhang
Presenter: Linqiang Jiang, PLA Strategic Support Force Information Engineering University, China

Abstract: Observation station position errors can significantly reduce the performance of the positioning algorithm. For DOA-TDOA hybrid positioning, this paper proposed a closed-form algorithm to jointly estimate the source and stations with station position errors. The method has two stages. At each stage, the pseudo-linear equation is first established, then the error equation is obtained, and finally the least squares solution of the error equation is obtained. Then, the algorithm is extended to multiple disjoint sources to get higher localization accuracy. The theoretical analysis shows that the accuracy of the source and stations can reach the Cramér-Rao lower bound (CRLB). Finally, the above theoretical analysis is proved by simulations.

NA40344

15:05-15:20

Title: An Outdoor Localization Approach based on Deep Neural Networks with CramerRao Lower Bound Aided Training Set Rebalancing

Authors: Mingyi You, Binhua Shi, Annan Lu, Caiyi Lou, Yunxia Ye, Bin Jiang, Kai Huang
Presenter: Binhua Shi, Communication Information Security Control Laboratory No. 36 Research Institute of CETC, China

Abstract: In this paper, we propose a time-difference-of-arrival (TDOA) based outdoor localization approach using a deep neural network (DNN) with a novel weighted mean squared error (WMSE) loss. The weight is determined aided by the Cramer-Rao lower bound (CRLB) of localization accuracy. A training set rebalancing strategy is proposed to approximate the WMSE loss with the classical MSE loss and make the training process efficient, without the need of collecting more training samples. Extensive numerical investigations of ideal and nonideal scenarios are included to examine the effectiveness of the proposed approach.

NA30258

15:20-15:35

Title: A peaking staggering transmission MAC protocol for underwater acoustic networks

Authors: Zijian Huang, Jinxiang Zhou, Yinbin Cai, Zihao Chen, Chun Shi, Wei Qi
Presenter: Zijian Huang, Guangdong Polytechnic Normal University, China

Abstract: The underwater acoustic networks (UANs) have the characteristics of long propagation delays and low bit rates. The characteristics above pose significant challenges in UANs media access control (MAC) protocol. Slotted floor acquisition multiple access (S-FAMA) protocol is widely used in UANs. This protocol is based on FAMA, and data packet collisions can be avoided by adding a time slot mechanism. However, S-FAMA is not suitable UANs when the number of nodes is dense and long propagation delays, because this will lead to a low system throughput. To overcome this shortcoming, this paper proposes a protocol based on S-FAMA, called peaking staggering floor acquisition multiple access (PST-FAMA). PST-FAMA introduces a near-far model and makes use of long propagation delays to improve system throughput. First of all, via the near-far model, it can effectively plan the data packet sequence and complete multiple data transmissions when in the situation of dense nodes and long propagation delays. Secondly, PST-FAMA sets a short time slot, and the idle of initiator nodes will be reduced. Simulation results show that comparing with S-FAMA, PST-FAMA improves the system throughput and minimizes the idle time of initiator nodes.

SESSION 3

Topic: Massive MIMO System and Key Technologies
Time: 13:30-15:50, Nov. 12, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/81673586285 Password: 111114

- **Session Chair: Prof. Shaoshuai Gao, University of Chinese Academy of Sciences, China**

NA00015

Invited Speech

13:30-13:55

Title: Optimization of Federated Learning Communications with Heterogeneous Quantization

Invited Speaker: Assoc. Prof. Congduan Li, Sun Yat-sen University, China

Abstract: The rapid development of machine learning in the field of artificial intelligence benefits from a large amount of training data. Due to the problems of data fragmentation and data isolation, federated learning was proposed. However, there is a communication bottleneck in the learning process of federated learning. To solve this problem, this paper adopts the method of quantization to optimize the communication of federated learning and quantifies features with different accuracy according to the feature importance. We compare the communication overhead between the communication optimization method and the non- communication optimization method, and give a theoretical explanation based on the scenario of detecting fraud in bank credit card transactions. Further, more applications of federated learning will be discussed.

NA30235

Invited Speech

13:55-14:20

Title: A Wideband Circularly Polarized Wearable Antenna Based on Metasurface for WBAN Applications

Invited Speaker: Professor Sen Yan, Xi'an Jiaotong University, China

Abstract: This paper presents a circularly polarized wearable antenna array based on metasurface with wideband for wireless body area network (WBAN). The antenna array consists of four metasurface antennas, and each antenna has a sub array including 2 x 2 metasurface elements. A ring-shaped feeding structure with four arms is employed in this array. Using this structure, a quasi-90° phase delay is generated between each adjacent arm, and thus the antenna array can radiate a circularly polarized pattern. For the wearable antenna array, the simulation -10 dB impedance bandwidth is from 3 GHz to 5.92 GHz with 65.5% relative bandwidth. And the 3 dB axial ratio bandwidth is from 3 GHz to 5.45 GHz with 58% relative bandwidth. The whole size of the antenna array is $1.59\lambda \times 1.59\lambda \times 0.09\lambda$ (106×106×6 mm3) at 4.5 GHz, and the maximum gain is 8.3 dBi. Finally, the Specific absorption rate (SAR) is evaluated on the human body phantom, and the values are far lower than the recommended standards by FCC. This flexible antenna array is an excellent candidate for WBAN and 5G applications.

NA11078

14:20-14:35

Title: Precoding Design for Uplink MU-MIMO-OTFS with Statistical Information of Doppler Shift

Authors: Yaochen Wang and Yuan Zhang
Presenter: Yaochen Wang, Southeast University, China

Abstract: This paper studies the precoding strategies for the uplink reduced cycle prefix (CP) multiple-input multiple-output orthogonal time and frequency space (MIMO-OTFS) modulation systems under high Doppler shift. The proposed precoding method is dependent on the feedback of Doppler shift statistics including the mean and the normalized derivation for each path of each user (UE), which aims to reduce the burden of channel state information (CSI) feedback. Then, we propose to decompose matrix and use linear combination to eliminate the inter-user interferences. In this way, the complexity of detection at the receiver can be reduced. Simulation results with different system parameters prove that the proposed method has improved the BER performance for the considered communication systems compared with the standard OTFS.

NA11031

14:35-14:50

Title: Low Complexity DOA Estimation Algorithms Based on Propagator for Massive MIMO Systems

Authors: Xin Liu, Zhongyan Liu, Yuwei Zhao, Yang Liu, Guochen Yu and Shun Na
Presenter: Xin Liu, Inner Mongolia University, China

Abstract: Massive multiple-input multiple-output (MIMO) has become one of the primary technologies for wireless communi- cation systems, in which accurate direction of arrival (DOA) estimation plays a critical role in interference cancellation and effective beamforming. However, it is a major challenge to develop DOA estimation algorithms with low-complexity and high-accuracy for massive MIMO systems. To address this issue, we propose two successive propagator method (PM) based DOA estimation algorithms for massive MIMO systems. The pro- posed computationally efficient modified PM algorithm utilizes conjugate rearrangement preprocessing on the received signals and orthogonalizes the noise subspace to achieve an accurate estimation under low signal-to-noise ratio and small number of snapshots. Furthermore, to avoid the spectrum-peak search of the PM-based method, we further propose a Propagator Method- Estimation of Signal Parameters via Rotational Invariance Tech- niques (PM-ESPRIT) algorithm, which exploits the rotational invariance of the propagator matrix and closed-form expressions to obtain angle estimations without spectrum-peak search. The PM-ESPRIT algorithm exhibits high accuracy while avoiding a large amount of computation caused by eigenvalue decomposition of the high-dimensional covariance matrix. Simulation results indicate that the proposed algorithms substantially enhance the performance and reduce the computational complexity in massive MIMO systems.

NA11090

14:50-15:05

Title: Linear and Nonlinear Detections for Noncoherent Spatial-multiplexing based MIMO-MASK

Authors: Longhui Li, Chao Yang, Zewei Hu, Xiaofang Deng, Lin Zheng
Presenter: Longhui Li, Guilin University of Electronic Technology, China

Abstract: Multiple-input-multiple-output (MIMO) based on energy detection has the advantages of being insensitive to Doppler shift and low complexity. However, the square-law processing causes the nonlinear mutual interference of MIMO spatial-multiplexing signal detection. In this paper, linear and nonlinear detections are derived for spatial-multiplexing based MIMO multi-level amplitude-shift keying (MIMO-MASK) mod- ulation. The linear low-complexity detection is based on the equivalent linear model with the complementary amplitude wave- form and the energy difference operation at receiver; The other nonlinear detection using deep neural network is theoretically analyzed to be suitable for the nonlinear model of mutual interference. The former requires estimation of real channel information, while the latter does not require pre-estimation of channel information but requires supervised network training. The performances of both detection algorithms are verified by simulations, and both of them are insensitive to Doppler shift.

NA21031

15:05-15:20

Title: Effect of Antenna Pattern on the Electromagnetic MIMO Communication

Authors: Yongxi Liu, Ming Zhang, Tengjiao Wang
Presenter: Yongxi Liu, Xi'an Jiaotong University, China

Abstract: Using ideas from the Fourier plane-wave expansion of a channel model, we establish an electromagnetic (EM) channel model considering the effect of both antenna sides and propagation environment. The coupling effect between antennas becomes more and more serious with the reduction of antenna element spacing. Due to scan impedance mismatch caused by coupling effect, each individual element in an array suffers from the loss of reflection efficiency, which leads to the decrease in channel capacity. With numerical simulation, we show that under this revised model, channel capacity will not increase unboundedly as the number of antenna elements in a fixed-size array increases.

NA21069

15:20-15:35

Title: Signals of Opportunity Navigation Using LTE Downlink Signals

Authors: Yiteng Wang, Huijie Zhu, Tianyi Liang, Jiachuan Qian
Presenter: Yiteng Wang, The 36th Research Institute of China Electronics Technology Group Corporation, China

Abstract: For the global navigation satellite system (GNSS) cannot meet the positioning requirements under occlusion or malicious interference, this paper proposes a receiver self-localization method using long-term evolution (LTE) downlink signals. The method is based on the multi-station time difference location mechanism. The signal acquisition of multi-base stations (BSs) is realized by signal demodulation. The transmission time difference calibration is used to solve the asynchronous problem among BSs. The synchronous signal and cell-specific reference signal are comprehensively detected to extract high-precision time difference parameters. The receiver can calculate and obtain its own position by using these timing parameters. Finally, a software-defined receiver is built to carry out experiments in the outdoor environment. Experimental results show that the positioning distance and moving direction are basically consistent with the actual situation. The root mean square error (RMSE) is less than 5m, which fully verifies the feasibility of LTE as an opportunity signal for navigation.

NA11077

15:35-15:50

Title: Matrix Factorization based Low-Feedback Precoding for Satellite Mobile Communications

Authors: Meidong Xia, Yuan Zhang, and Feng Zhu
Presenter: Meidong Xia, Southeast University, China

Abstract: Precoding technology has been considered as a key technology in multibeam satellite mobile communication systems equipped with massive multiple-input-multiple-output (MIMO) antenna arrays. However, traditional precoding technology faced the challenge of long propagation delay which usually causes the channel state information (CSI) to be outdated in satellite mobile communications. To solve this problem, this paper proposed a low-feedback precoding scheme based on matrix factorization. The channel matrix is divided into two channel sub-matrices, one representing antenna effects and the other representing multipath effects. The proposed scheme performs precoding at the transmitter to eliminate antenna effects, and each user performs equalization at the receiver separately to eliminate the multipath effects. The proposed scheme only needs the satellite to obtain partial CSI which changes usually on a large time scale, thereby reducing the performance loss caused by outdated CSI, and overcomes the influence of the Doppler shift. Simulation results show that the proposed scheme can achieve better bit error rate performance compared to traditional precoding schemes.

SESSION 4

Topic: Electronics and Communication Engineering
Time: 13:30-15:50, Nov. 12, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/89549029505 Password: 111114

- **Session Chair: Prof. B. Kishore, Mahalingam College of Engineering and Technology, India**

NA11021-A

Invited Speech

13:30-13:55

Title: Mode Converter Based on the Few Mode Fiber Long-Period Gratings
Invited Speaker: Prof. Yunqi Liu, Shanghai University, China

Abstract: We demonstrate the fabrication of long-period gratings (LPFGs) in few mode fibers (FMFs) by using focused carbon dioxide laser. The mode coupling and characteristics of the LPFGs written in the FMFs were investigated experimentally and theoretically. The generation and conversion of the orbital angular momentum (OAM) modes were achieved by the special designed gratings. The FMF-LPFGs could have promising application as all fiber mode converters for mode-division-multiplexing optical communications and high sensitivity optical sensors.

NA40412-A

Invited Speech

13:55-14:20

Title: Optical fiber integrated with two-dimensional materials for photonic and optoelectronic applications
Invited Speaker: Assoc. Prof. Jin-hui Chen, Xiamen University, China

Abstract: Low-loss silica optical fibers, semiconductor lasers and erbium-doped fiber amplifiers lay the foundations of the modern optical communications. With the development of materials science and manufacture technology, the conventional homogeneous core-cladding structures in a silica fiber have evolved with a new paradigm shift by combining the photonic structures and functional materials. The emerging trends in optical fiber aim to break the fundamental limit by a single structure and material, and extend their photonic and optoelectronic applications. Here we review the recent advances in two-dimensional (2D) materials fiber integration for all-fiber photonics and optoelectronics [1]. We discuss the basic properties of several mainstay 2D materials and their heterostructures, the design principles of fiber-2D-materials integrations, the current and potential applications, and the challenges and opportunities in this field.

NA31097

14:20-14:35

Title: A High-sensitivity Wake-up Receiver using Tunnel Diode for ISM Band
Authors: Bingru Wu, Diandian Zhang, Tao Ma, Ruixuan Jiang, Hanming Gao, Guanghui Liu
Presenter: Bingru Wu, Xidian University, China

Abstract: In this paper, a new ultra-low power wake-up receiver (WUR) is presented for use in Wireless sensor networks (WSNs), designed with low-cost off-the-shelf components. It is comprised of a low-power reflection amplifier and an envelope detector. The reflection amplifier enhances the reflection gain of 38dB for impinging RF power levels as low as -98dBm. The envelope detector extracts the envelope of OOK wake-up signal and generates digital data for the microcontroller or IC using zero-bias diodes and a low-power comparator. Additionally, we conducted experiments to verify the performance of the prototype in terms of power consumption, sensitivity and bit rate. The prototype achieves the scalable bit rate from 20bps to 1kbps with the sensitivity from -98dBm to -90dBm at the frequency of 926MHz. The power consumption is only 227μW regardless of bit rate.

NA11104

14:35-14:50

Title: An A3C Deep Reinforcement Learning FPGA Accelerator based on Heterogeneous Compute Units
Authors: Ziyu Li, Fen Ge, Fang Zhou, Ning Wu
Presenter: Ziyu Li, Nanjing University of Aeronautics and Astronautics, China

Abstract: Deep reinforcement leaning (DRL) has a great performance in intelligent decision-making question. As one of well-performance DRL algorithms, Asynchronous Advantage Actor-Critic (A3C) can make distributed agents work simultaneously to infer and train without experience pool. However, the multiple agents also bring complex deep neural network (DNN) computations in each agent which costs the almost time in A3C algorithm. In this paper, we propose a DRL FPGA accelerator based on heterogeneous compute units for A3C algorithm to reduce the DNN computing periods. According to A3C algorithm computing flow, we implement both inference and training steps on accelerator and pipeline their computations. In DNN forward propagation (FP) and backward propagation computing (BP), the Multiply-ADDer-tree (MADD) structure with high input parallelism and Multiply-Accumulation (MAC) structure with high output parallelism are proposed to be employed, respectively. Heterogeneous computing method makes the weight parameters layout of inference and training consistent, and improves the access efficiency of on-chip memory. Experimental results show that our design achieves 40-times speedup in inference-training speedup compared to CPU, and 54-times speedup compared to GPU. Moreover, our heterogeneous computing method lead to better efficiency in memory accessing compared to exiting approaches.

NA21075

14:50-15:05

Title: Intelligent bearing fault diagnosis using adaptive time-frequency convolutional features with multi-task learning

Authors: Simin Li, Youjiang Liu, Yongtao Qiu and Shengli Wang
Presenter: Simin Li, Institute of Electronic Engineering, China Academy of Engineering Physics, China

Abstract: Deep learning based fault diagnosis methods can extract representative and distinguish features automatically from raw signals and have achieved promising results in recent years. However, deep models rely heavily on massive labeled data and do not generalize well under varying load conditions. Besides, both temporal features and frequency features of raw vibration signals provide useful information in fault diagnosis and should be fully exploit to acquire better performance. To address these issue, a dual-input model based on a convolutional neural network with attention mechanism and multi-task learning strategy is proposed in this paper. The model uses both temporal and frequency adaptive features to achieve end-to-end fault diagnosis. First, a two-branch one-dimensional CNN is designed to learn rich and complementary features from both temporal and frequency data in parallel. Moreover, attention mechanism is adopted in the two-branch CNN to further increase the adaptability of the proposed model under different working loads. Finally, to obtain robust and discriminative features as well as enhance recognition accuracy, a multi-task learning strategy is also employed to better optimize the whole network. Experimental results over the standard Case Western Reserve University (CWRU) bearing fault diagnosis benchmark dataset demonstrate the superiority of our proposed model and can achieve a high fault recognition rate under variable load conditions with fewer training samples.

NA21073

15:05-15:20

Title: 3D Dynamic Ray-Tracing Method for Vehicle-to-Vehicle Propagation Channels

Authors: Gang Liu, Liqiang Niu, Haoyi Xu, and Chonghu Cheng
Presenter: Gang Liu, Taishan University, China

Abstract: Conventional ray-tracing (RT) methods are not applicable to complex scenarios considering moving scatterers due to the huge increased complexity. In this paper, a three-dimensional (3D) dynamic RT method considering moving scatterer effects is presented. A simplified preprocessing method for dynamic scenario is proposed to remove the repeated scenario representations and date processing. Moreover, a compound acceleration method is proposed to improve the simulation for each time instant. Finally, the proposed method is applied to a V2V tunnel scenario, numerical analysis indicates that the method can be served as an effective tool for predicting the channel characteristics in complex dynamic scenarios.

NA40385

15:20-15:35

Title: Millimeter Wave Beam Tracking Scheme with Neural Network Embedded Kalman Filter

Authors: Jienan Chen, Tingyong Wu, Chentao Liang, Wei Xiang
Presenter: Jienan Chen, University of Electronic Science and Technology of China, China

Abstract: With an ever-increasing demand for wireless access capacity, the Millimeter-wave (mmWave) has become a promis- ing technology for the forthcoming B5G/6G communications. Unfortunately, consistent high accuracy beam tracking is still a challenging task due to the narrow beam of mmWave. To address this challenge, we propose an intelligent neural network (NN) embedded Kalman filter (KF) scheme. The KF filter can provide robust beam tracking but with a penalty of accuracy loss, if the state transition function deviates from the changing of beam direction in practical scenarios. In our proposed scheme, the acquisition of the state transition function in the KF is converted to a neural network training process by introducing variance Bayesian inference. Therefore, the proposed scheme is a hybrid model-data-driven solution, which improves the prediction accuracy while inheriting the KF robustness. To verify the effectiveness of our proposed solution, we implement the proposed scheme on a software-defined radio system and conduct field testing. Experimental results illustrate that the proposed algorithm outperforms the existing beam tracking methods in terms of mean square error of beam angle prediction.

NA30310

15:35-15:50

Title: Transparent Antenna Research and Application

Authors: LI Nan, ZHAO Jie, SHAO Zhe, and DENG Wei
Presenter: LI Nan, China Mobile Research Institute, China

Abstract: With the rapid development of 5G network and the breakthrough of new materials, various of new antennas have been developed. The transparent antenna, which based on optically transparent materials, is highly transmittance to visible light. It overcomes the limitations of conventional antenna installation, highly harmonious with the environment, and achieves the antenna transparency effect, has a wide range of application prospects. This paper expounds the theory and design method of transparent antenna, introduces its applications and trails applied in mobile communication, and finally looks into the future applications of transparent antenna in intelligent terminal, automobile, satellite and other fields.

SESSION 5

Topic: Communication and Signal System
Time: 13:30-15:55, Nov. 12, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/86088803609 Password: 111114

- **Session Chair: Prof. Sanjay Singh, Manipal Institute of Technology, India**

NA30263

Invited Speech

13:30-13:55

Title: Real-time Hardware Emulation of Frequency Non-Stationary UWB Channels with Continuous Frequency Response

Invited Speaker: Professor Qiuming Zhu, Nanjing University of Aeronautics and Astronautics, China

Abstract: Ultra-wideband (UWB) communication technology has been widely used for indoor localization and is promising to provide high transmission rate in the future communication networks. Considering the frequency non-stationarity of channel parameters, a UWB channel model with continuous frequency response is proposed. To improve the real-time performance and reduce the complexity of hardware implementation, a discrete channel model for hardware implementation is obtained, and then the closed-form of this discrete UWB channel model is derived. Based on which, a real-time channel emulator is developed on a software-defined radio hardware platform, where a parallel multi-channel data processing architecture is adopted to realize the real-time processing of high-speed data. The results show that the output results of developed channel emulator are well consistent with the measured results of Vector Network Analyzer (VNA) in an indoor scenario and have better performance of delay resolution than that of traditional channel emulator. The channel emulator can be used for optimization, verification, and evaluation of UWB communication systems.

NA21080

13:55-14:10

Title: BEM Based Fast Time-varying Channel Estimation Method for 5G Integrated Satellite Systems

Authors: Shunyao Yang, DongDong Wang, Lizhe Liu, Bin Wang, and Chenhua Sun
Presenter: Shunyao Yang, Academy for Network & Communications of CETC, China

Abstract: This paper proposes a channel estimation method based on discrete prolate spheroidal base extension model (DPS-BEM) for 5G integrated low earth orbit (LEO) satellite systems, which takes the cascade structure of least square (LS) estimator and Kalman filter as the core. Firstly, DPS-BEM is utilized to accurately fit the time-domain channel state matrix. The preliminary estimation coefficients of the basis function could be acquired by a simple and easy implemented LS estimator. Subsequently, the Kalman filtering is cascaded to attenuate the influence of noise, so that the error of the LS estimator can be substantially diminished. Simulation results show that the proposed method has higher precision and robustness compared with the existing common methods.

NA11040

14:10-14:25

Title: A Narrowband Sound Source Localization Method and System Based on A Non-uniform Linear Microphone Array

Authors: Xiaoyu Qian, Xunrui Tang, Ziyuan Wang, Qiao Meng
Presenter: Xiaoyu Qian, Southeast University, China

Abstract: Based on the phase delay estimation of narrowband signals, a signal localization method is proposed in this paper by using a non-uniform linear array, which solves the phase wrapping problem caused by the increase of array element spacing and improves the accuracy of localization. This paper proposes an estimation algorithm for correcting the amount of wrapping and calculating the time delay in the case of non-uniform linear array approach, and gives the conditions that need to be satisfied for non-uniform array element spacing. The signal localization method improves the available array aperture for positioning and greatly reduces the number of array elements required for the same aperture compared to a general uniform linear array, thus reducing the need for subsequent signal processing equipment. A localization system is also constructed and tested. The experiments show that the method effectively improves the accuracy of localization of narrowband sound sources in open space.

NA11048

14:25-14:40

Title: A Bias Reduction Method for TDOA\GROA-Based Localization

Authors: Ziqiang Zhang, Bin Yang, Ding Wang and Tiantian Chen
Presenter: Ziqiang Zhang, PLA Information Engineering University, China

Abstract: This paper addresses the low noise level tolerance problem faced by hybrid TDOA and GROA-based source localization. Bias reduction method has been researched in the TDOA and even extended for hybrid positioning. However, due to the high-dimensional nonlinear nature between parameters, the performance of traditional method decreases rapidly at large signal-to-noise ratio level. To improve the location accuracy, especially at high noise levels, a new bias reduction method is proposed here. The new method imposes a quadratic equality constraint to optimize cost function and uses a prior estimate to linearise the constraint to obtain the optimal solution. By utilizing the constraint between parameters, the bias is further reduced. Computer simulations are performed to support the effectiveness of accuracy improvement.

NA40415

14:40-14:55

Title: A detection algorithm of amplitude and phase consistency based on deviation degree and correlation coefficient

Authors: Mingshan Yang, Yang Zhao, Xiaoyan Du, Xianfeng Zhang
Presenter: Yang Zhao, Zhengzhou University, China

Abstract: In order to solve the low efficiency of detecting the amplitude and phase consistency of the phased array receive modules, an amplitude and phase consistency detection algorithm for phased array receive module is proposed. The algorithm detects the amplitude and phase consistency through the test data of the scattering parameters of the phased array receive module. Deviation degree and Pearson correlation coefficient are taken as the features of amplitude and phase consistency, and then k-means clustering algorithm is used to complete the detection of amplitude and phase consistency. Through the experimental verification, this method can efficiently detect the module with inconsistent amplitude and phase, so as to facilitate the next repairs and testing.

NA11084

14:55-15:10

Title: Waveform Recognition of UAV Swarm Communication in Multipath Channel

Authors: Ruping Zhai, Sai Li, Shuheng Zhang, Jiarong Ping
Presenter: Ruping Zhai, Nanjing University of Aeronautics and Astronautics, China

Abstract: The electromagnetic environment of UAV swarm communication is complex, and phenomena such as user interference, multipath fading and frequency shift occur. The performance of the waveform recognition algorithm under the traditional AWGN channel is greatly reduced in this scenario. To solve this problem, this paper proposes a waveform recognition algorithm for UAV swarm communication in multipath channel. Firstly, establish the multipath fading channel model of UAV swarm communication under Alpha pulse interference. Then, aiming at the problem of Alpha pulse interference among swarm users, extract the generalized cyclic mean and generalized cyclic spectrum features of the signal, and establish the waveform feature matrix of UAV swarm communication in multipath environment. Finally, the SAE deep neural network UAV swarm communication waveform recognition model is established. The simulation results show that the algorithm proposed in this paper has strong robustness in the complex environment of Alpha pulse interference, multipath fading and frequency shift, and realizes the recognition of six kinds of UAV swarm communication waveforms. At the same time, the recognition accuracy of more than 80% can be guaranteed when the signal-to-noise ratio is -10 dB.

NA30309

15:10-15:25

Title: CNN-Zero: A Zero-Shot Learning Framework for Jamming Identification

Authors: Ningsong Zhang, Junren Shen, Yuxin Shi, and Yusheng Li
Presenter: Ningsong Zhang, National University of Defense Technology, China

Abstract: Anti-jamming is a critical issue of wireless communication security, where jamming identification is an important pre-stage of anti-jamming. However, it is challenging to perform a jamming identification task in the absence of some jamming classes. To overcome this obstacle, we propose a zero-shot learning framework CNN-Zero, which aims to identify the known and unknown jamming signals. Specifically, we employ CNN to learn the potential representation of the semantic feature space of jamming signals. Then, we build a hybrid loss

function consisting of attribute distance loss, cross entropy loss and reconstruction loss to ensure the semantic features have greater minimum inter-class distance than maximum intra-class distance. Finally, we build an appropriate distance measurement matrix to identify known and unknown jamming signals. Experimental results prove that compared with the supervised method using neural networks, CNN-Zero achieves a better average accuracy between eight jamming signals even in the absence of training samples.

NA21047

15:25-15:40

Title: Improved Hierarchical Architecture for Graph Classification

Authors: Zhimo Li
Presenter: Zhimo Li, Guilin University of Electronic Technology, China

Abstract: The existing methods of graph classification often do not consider the information of the graph from multiple perspectives, nor do they dynamically fuse the relevant information scores of nodes, which will lead to incomplete graph structure information. Additionally, after sending the coarse graphs obtained from the pooling layer to the readout layer, the graph representations output by the readout layer is sent to the linear layer directly, which will cause the final generated graph representations containing redundant information. In response to the above issues, two improvements are proposed in this paper: (1) Consider the graph structure from multiple perspectives so that the second-order neighbor information is introduced. Thereby the structural relationship among neighbor nodes can be fully used to strengthen the integrity of graph structure. After that, the structure and feature information is dynamically fused. (2) Analyze the importance of each coarse graph obtained from graph pooling via attention and then designate weights according to their importance. Eventually, the more representative graphs are obtained. The results of the experiments on four different datasets reveal that this fashion can achieve better performance in graph classification tasks.

NA40354

15:40-15:55

Title: The Appropriate Image Enhancement Method for Underwater Object Detection

Authors: Zheng Zhang, Qingshan Tong, Chuanchuan Yi, Xianhui Fu, Jia Ai and Zhaopeng Wang
Presenter: Zheng Zhang, ChangSha University of Science and Technology, China

Abstract: Underwater datasets usually have blurred objects, low contrast, and color distortion, which seriously restrict the performance of the target detector on it. It is very important to use data enhancement methods to improve the original dataset. In this paper 7 target detection models are trained on Trash-ICRA19 underwater datasets, namely Faster-RCNN, SSD, YOLO V1-V5. Through comparison, it is found that YOLOV5 has the best performance with 79.7 AP and 138.89 FPS. Then three methods about data enhancement are adopted to improve the UDD underwater datasets, namely Underwater Dark Channel Prior(UDCP), Contrast-Limited Adaptive Histogram Equalization(CLAHE), and Relative Global Histogram Stretching(RGHS). Comprehensive comparison found that CLAHE and RGHS can have a better recovery effect. Finally, the YOLOV5 model is re-trained on the enhanced UDD underwater dataset. Compared with visual results, these enhancement methods can make the detector better distinguish between objects and backgrounds.

SESSION 6

Topic: 5G/6G and Future Communication Technology
Time: 13:30-16:00, Nov. 12, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/86924134522 Password: 111114

- **Session Chair: Assoc. Prof. Yu Yao, East China Jiaotong University, China**

NA40364

Invited Speech

13:30-13:55

Title: Pre-established Entanglement Distribution with Time-guaranteed Memory Cells Selection in Quantum Networks

Invited Speaker: Professor Yongli Zhao, Beijing University of Posts and Telecommunications Beijing, China

Abstract: Quantum entanglement enables numerous quantum applications such as secure communication. Based on entanglement-based quantum networks, long-distance entanglement establishment between two distant end nodes is vital to realize practical quantum networks. However, due to the decoherence and imperfect quantum operations such as the non-determinism of entanglement swapping, the latency of remote entanglement distribution will be increased, simultaneously, ongoing quantum operations will be cut off caused by the short coherence time of quantum memory. In this article, we propose a pre-established entanglement distribution algorithm which contains a time-guaranteed memory cells selection algorithm, aiming to choose the maximum time-matching entangled particle in each node to establish end-to-end entanglement. Simulation results show that for the different scales of grid network topologies, all success probability values are increasing with increase the size of the memory cells and the size of the time slots. Considering constructing the large scale of quantum network, it′ s necessary to consider employing high multi-mode capability and long lifetime quantum memory.

NA40399

Invited Speech

13:55-14:20

Title: 5G Integrated Radio Transmission scheme for Low Earth Orbit Satellite Access Network

Invited Speaker: Senior Engineer Dongdong Wang, Academy for Network & Communications of CETC, Science and Technology on Communication Networks Laboratory, China

Abstract: This invited speech comprehensively analyzes the channel transmission characteristics of the low earth orbit (LEO) satellite. Based on the above analysis, the problems that each physical layer process of terrestrial 5G NR are directly applied to LEO satellite access network is further analyzed, then the feasible implementation schemes for each physical layer process are carefully designed. Furthermore, the core algorithms of each key step in each physical layer process are briefly discussed.

NA55021

Invited Speech

14:20-14:45

Title: Service Offloading in B5G/6G Collaborative Edge Computing Based on Graph Neural Networks

Invited Speaker: Assoc. Prof. Peng Yu, Beijing University of Posts and Telecommunications, China

Abstract: Service offloading in collaborative edge computing can realize full use of the limited resources of edge nodes to achieve efficient parallel computing. The existing research mainly focuses on service delay but pays insufficient attention to the network status, which will easily cause unbalanced resource utilization. Therefore, we propose a resource and delay aware fine-grained service offloading mechanism. First, we propose a novel network-adaptive service graph reconstruction algorithm to reduce the complexity of service offloading and the transmission delay, which includes service graph partition, dependency conflict detection and elimination, and service graph re-creation. Next, to better balance link and node resource utilization respectively, we propose original graph-based and association graph-based service graph mapping algorithms based on graph neural networks. A goal-directed affinity-based loss function is explored for them, which aims to address the difficulty of label generation in supervised learning. Generally, our fine-grained service offloading mechanism enables short execution time and strong scalability, and is applicable to dynamic edge networks.

NA11003

14:45-15:00

Title: Energy-efficient Edge Association in Digital Twin empowered 6G Networks

Authors: Ruixi Zhao, Ke Zhang, Yan Zhang
Presenter: Ruixi Zhao, University of Electronic Science and Technology of China; Guangdong Laboratory of Artificial Intelligence and Digital Economy, China

Abstract: Digital twin (DT) emerges as a promising technology to realize highly reliable and low-latency communication in 6G. The co-evolution between physical devices and their virtual twins in DT technology is crucial that guarantees efficient operation of Digital Twin Edge Networks (DITEN). However, due to the huge amount of data transmitted from physical layer to digital twin layer and the heavy tasks offloading to edge servers, the co-evolution may cause quite heavy energy consumption of user devices and high computation overhead of edge servers. In this paper, we propose a digital twin edge association scheme which integrates digital twins with edge networks to enable low energy consumption and low computation overhead edge association. First, we introduce a DITEN model and define energy-efficient edge association problem. Then, we solve the problem in a Stackelberg Game model approach and give performance evaluation results. Finally, we conclude the paper and discuss future work.

NA11035

15:00-15:15

Title: Research and Design of Dual-Band 1:8 Wilkinson Power Dividers for 5G

Authors: Xicong Chen and Fumin Lin
Presenter: Xicong Chen, Guangdong University of Technology, China

Abstract: In this paper, a dual-band 1:8 Wilkinson power divider operating at 4.9GHz and 26GHz for 5G application is proposed. It adopts double-section coupled transmission line and two isolation resistances, and achieves low insertion loss through low-loss analysis. The measure results show that the return loss of all ports is less than -15dB and the insertion loss is less than -9.7dB in 4.54-5.34GHz. At 26GHz, S11<-20dB and the return loss of outputs is greater than -14dB. The insertion loss at 26GHz is less than -12.5dB. In dual-band, the design shows good amplitude and phase consistency and the isolation is better than 13dB. This design can be applied to 5G dual-band multi-port wireless communication in Sub-6GHz and millimeter wave bands.

NA31093

15:15-15:30

Title: Satellite Ephemeris Broadcasting Architecture for 5G Integrated LEO Satellite Internet

Authors: Jianwei Li, Dongdong Wang, Lizhe Liu, Bin Wang and Chenhua Sun
Presenter: Jianwei Li, Academy for Network & Communications of CETC Science and Technology on Communication Networks Laboratory, China

Abstract: This paper proposes a satellite ephemeris broadcasting architecture for 5G integrated low earth orbit (LEO) Satellite Internet based on two-line element (TLE) ephemeris. By periodically broadcasting the TLE ephemeris, which can be used to assist the user equipment (UE) for satellite selection, Doppler frequency offset and time advance (TA) pre-compensation, etc., the design of the 5G integrated LEO satellite air interface could be greatly simplified. The proposed architecture mainly comprises three stages, the generation, distribution and application of TLE ephemeris. (1) The accurate TLE ephemeris is generated by the simplified general perturbations-4 (SGP4) orbital model, whose input is obtained by the data combination of the orbital data acquired from the spaceborne global navigation satellite system (GNSS) and the satellite tracking station, respectively. (2) The generated ephemeris is sent to the internet, and then be uploaded to its corresponding LEO satellite by the feeder link. The UEs can either obtain the ephemeris from the satellite or from the terrestrial base station. (3) The UE equipped with GNSS system utilizes the TLE ephemeris to calculate the orbital information, Doppler frequency offset and timing advance, etc., so as to realize the efficient and reliable communication with the LEO satellites. The simulation results show that the proposed ephemeris broadcasting architecture can provide reliable and necessary priori information used for the entire physical layer communication process of 5G integrated LEO Satellite Internet over a period of time.

NA21083

15:30-15:45

Title: Noise Prediction Based on Machine Learning in Quantum Secured SWDM B5G Fronthaul Networks

Authors: Chenglong Wang, Yongmei Sun, Weiwen Kong and Yaoxian Gao
Presenter: Chenglong Wang, Beijing University of Posts and Telecommunications, China

Abstract: The fronthaul network is an essential way to improve the comprehensive performance of beyond fifth generation (B5G) communication network. Space-wavelength division multiplexing (SWDM) can effectively improve its capacity, and quantum key distribution technique can provide unconditional information security for it. In quantum secured SWDM B5G fronthaul network, quantum signals are affected by noises generated by classical signals, such as spontaneous Raman scattering, four-wave mixing and inter-core crosstalk. Evaluating these noises in real-time will increase the time delay of the whole network. In this paper, we propose two machine learning (ML) models (XGBoost and LightGBM) to predict these noises. Simulation results show that the ML models can reduce the noise evaluation time by up to 98.8%. Besides, the available channel predicting accuracy rate is close to 100%. The minimum noise predicting accuracy rate increases with the increasement of the channel occupancy rate and can reach 100% when channel occupancy is higher than 80%.

NA30280

15:45-16:00

Title: A Survey on Terahertz Communication Theory Assisted by Intelligent Reflecting Surface and Device-to-Device Technologies

Authors: Wei Xun, Yaxuan Liu, Yiyang Ni, Haitao Zhao, Zhuoran Xu, Xingfeng Ge
Presenter: Wei Xun, Nanjing University of Posts and Telecommunications, China

Abstract: Terahertz wireless communication meets the transmission needs of future networks with its ultra-high bandwidth. However, its practical application is seriously restricted by its large path loss and severe blocking effect. The intelligent reflecting surface and device-to-device technologies can be expected to assist terahertz communication to solve the above problems. However, the corresponding research is still at the initial stage. Under the circumstances, this paper summarizes the existing research results and analyzes the potential of application of intelligent reflecting surface and device-to-device technologies in terahertz communication.

SESSION 7

Topic: Optical Communication and Wireless Location Technology
Time: 13:30-16:40, Nov. 12, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/86108605540 Password: 111114

- **Session Chairs:**
  Prof. Jiagui Wu, Southwest University, China
  Assoc. Prof. Mengyuan Ye, China University of Geosciences, China

NA55019

Invited Speech

13:30-13:55

Title: A Novel Cooperative Localization Method based on Direction-of-Arrival and Time-Difference-of-Arrival Measurements for Over-the-horizon Shortwave Emitter

Invited Speaker: Assoc. Prof. Ding Wang, PLA Strategic Support Force Information Engineering University, China

Abstract: The location of long-distance shortwave emitters is of great practical significance in the field of national defense security. The shortwave multi-station positioning system mainly includes direction-of-arrival (DOA) intersection location and time-difference-of-arrival (TDOA) intersection location. Both systems have their own advantages and disadvantages in performance. In order to combine the advantages of the two positioning technologies, this paper focuses on the cooperative positioning problem based on the DOA and TDOA measurements. First, the two-dimensional DOA and TDOA observation models are established for the over-the-horizon propagation scenario. Subsequently, the Cramér-Rao lower bound (CRLB) of positioning accuracy is derived in the presence of measurement errors in ionosphere virtual height. Aiming at the strong nonlinear characteristics of the observation equations, a new DOA/TDOA cooperative localization method is proposed. Finally, the asymptotic efficiency of the new estimator is proved by using the first-order error analysis approach. The new method is composed of two phases. In the first stage, the shortwave DOA observation equation is transformed into pseudo-linear observation equation by introducing an auxiliary variable and solving a quadratic equation with one unknown. Then, the optimization model with two quadratic equality constraints is constructed, and an iterative optimization algorithm based on matrix QR decomposition is proposed to obtain the intermediate estimation of the emitter position. The second stage transforms the shortwave TDOA observation equation into pseudo-linear observation equation by combining the intermediate estimate given in the first phase, and an iterative constrained weighted-least-squares (WLS) estimator based on matrix decomposition is proposed again to achieve emitter localization. Simulation results show that the new cooperative localization method has good global convergence, and its localization performance can reach the CRLB, and it can obtain high cooperative gain.

NA55025

Invited Speech

13:55-14:20

Title: Service Provisioning in WSS-based All-Optical Data Center Networks

Invited Speaker: Assoc. Prof. Yongcheng Li, Soochow University, China

Abstract: Dragonfly is an important network topology for data centers to efficiently serve high-performance computing (HPC) traffic flows. In this paper, we construct a WSS-based all-optical data center network (DCN) with Dragonfly topology and investigate its routing, wavelength, and time slot allocation (RWTA) problem. Two heuristic algorithms, including the shortest-path-based (SP) algorithm and the least-delay-path based (LDP) algorithm, are proposed. Simulation results show that the LDP algorithm is efficient in improving the performance of the proposed all-optical DCN with Dragonfly topology in terms of task completion time (TCT).

NA55032

Invited Speech

14:20-14:45

Title: Fiber-Enabled Optical Wireless Communications in the Beam Domain

Invited Speaker: Assoc. Prof. Chen Sun, Southeast University, China

Abstract: Optical wireless communications with a wealth of additional spectrum, can provide an extremely high data rate, presenting a promising direction for 6G communications. Many existing works, including visible light communications and infrared light communications, try to reach this goal, but suffer from the limitation of serving user numbers and user mobility. To tackle these problems, we propose a fiber-enabled optical wireless communication (FE-OWC) system, comprising optical antennas, optical chains, and baseband units. The innovative

optical antenna, consisting of an array of fiber ports and a transceiver lens, forms a number of optical beams, providing full beam coverage. Then, we design downlink and uplink multi-user MIMO transmission schemes and develop asymptotically optimal schemes for a large number of fiber ports. Numerical results illustrate that the FE-OWC system has the potential to support over 10 Gbps data rate per user and the Tbps system throughput required in future 6G mobile communications.

NA55031

Invited Speech

14:45-15:10

Title: Pre-Calculated Space-Ground Integrated Multi-Dimensional Structure (P-SGMDS) based Protection Scheme in Space-Ground Integrated Optical Networks

Invited Speaker: Assoc. Prof. Xin Li, Beijing University of Posts and Telecommunications, China

Abstract: Network survivability has always been an important research focus in the long-haul and large-capacity terrestrial optical network (TON). To fulfill the data transmission and reduce the impact of abnormal conditions, various survivability technologies such as the pre-configured structure based protection scheme, the multipath protection scheme, the link/path based restoration scheme, the disaster-aware network deployment scheme, etc., have been proposed. However, most existing survivability technologies merely rely on the TON itself and thus it is difficult to deal with widespread link failures, network islanding, and even network paralysis, caused by natural disasters. Natural disasters pose a big challenge to the network survivability design. In this article, we focus on designing the disaster-resilient TON with the assistance of the satellite optical network (SON). A novel pre-calculated space-ground integrated multi-dimensional structure (P-SGMDS) is proposed. Numerical results show the P-SGMDS scheme has high resource efficiency and protection success rate.

NA21019

15:10-15:25

Title: PAPR Optimization for Underwater Visible Light Communication System

Authors: Junning Zhang, Lihao Zhao, Liwei Yang, Chen Jin and Shusheng Lv

Presenter: Lihao Zhao, Beijing Information Science and Technology University, China

Abstract: This work assesses the algorithm for reducing PAPR in underwater visible visual communication employing OFDM technology to the conventional PAPR algorithm. In the simulation experiment, orthogonal frequency division multiplexing (OFDM) and multi-input multi-output (MIMO) are permed to reduce multipath interference and signal-to- noise ratio (SNR). The simulation findings reveal that the system has a significant bit error rate, high reliability, and improved overall performance.

NA11051

15:25-15:40

Title: A CSI based Localization and Identification Recognition Algorithm Using Multi-task Learning and Deep Residual Shrinkage Network

Authors: Yanzhao Guo and Jun Yan

Presenter: Yanzhao Guo, Nanjing University of Posts and Telecommunications, China

Abstract: With the increasing requirements of wireless sensing technology, device-free based wireless sensing technique has received much attentions. In this paper, the channel state information (CSI) obtained from Wi-Fi signal is proposed for localization and identification using multi-task learning and deep residual shrinkage network (DRSN). First, the Hampel filter and wavelet filter are used to remove outliers and mitigate noise, respectively. Then, the hard parameter sharing based multi-task learning framework is used for localization and identification recognition training. Specially, the DRSN is used for feature extraction in the shared hidden layer. The loss function is defined as the weight sum of the loss function of each task. The experimental results show that the accuracy of localization and identification of the proposed algorithm are 89.2% and 92.3%, respectively. It can achieve high precision joint task identification of location and identity.

NA30215

15:40-15:55

Title: An Effective User Localization and Environment Reconstruction Algorithm for WiFi Systems

Authors: Yuan Tang, Zhihai Zhang, Xinhong Pan, Heyun Lin and Yuan Chen

Presenter: Yuan Chen, Communication University of China, China

Abstract: Due to the cost-effective and easy-to-deploy characteristics, WiFi has been widely used in indoor localization. For millimeter wave (mmWave) WiFi indoor communication

systems, we develop a two-stage algorithm to achieve user localization and environment reconstruction in this paper. In the first stage, accurate estimation of parameters as well as the reconstructed sparse signal can be obtained through the improved orthogonal matching pursuit (IOMP) algorithm. In second stage, we construct the geometric model of positions, and implement user localization and scattering environment mapping via computation combined with the estimated parameters. The proposed algorithm has low complexity and requires a small number of sub-carriers to realize user localization and environment reconstruction. Simulations verify the effectiveness of the proposed algorithm.

NA40414

15:55-16:10

Title: Data-adaptive CNN used for Multi-parameters Estimation in High-precision Indoor localization

Authors: Sipeng Tang, Youyun Xu and Wei Li
Presenter: Sipeng Tang, Nanjing University of Posts and Telecommunications, China

Abstract: In recent years, CSI-based WiFi indoor positioning has attracted much interest because CSI (Channel State Information) measurement becomes more and more convenient. AoA (Angle of Arrival), AoD (Angle of Departure) and ToF (Time of Flight) based on CSI have been widely used in WiFi based indoor positioning. Traditional algorithms such as MUSIC algorithm are difficult to achieve the positioning accuracy required for practical applications due to the influence of multipath. In this paper, we propose a Data-adaptive CNN(DA-CNN) algorithm for high accuracy parameter estimation in indoor localization. The algorithm uses the super net, which can search the neural architecture suitable for CSI data since the neural architecture has significant influence on the accuracy of indoor localization. We further propose a unique CSI processing method, which first removes the CSI phase shift caused by each two parameters of AoA, AoD and ToF in CSI, and then uses this clean data to estimate the other parameter. Simulation results show that DACNN can greatly improve the estimation accuracy. Compared with the common neural networks algorithm, the estimation accuracy of AoA and AoD angle can be improved by nearly 40%, and the estimation accuracy of ToF can be improved by nearly 30%.

NA40333

16:10-16:25

Title: Performance Study of Model-driven based Neural Network for VLC Channel Impairments Compensation

Authors: Pu Miao, Hui Peng, Yu Yao, Peng Chen, and Daming Tian
Presenter: Pu Miao, Qingdao University, China

Abstract: Inspired by the model-solving procedure of Volterra equalizer, an efficient nonlinear post equalization (NPE) based on the combined convolutional neural network (CNN) and long-short term memory (LSTM) is proposed to mitigate the channel nonlinearity in visible light communication (VLC) system. Our insight is to employ the Volterra feature as spatial input, and then take advantage of the CNN to extract the implicit feature of nonlinearity and utilize the LSTM to predict the original transmitted signal from the distorted ones at the receiver end. Results demonstrate that the proposed scheme can provide a fairly fast convergence during the training stage and can effectively mitigate the overall nonlinearity of the system at the testing. Furthermore, it can recover the original signal accurately and exhibit an excellent bit error rate performance as compared with the conventional equalizer, demonstrating the prospect and validity of this methodology for channel impairments compensation.

NA21039

16:25-16:40

Title: MMSE-SD Detection based Mitigation of Interference in Visible Light Communication Systems

Authors: Xinyu Li, Liwei Yang, and Maiyun Zhang
Presenter: Xinyu Li, China Agricultural University, China

Abstract: Visible light communication (VLC) is an emerging wireless communication technology that uses light signals emitted from LEDs (Light Emitting Diode), etc. as information carriers to disseminate information. In this paper, we propose a new algorithm to improve the performance of VLC systems. The core of the algorithm is to combine the advantages of the spherical decoding (SD) algorithm and the minimum mean square error (MMSE) algorithm to obtain relatively accurate channel statistics, taking into account issues such as noise interference. The performance of Bit Error Ratio (BER) and sum-rate of the system is verified by using the spherical decoding based minimum mean square error (MMSE-SD) optimization algorithm and other algorithms at the receiver of the system. The whole experimental results illustrate that the scheme proposed in this paper improves the overall performance of the VLC system.

SESSION 8

Topic: Performance Analysis of Wireless Communication System and Network
Time: 15:50-18:25, Nov. 12, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/84231845366 Password: 111114

- **Session Chair: Assoc. Prof. Bo Li, Ningxia University, China**

NA55017

Invited Speech

15:50-16:15

Title: Wireless Beam Modulation: A Novel Modulation-Free mmWave System for Energy- and Cost-Efficient Communication

Invited Speaker: Professor Jienan Chen, University of Electronic Science and Technology of China, China

Abstract: With rich spectrum resources, millimeter wave (mmWave) is considered to be a promising technology to solve the heavy spectrum congestion in sub-6GHz and support high-speed transmission. The actual mmWave systems need to utilize radio frequency (RF) components to complete the transmission, conversion and processing of mmWave signal. However, an RF component consists of mixers, filters, phase-locked loops (PLL), power amplifiers, etc., which results in high costs and power computation of RF chains. Consequently, the above disadvantages greatly limit the practicability of mmWave communication systems. To solve the above challenge, we propose a novel energy- and cost-efficient wireless beam modulation (WBM) mmWave system based on the attenuation characteristics of the spatial channel. The characteristics are no longer considered a detrimental phenomenon but are used to achieve modulation. Consequently, the transmitter of the WBM system still provides hundreds of megabits of transmission without complex RF components and phase shift networks, which determines that the proposed WBM system can achieve high-speed transmission with low-cost and low-power consumption based on extremely simple hardware implementation. It is believed that the proposed WBM system bridges the gap between high-speed mmWave communication and energy-efficient data transmission, which may have significant potential in guiding the designs of future 6G-enabled communication systems.

NA40439

Invited Speech

16:15-16:40

Title: Convolutional Neural Network for Performance Monitoring and Modulation Formation Recognition in Communication System

Invited Speaker: Assoc. Prof. Danshi Wang, Beijing University of Posts and Telecommunications, China

Abstract: In this paper, a deep learning-based method is proposed for system damage identification and modulation format recognition in satellite communication system. Four typical damages are studied, including atmospheric channel impairments and hardware imperfections. In addition, total of ten modulation formats are generated, from low-order phase modulation to complex quadrature amplitude modulation. All the data are converted into image data and processed from the perspective of image recognition using convolutional neural network without feature engineering.

NA11065

16:40-16:55

Title: Spectrum Analysis for Modulation Classification in Aeronautical Wireless Communication Systems

Authors: Kun Liu, Xin Xiang, Wanze Zheng, Yishi Sun, Liyan Yin and Chunhui Li
Presenter: Kun Liu, Air Force Engineering University, China

Abstract: The degeneration of signal time-frequency characteristics has impeded the performance of correlation algorithms. To address this issue, a generative adversarial network (GAN)-based recognition framework is proposed for aeronautical wireless communication systems. It consists of GAN and different dimensional of recognition networks. Firstly, we transform the sampling signals into time-frequency (TF) maps using a short-time Fourier transform (STFT), which shows an apparent signal frequency variation with time. And then, we design an improved GAN, transferring the TF maps affected by the multipath effect into pure maps, to weaken the interference of channels.

Next, we put forward the two-dimensional (2D) recognition networks to extract signal time-frequency characteristics, and a deep long short-term memory (LSTM) network was introduced to obtain the time correlation from the TF maps. The experimental results show that the performance of the proposed GAN-based recognition framework is superior to that of conventional algorithms, especially performing in aeronautical multipath wireless channels. When the channel parameters change rapidly, the recognition rate of the proposed algorithm is more than 95.0%.

NA21045

16:55-17:10

Title: An improved DFC-based Cooperative Spectrum Sensing for Cognitive Radio in the Presence of Malicious Users

Authors: Yongnu Jin, Jiancheng Sun, Yaohui Bai, and Sang-Jo Yoo
Presenter: Yongnu Jin, Jiangxi University of Finance and Economics, China

Abstract: In cognitive radio networks (CRNs), cooperative spectrum sensing (CSS) can effectively improve sensing performance by taking advantage of spatial diversity of participating second users (SUs). However, the spectrum sensing data falsifying attack (SSDFA) caused by malicious second users (MSUs) severely degrades the performance of CSS networks. In this paper, to defend against the SSDFA of MSUs, we propose a new CSS mechanism based on distributed fusion centers and overlapping clusters (DFCs-OCs). With this new architecture, our proposed linear combining CSS algorithm improves the CSS performance by mitigating the effects of MSUs on decision making through updating the reputations of SUs and OCs. Extensive simulation results prove that the proposed CSS scheme performs far better than related recent studies under both high and low signal-to-noise ratio conditions in CRNs, where MSUs occupy nearly half of all SUs.

NA21023

17:10-17:25

Title: Ultra-Wideband Spectrum Monitoring Using Software Defined Radio

Authors: Huijie Zhu, Binhui Chen, Yiteng Wang, and Lijun Wang
Presenter: Huijie Zhu, The 36th Research Institute of China Electronics Technology Group Corporation, China

Abstract: This paper presents an ultra-wideband spectrum monitoring system using a software defined radio platform. The system has been developed by using an Ettus X310 universal software radio peripheral (USRP) for data acquisition and a laptop for displaying the graphical user interface. The system can operate in two modes with two different daughter boards installed. One of the operation modes allows simultaneously monitoring up to two different channels, each with a maximum sampling bandwidth of 200 MHz, or simultaneously monitoring up to four different channels, each with a maximum sampling bandwidth of 100 MHz. The other operation mode allows monitoring a single channel with a maximum sampling bandwidth exceeding 300 MHz. Furthermore, unlike the widely adopted GNU Radio software, the proposed system software is friendly to the Microsoft Windows operating system.

NA11039

17:25-17:40

Title: Trajectory Radius Optimization for Throughput Maximization of UAV Networks in Emergency Scenarios

Authors: Jinbo Zhang, Haoyue Wang, Jian Qiao, Naicheng Gong, Yandong Zhang
Presenter: Haoyue Wang, The 54th Research Institute of CETC, China

Abstract: With the advantages of high mobility, flexible operation and on-demand deployment, the Unmanned Aerial Vehicle (UAV) is considered to be a promising application. Consideration of the damage to the ground base station (BS) in emergency scenarios, it is difficult for Internet of Things (IoT) nodes to exchange information with the outside effectively. In this article, a wireless information transmission network for UAV based on multiple IoT nodes is proposed, which the UAV serves as an aerial BS distributing data to the IoT nodes. According to the network, an optimization scheme for the radius of UAV trajectory is proposed. The goal is to maximize the achievable sum rate of all IoT nodes by optimizing the UAV trajectory radius, while meeting the constraint of average achievable rate of each IoT node. As the formulated problem suffers non-convexity, an efficient iterative algorithm is proposed to address it. Finally, the effectiveness of the proposed scheme is verified by the numerical results.

NA21044

17:40-17:55

Title: Throughput-guaranteed Cross-layer Design for Multi-channel Wireless Networks

Authors: Fan Zhang and Baozhu Li
Presenter: Fan Zhang, Shandong Management University, China

Abstract: Applying multi-channel technology to wireless networks can improve the utilization rate of spectrum resources and increase system capacity. For multi-channel wireless networks with multiple paths between source and destination node, a novel routing selection algorithm is presented in this paper according to the existing scheduling policy LDCSA for single-hop flows. After that, a cross-layer scheme named M-LDCSA across the MAC layer and network layer is formed by jointly considering routing and scheduling. Using Lyapunov drift, the scheme is proved to guarantee a stable throughput capacity region, which is a subregion of the maximum capacity region. That is, M-LDCSA is throughput-guaranteed. Simulation results show that the throughput performance of the proposed M-LDCSA algorithm is better than that of other comparable cross-layer schemes. In addition, the implementation complexity of M-LDCSA does not increase with network size, which gives M-LDCSA the advantage of low-complexity in practical distributed network systems.

NA30277

17:55-18:10

Title: Radio Environment Map Construction Based on Random Forest Regression

Authors: Yixiao Du, Hongjun Wang, and Jinfan Liu
Presenter: Yixiao Du, National University of Defense Technology, China

Abstract: Radio environment map is an effective tool for electromagnetic environment awareness and spectrum resource management, which can be constructed by spatial interpolation methods. In order to improve the quality of radio environment map construction, this paper applies machine learning technologies to spatial interpolation and proposes a random forest spatial interpolation algorithm improved by the golden jackal optimizer. Initially, establish a random forest regression model for spatial interpolation based on machine learning method by using data of measurement points. Then optimize parameters of the model with the help of golden jackal optimizer. At last, utilize the optimized random forest regression model to interpolate missing data of the radio environment map. Experiment results demonstrate that the proposed algorithm has better performance in construction accuracy compared to classical spatial interpolation algorithms.

NA40321

18:10-18:25

Title: RIS-Assisted Beamforming for FDD Multi-User Communications

Authors: Wei Zhang and Yi Jiang
Presenter: Yi Jiang, Fudan University, China

Abstract: Reconfigurable intelligent surface (RIS) is now widely regarded as a promising technology for the beyond 5G (B5G) and the 6G wireless communications. This paper considers a frequency division duplex (FDD) multi-user communication system, in which a RIS is deployed to assist both the uplink (UL) and the downlink (DL) signal transmissions. To maximize the UL-DL sum rate of the FDD system, we propose two methods based on the conventional conjugate gradient (CCG) and the Riemannian conjugate gradient (RCG) for jointly optimizing the reflection phases of the RIS, the DL power allocation for each user, and the precoding matrix. We also present a comparative analysis of the computational complexity of the two methods. The simulation results show that both the CCG and the RCG effectively improve the sum-rate performance of the RIS-assisted FDD system.

SESSION 9

Topic: Communication Network Security
Time: 15:50-18:25, Nov. 12, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/81069396768 Password: 111114

- **Session Chairs:**
  Prof. Hong-Mei Zhang, Guilin University of Electronic Technology, China
  Assoc. Prof. Li Jiang, Guangdong University of Technology, China

NA55012

Invited Speech

15:50-16:15

Title: Blockchain-based Federated Interaction in Optical Network

Invited Speaker: Prof. Hui Yang, Beijing University of Posts and Telecommunications, China

Abstract: This paper proposes a federated hierarchical trust interaction architecture for the cross-domain IoT. Blockchain-based Federated Interaction in cross-domain IoT combines federated learning with blockchain to propose a credible evaluation model which ensures the safety and dependability of blockchain users.

NA55002

Invited Speech

16:15-16:40

Title: Research on channel modeling and signal detection on ultraviolet communication

Invited Speaker: Assoc. Prof. Su Ping, Tsinghua Shenzhen International Graduate School, Tsinghua University, China

Abstract: Ultraviolet communication utilizes ultraviolet light within a 'sun-blind' wavelength range of 200~280nm to realize communication. Compared with the traditional RF communication system, the UV communication system has the potential advantages of license free bandwidth, low power consumption and miniaturized transceiver, outstanding transmission power density and strong anti-interference ability. Compared with infrared and visible light communication, ultraviolet communication has the advantages of low background noise, good confidentiality and high data transmission rate. In addition, the ultraviolet communication system has no strict requirements on the positions of the transmitter and receiver, so it can be applied to many communication scenarios, such as line-of-sight communication, non-line-of-sight communication and omni-directional communication.

The research group has done a lot of in-depth research on the channel model, transceiver, modulation, coding and other aspects of UV communication system, and has produced a lot of innovative results, including UV communication single scattering integral model, single scattering approximation model, multiple scattering integral model, Monte-Carlo integral model, omni-directional Monte Carlo simulation model, the impact of jitter effect at the transceiver, UV communication modulation and coding algorithm, single input multiple output nonlinear receiver, etc., which laid a good foundation for the development and application of UV communication.

NA11070

16:40-16:55

Title: Optimal Software Distribution and Allocation Strategies for Improved Datacenter Resource Utilization

Authors: Xiang Luo, Xiaoyuan Cao, Kai Luan, Qiang Bian, Zhi Li, Qiang Zhang, Yang Ning, Xinkai Miao

Presenter: Xiang Luo, 15th Research Institute of China Electronics Technology Group Corp (CETC), China

Abstract: In this paper, we propose software distribution and allocation strategies to improve the resource utilization for distributed military command centers. For the software distribution strategy, software are divided into multiple slices and simultaneously transmitted along different paths in parallel, with other command centers as cache nodes for shared and collaborated data transit. For the software allocation strategy, we adopt an adapted integer multi-knapsack model to allocate software groups on different servers to

utilize the server resource in a load-balanced way for enhanced system stability. The simulation results demonstrate that our delivery model achieves 90% time reduction, and our software allocation model increases 25% resource utilization.

NA30286

16:55-17:10

Title: A single-observer passive location algorithm base on weighted least squares criterion

Authors: Jiang bin, Lu An′ nan, You Mingyi, Lou Caiyi, Ye Yunxia, Huang Kai, Shi Binhua
Presenter: Jiang Bin, Communication Information Security Control Laboratory, China

Abstract: Passive location system that locates "silent" targets using an non-cooperative opportunistic source (also called external illuminator) is great importance in a variety of applications. To solve the problem of using a single observation station to receive a single external radiation source signal to realize the target location, the paper proposes a weighted least squares location algorithm combining direction finding and time difference information. In this algorithm, the location problem is constructed as a weighted least squares model considering the error of each measurement information, and then the grid search strategy is used to solve the model to obtain the target location. After that, the positioning error of the algorithm is theoretically analyzed, and the influence of direction finding error, measurement time difference error, observation station position error and external radiation source position error on the target positioning error is studied. Finally, the performance of the algorithm is verified by several simulation tests.

NA40377

17:10-17:25

Title: Enhanced Mobile IoT Security Protection Method Based on CPK and Zero Trust

Authors: Ziyi Jia, Wei Wu, Zhe Jia, Xiaopeng Yang, Qiang Wang and Hao Li
Presenter: Ziyi Jia, Science and Technology on Communication Networks Laboratory, China

Abstract: The security protection of mobile Internet of Things (IoT) is becoming increasingly important. In the traditional Single Package Authorization (SPA) protocol, the authenticity of the terminal cannot be proved. This paper propose a Combined Public Key (CPK) and zero-trust based architecture to protect mobile IoT from identity forgery attacks. Specifically, we adopt an enhanced SPA protocol based on CPK, where the CPK matrix merges of multi-dimensional information about users, devices, events and time. In this way, every event is encrypted. Besides, through adopting CPK, the deficiency of subject authenticity proof in SPA can be compensated. Experiments verify the efficiency and validity of the proposed CPK-based SPA authentication method in comparison with the state-of-the-art SPA protocol.

NA30300

17:25-17:40

Title: Intelligent Reflecting Surface Enhanced Secure Communication with Multi-Eavesdroppersf

Authors: Binghui Qian, Jingping Qiao, Xintao Dong, Jie Tian, Tiantian Li, and Haixia Zhang
Presenter: Binghui Qian, Shandong Normal University, China

Abstract: This paper studies an IRS-assisted secure communication system, where the confidential signal is intercepted by multiple eavesdroppers. Considering imperfect eavesdroppers channel state information (ECSI), we first analyze the worst-case secrecy rate (WCSR) performance. To maximize the secrecy rate performance, the reflecting amplitudes and phase shifts at the IRS are jointly designed, and an iterative algorithm is proposed. Adopting the block coordinate descent (BCD) method, the closed-form solution is obtained. Simulation results demonstrate that the joint design of reflecting amplitudes and phase shifts can significantly improve the secrecy performance compared with the traditional phase-shift design. Moreover, results also reveal that the secrecy performance of finite discrete values of phase shifts can approach that of continuous values.

NA21084

17:40-17:55

Title: A Resource Allocation Scheme for Independent Core Transmission of Quantum Key Distribution

Authors: Lingfeng Lu, Yongmei Sun, Yaoxian Gao and Weiwen Kong
Presenter: Lingfeng Lu, Beijing University of Posts and Telecommunications, China

Abstract: To ensure the security of optical networks in the future, integrating quantum key distribution (QKD) with optical networks is one of the solutions. Moreover, the optical network based on multi-core fiber (MCF) is also one of the ways to improve the transmission capacity. Therefore, we study the integration of QKD into MCF-enabled optical networks. Aiming at the resource allocation problem of MCF-enabled wavelength division multiplexing optical networks, this paper proposes a resource allocation scheme which is suitable for independent-core-transmission of classical signals and quantum signals. For core resource, we propose the alternate core allocation algorithm. For wavelength resource, we propose the iteration-based wavelength allocation algorithm. The overall scheme uses the proposed two algorithms to first allocate the core and then allocate the wavelength. The simulation results show that the proposed scheme has a great improvement in secret key rate (SKR) compared with the benchmark scheme on the regular hexagonal 7-core fiber and 19-core fiber. And the proposed scheme still has good performance under long transmission distance and high classical signal power.

NA40386

17:55-18:10

Title: Channel prediction using a system of ordinary differential equation

Authors: Lei Wang, Guanzhang Liu and Jiang Xue
Presenter: Lei Wang, Xi′ an Jiaotong University, China

Abstract: In massive Multiple-input Multiple-output (MIMO) systems, it is crucial to predict channel state information (CSI) at future moments. In mobile scenarios, outdated CSI will have a serious negative impact on transmission systems, which results in system performance degradation. Timely channel prediction can compensate performance loss caused by mobility. In this paper, we propose a hybrid evolutionary method for identifying a system of ordinary differential equation (ODE) to predict CSI, called HEODE. In the first place, the tree-structure based evolutionary algorithm is used to evolve the system architecture, and an explicit ODE model is obtained. Then, a optimization algorithm to optimize the parameters of the display model of ordinary differential equation. Finally, the optimal ODE model for CSI prediction is obtained. Besides, the effective of interval prediction is given. Compared to the autoregressive (AR) prediction method and genetic programming (GP) based prediction method, experimental results reveal that the proposed method is feasible and efficient for channel prediction.

NA21041

18:10-18:25

Title: UAV Swarm Type Recognition Algorithm Based On Dual-domain Fusion Features And Feature Selection

Authors: Shuheng Zhang, Ruping Zhai and Yongkai Liu
Presenter: Shuheng Zhang, Nanjing University of Aeronautics and Astronautics, China

Abstract: At present, the UAV type recognition algorithms in the literature only realize the identification of a single UAV type through the signal characteristics of the communication domain or radar domain, and there are problems such as low recognition accuracy. Aiming at the above problems, this paper proposes a UAV swarm type recognition algorithm based on the fusion characteristics of communication signals and radar signals. First, the high-order cumulant and instantaneous feature statistics of the swarm communication signal are extracted, and the radar track features are fused to construct the UAV swarm feature matrix; secondly, an improved feature selection algorithm—Secondary Screening of Neighbourhood Components Analysis (SSNCA) is proposed to reduce the dimensionality of the fusion feature matrix; finally, a Sparse Autoencoder Network (SAEN) is used for swarm type identification. The simulation results show that the algorithm significantly reduces the dimension of the swarm feature matrix (only 27% of the original matrix dimension); at the same time, when the Signal-to-Noise Ratio (SNR) is 0 dB, the correct rate of identifying five swarm types can reach 88%.

SESSION 10

Topic: Photonics and Optical Communication
Time: 16:05-18:45, Nov. 12, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/81673586285 Password: 111114

- **Session Chairs:**
  Assoc. Prof. Lu Zhang, Zhejiang University, China
  Professor Chen Chen, Chongqing University, China

NA11010-A

Invited Speech

16:05-16:30

Title: Silicon integrated multimode components
Invited Speaker: Assoc. Prof. Mengyuan Ye, China University of Geosciences, China

Abstract: As an effective way to increase transmission capacity, multimode photonics has attracted increasing attentions in past decades. On the other hand, silicon photonics is of significant interest for its compatibility with the mature CMOS technology. Remarkable progress on silicon integrated multimode photonics has been made over 10 years, and continuous researches on new material, novel structure and intelligent design are still highly desired. Here we demonstrate recent progress on silicon integrated multimode components and discuss the future challenges on this topic.

NA11011-A

Invited Speech

16:30-16:55

Title: Silicon Photonic Devices for Communications — Some Recent Key Advances
Invited Speaker: Professor Wei Jiang, Nanjing University, China

Abstract: Silicon photonics has shown great potential for communication applications. We will review our recent progress on key silicon photonic devices for these applications, including high-speed modulators and optical phased arrays. High-speed modulators are widely used in optical communications and optical interconnects. While micro/nano-structure-based modulators are often adopted where small sizes and low power are desirable, Mach-Zehnder (MZ) modulators are widely used for their assumed stable performance, In reality, micro-nano/structure-based modulators often suffer from insufficient extinction ratio and sometimes may need relatively high driving voltage. The traveling-wave electrodes of MZ modulators are still susceptible to fabrication variation, causing impedance mismatch and degraded performance. We will present our recent work towards these critical issues. Silicon-based optical phased arrays (OPAs) can potentially transform free-space optical communications. Waveguide superlattice-based optical phased arrays have, for the first time, realized half-wavelength pitch OPAs. But aligning the phases of the elements of an OPA is time-consuming, becoming a bottleneck in real applications. Assisted by artificial neural networks, we have developed a rapid, non-iterative, accurate phase calibration technology for OPAs.

NA55003

Invited Speech

16:55-17:20

Title: OFDM with index modulation and its application in visible light communication systems
Invited Speaker: Professor Chen Chen, Chongqing University, China

Abstract: In recent years, OFDM with index modulation (including single-mode index modulation and dual-mode index modulation) has been widely applied in wireless communication systems. Due to its unique advantages in energy efficiency or spectral efficiency, OFDM with index modulation has also been introduced in visible light communication (VLC) systems. In this speech, we will first briefly introduce VLC for 6G. Then, we will describe the basic principle of OFDM with single-mode index modulation and OFDM with dual-mode index modulation. Finally, we will discuss our recent works about VLC using OFDM with index modulation. Our results show that index modulation-aided OFDM techniques are applicable to various VLC scenarios, such as low-SNR scenario, high-SNR scenario and multi-user scenario, which can achieve superior transmission performance than conventional OFDM.

NA55018

Invited Speech

17:20-17:45

Title: Silicon photonic integrated chip for RF self-interference cancellation

Invited Speaker: Professor Xiuyou Han, Dalian University of Technology, China

Abstract: The in-band full-duplex (IBFD) technology transmitting and receiving signals simultaneously on the same frequency, can double the spectrum utilization efficiency and data transmission rate, and has a great potential application in B5G and 6G communications. However, the high-power signal sent from the transmitting antenna will interfere the low-power signal of interest that received by the receiving antenna, or even submerge it completely, which is called RF self-interference. The RF self-interference is a key issue to be resolved for the application of IBFD. The photonic technology for RF self-interference cancellation (SIC), compared with the electronic technology, has the advantages of large instantaneous bandwidth, wide frequency coverage range, and high time delay tuning precision, exhibiting a promising solution for RF SIC. To meet the application requirement of IBFD communications especially for the mobile terminals in new generation of wireless communications, the size, weight and power must be considered for the photonic RF SIC. It is desirable to integrate the discrete optoelectronic devices on to a compact platform. This report will present the recent work in our group about integrated photonic SIC chip on silicon photonics platform. The silicon photonic integrated chip with the size of 1.2 mm × 5 mm comprises of multiple function units, including phase modulation, delay and amplitude tuning, sideband filtering and photodetection, which complete the matching conditions for SIC. It can operate over the wide frequency range of 5 GHz-25 GHz with the good SIC performance. For the IBFD communication demonstration, the cancellation depth of 24 dB in the bandwidth of 100 MHz at the center frequency of 12.4 GHz is measured and the signal of interest with 16-QAM modulation is recovered successfully.

NA11062

17:45-18:00

Title: A Fuzzy Logic System-Based Multidimensional Integrated Routing and Wavelength Assignment Method in Optical Network-on-Chip (ONoC)

Authors: Jiahe Zhao, Hui Li and Feiyang Liu

Presenter: Jiahe Zhao, Xidian University, China

Abstract: In Optical Network-on-Chip (ONoC), both routing and wavelength assignment have an impact on the Optical Signal-to-Noise (OSNR), which further influence the power efficiency and scalability. In this work, we propose a multidimensional Integrated RWA method based on the fuzzy logic system (named as I-RWA) which considers routing and wavelength assignment. OSNR, traffic distribution, waiting delay and wavelength utilization are taken into consideration at the same time. The effect of wavelength assignment on OSNR is also discussed. The evaluation results show that the proposed method I-RWA can obtain the best performance in OSNR and is feasible to be adapted for other more performance factors.

NA30225

18:00-18:15

Title: A Novel Application of Optical Wireless Communication and Positioning Systems: Low-Cost Obstacle Detection

Authors: Kehan Zhang, Bingcheng Zhu, and Zaichen Zhang

Presenter: Kehan Zhang, Southeast University, China

Abstract: Visible light communication and positioning (VLCP) systems have been rarely researched to sense and model the obstacles. However, the accumulating database containing the signal amplitudes and receiver positions can be exploited to detect and reconstruct the positions and shapes of the obstacles. In this work, we propose an algorithm to model the obstacles in a VLCP system, where several light-emitting diodes (LEDs) are set at known positions, and the users equipped with photodiodes (PDs) randomly move to receive the LEDs' signals at different positions. Based on the received signals, the blocked links between the users and LEDs can be distinguished, and thus we can reconstruct the obstacle information. Simulation and analytical results show that the algorithm can estimate the positions and shapes of obstacles. Such an algorithm expand the services of the VLCP systems, and can sense the three-dimensional (3D) information of the environment through the light channel coefficients so as to circumvent the expensive devices, such as laser radars. The proposed algorithm can also support navigation and prediction of wireless channel fading.

NA11063

18:15-18:30

Title: A Loss-aware Growing Ring Self-Organizing Map (GRSOM)-based Mapping Algorithm in Optical Network-on-Chip (ONoC)

Authors: Yuxiang NIU, Hui LI, and Feiyang LIU
Presenter: Yuxiang NIU, Xidian University, China

Abstract: Optical Network-on-Chip (ONoC) is promising to provide a high-performance on-chip communication for future many-core processors, with high bandwidth and low power consumption. However, the reliability challenges, due to the loss and crosstalk, limit the power efficiency and scalability of ONoC. This work proposes a Growing Ring Self-Organizing Map (GRSOM)-based mapping algorithm in ONoC, which optimizes the loss of on-chip optical communications, thus improving the power efficiency and reliability. The evaluation results show that the proposed mapping algorithm has advantages in terms of computational complexity, running speed and accuracy, and can meet the loss requirement.

NA30227

18:30-18:45

Title: A Novel Receiver Based on Rotational Double Prisms for Optical Wireless Communication

Authors: Fei Yun, Zaichen Zhang, Shengjian Chen, Wenhan Li and Kehan Zhang
Presenter: Fei Yun, Southeast University, China

Abstract: Optical wireless communication (OWC) has the potential to be applied in indoor, outdoor, and vehicle-to-vehicle communications for its lager bandwidth, high data rate and high security. Optical devices usually need communication link alignment in the OWC system, which can be realized with universal joints and fast steering mirrors to avoid the alignment error caused by atmospheric turbulence and bad weather. However, optical devices such as universal joints and fast steering mirrors have the disadvantages of inflexible and incompact structure because of its large size, which is unsuitable for small communication systems. To overcome these disadvantages, a novel receiver for the OWC system is proposed in this paper, which mainly uses double prisms to deflect light to the photodiodes (PDs). The proposed receiver system is compact and of small volume, which can receive signals in a large angle range. In addition, a light deflection algorithm is designed for the receiver to make the light converge to the PDs. The simulation results show that the receiver can receive light within the divergence angle of 40°and achieve good alignment.

SESSION 11

Topic: Digital Communication System and Function Optimization
Time: 16:05-18:30, Nov. 12, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/89549029505 Password: 111114

- **Session Chair: Assoc. Prof. Dong Yin, National University of Defense Technology, China**

NA11105

Invited Speech

16:05-16:30

Title: EPM-SR: efficient performance measurement framework for KPIs to support segment routing over IPv6 Network

Invited Speaker: Assoc. Prof. Wenting Wei, Xidian University, China

Abstract: Segment Routing (SR) over IPv6 (SRv6 in short) is a promising solution to support advanced services, which is the instantiation of SR architecture for the IPv6 dataplane. The rapid development of the standardization and implementation for SRv6 is driving a critical need for accurate and scalable network performance measurement (PM) and monitoring techniques. There has been an emerging interest towards designing and enhancing PM for SRv6, however, it is still challenging to design a PM framework to produce accurate and real-time evaluation of key Performance Indicators (KPIs), while supporting software and hardware implementations of SRv6. In this paper, we provide an efficient PM solution for SRv6-enabled networks (termed as EPM-SR), considering both data plane and control plane aspects. EPM-SR provides accurate and real-time measurement of per-flow performance metrics, including packet delay, jitter and loss using two bits or less in the header of each packet. We have leveraged EPM-SR to validate the implementation of SRv6 behaviors in the Linux kernel and evaluate KPIs performance of the SRv6 implementation in both a simulation verification platform and a pressure testbed.

NA21022

16:30-16:45

Title: Energy Efficiency Optimization for Distributed RIS-assisted MISO System Based on Statistical CSI

Authors: Chenghong Yang, Kai Yu and Xiangbin Yu
Presenter: Chenghong Yang, Nanjing University of Aeronautics and Astronautics, China

Abstract: This paper optimizes the energy efficiency of distributed RIS-assisted communication system. Considering no channel estimation capability at Reconfigurable Intelligent Surface (RIS), an optimization scheme based on Statistical Channel State Information (SCSI) is given first. The traditional SCSI scheme cannot utilize the channel estimation capability of the Base Station (BS), so a scheme based on Two-Timescale (TTS) is further proposed. For the optimization, the triangular inequality and the successive convex approximation (SCA) method are employed in this paper to solve for the RIS elements phase shift. The singular value decomposition (SVD) and maximum ratio transmission (MRT) principle are adopted to solve the BS transmit beamforming in two schemes, respectively. By using partial derivatives, a closed-form equation for the optimal transmit power can be obtained. The system energy efficiency is maximized by optimizing the RIS element phase shift, BS transmit beamforming and BS transmit power, jointly. The simulation results indicate that after the joint optimization, the energy efficiency has been significantly enhanced. The performance improvement is 10.3% (SCSI) / 10.8% (TTS) after optimization.

NA21034

16:45-17:00

Title: A multi access VPDN network model

Authors: Jun Tao, Huan Chen, Xingxing She and Huamin Liu
Presenter: Huan Chen, Anhui Institute of Information Technology, china

Abstract: VPN network is widely used at present, among which L2TP VPDN can better solve the problem of decentralized users accessing private networks, but users accessing through a variety of network types and multiple ISP will have higher time prices and occupy more bandwidth resources. Aiming at these drawbacks, a multi access L2TP VPDN network model named ILP is proposed, which has the characteristics of security and low cost. The simulation experiment of the new model is carried out, and the experimental results are analyzed by Waxman mathematical model, which shows that the results of the network simulation experiment are excellent. Finally, according to ILP model, the actual network is constructed, and all parameters operate normally.

NA21017

17:00-17:15

Title: A Spectrum-Sharing Multiple Terminals Transmission Method in VSAT Networks

Authors: Zheng Wang, Tian Li, Xinwei Yue, Yanfei Wu
Presenter: Tian Li, The 54th Research Institute of China Electronics Technology Group Corporation, China

Abstract: Very small aperture terminal (VSAT) networks have been widely used for multiple terminals transmission in satellite communications. It enables the hub station and multiple terminals to transmit data interactively in a star topology. With the ever-growing demand of satellite communication services, the VSAT network could not provide enough spectral resources for huge number of terminals accessing in. In this paper, a spectrum-sharing transmission method is proposed to improve the network spectral efficiency. Recognizing the different transmission abilities of antennas equipped at the hub station and the terminals, we allocate the terminals inside the hub station frequency band without spending more spectral resources. The performance of the studied algorithm is further theoretically analyzed. Simulation results confirm the advantages of the spectrum-sharing strategy in terms of the ergodic sum rate.

NA11023

17:15-17:30

Title: Achievable Rates of Asynchronous Uplink Non-orthogonal Multiple Access with GMSK

Authors: Sai Li, Chaoyi Wang, Chongzheng Hao, Jie Li
Presenter: Sai Li, Nanjing University of Aeronautics and Astronautics, China

Abstract: Non-orthogonal multiple access (NOMA) is proposed to address the challenges of future wireless network. Recently, asynchronous NOMA (ANOMA) has gained attention due to its higher achievable rates. However, the known NOMA/ANOMA usually focus on linear modulations, which ignores the linearity of the power amplifier (PA) of the transmitter that can lead to a power backoff. Gaussian minimum shift keying (GMSK) is an attractive nonlinear waveform with constant envelope, which allows the PA to be operated at a high efficiency. In this paper, an uplink ANOMA scheme with GMSK is proposed for the first time. Then, the achievable sum rates with different detectors are derived to evaluate the performance of the proposed scheme. Further, the ANOMA with linear waveforms is provided to highlight the significance of our work. Numerical results show the advantages of nonlinear systems in nonlinear performance are more significant than that of linear systems in the achievable sum rate. For any detectors, the achievable sum rate has a negligible loss for the approximate GMSK signal based on Laurent decomposition, and a larger achievable sum rate can be obtained by setting the time offset between users.

NA30259

17:30-17:45

Title: On the Construction of Polar Codes in Two-User Downlink NOMA with Power Allocation and Constellation-Rotation

Authors: Benjamin K. Ng and Chan-Tong Lam
Presenter: Benjamin Ng, Macao Polytechnic University

Abstract: We consider the joint construction of polar codes and power allocation based on rotated QPSK constellation in the two-user downlink non-orthogonal multiple access (NOMA) system. Our work is suitable for IoT-like networks where lightweight devices employ simple constellations with low data rate traffic, and the traditional coding performance analysis assuming Gaussian inputs and infinite blocklength may become less accurate. With the goal of achieving fairness and minimizing the maximum block-error-rate (BLER) among the NOMA users, the construction of polar codes, which takes into consideration the BLER estimated by the Gaussian-approximation-based density evolution (GA-DE) method, is jointly determined with the constellation-rotation angle and the power allocation over the NOMA users. Simulations verify that the proposed approach yields generally comparable BLER performance as the LDPC codes over the range of SNR considered while having shorter blocklength.

NA21035

17:45-18:00

Title: The Smart SD-WAN Architecture

Authors: Weiqiang Cheng, Feng Yang, Tingting Han, Ruibo Han, Wenying Jiang, Geng Zhang, Jin Yang and Xiaoqiu Zhang,
Presenter: Tingting Han, Research Institute of China Mobile Communications Co., Ltd Beijing, China

Abstract: Software-Defined Wide Area Network (SD-WAN) is an overlay architecture that uses Software Defined Network (SDN) technology across WANs to build a secure unified connectivity over multiple access mode. SD-WAN solves many problems of traditional leased lines for operators, such as the difficulty of unified access and management. Whereas, SD-WAN cannot be aware of the underlay network, so it cannot provide differentiated, guaranteed Service Level Agreement (SLA) services. So, we proposed the Smart SD-WAN Architecture, which combined the traditional SD-WAN and Segment Routing over IPv6 (SRv6) to realize an end-to-end SRv6 tunnel connection. It can ensure quality of service (QoS) by realizing the collaboration of the Underlay and the Overlay, while integrating virtual network elements in the cloud to provide service function chaining (SFC). Furthermore, it integrates cloud and network resources to provide enterprise users with new cloud service experience.

NA21056

18:00-18:15

Title: Designing of Decision Criterion on FCrSK in Time-frequency Dual Selective Channel

Authors: Xiaohong Nie, Chao Yang, Linan Wang, Jing Zhang and Lin Zheng
Presenter: Xiaohong Nie, Guilin University of Electronic Technology, China

Abstract: With the increasement of frequency band and platform mobility, communication system faces more severe time-frequency double dispersion influence. Folded chirp-rate shift keying (FCrSK) modulation technique has been proposed to solve communication transmission problem in high dynamic doppler channel owe to its time-frequency shift invariance. However, it dose not consider some influence of time-frequency dual selective channel (TDSC). In this paper, spectrum structure of FCrSK after dechirp will be deduced in TDSC and a decision criterion for FCrSK is designed from spectral energy concentration to utilize multipath energy. And this decision criterion is more suitable for FCrSK in TDSC than frequency domain peak to average ratio (FPAR). Besides, the system has no rely on channel state information and has better performance at high SNR in TDSC than Lora. Furthermore, it is superior to Lora in and time-varing doppler channel. So FCrSK with this criterion can provide a good way for high reliability and low latency communication in future.

NA00010

18:15-18:30

Title: A BRL-POMDP Based Cross-layer Optimization of Dynamic Spectrum Access

Authors: Rongkui Zhang
Presenter: Rongkui Zhang, Shenzhen Forsafe System Technology Co.,LTD, China

Abstract: High dynamic wireless environment poses a unique challenge to telemetry network. In the broadband telemetry network based on cognitive radio (CR), airborne nodes should not only detect free frequency bands through broadband spectrum sensing, but also focus on necessary dynamic spectrum access (DSA) to effectively improve spectrum utilization. However, many existing related research has the following shortcomings: First, largely formulated as MDPs which require the networks with full knowledge, the partial observing restricted by the resource limited condition should be considered to expand the generality of application; Second, prior and posterior distributions over model parameters are not taken into account by studies of traditional POMDP-based DSA to influence the optimization of action selection; Third, most of researches manage to improve the single MAC layer or PHY layer indicators configuration without considering the power-limited condition, so the application has been largely restricted. To solve the above problems, in this paper we propose a novel cross-layer optimization DSA method based on Bayesian reinforcement learning framework extended POMDP model. First of all, the SUs′ spectrum sensing and access problem under the hardware and power-limited condition is modeled as a BRL-POMDP by combining the MAC layer and the physical layer parameters in this design; then the POMDP model is converted to belief state Markov decision process; finally, the algorithm which relies on a sampling of the posterior over model parameters to track the belief is used to find the optimal spectrum sensing and access strategy. Simulation results show that the introduced algorithm can effectively improve the transmission capacity and spectrum utilization, as well as reduce the BER in the power-limited and high dynamic condition.

SESSION 12

Topic: Network Authentication and Security
Time: 16:10-18:35, Nov. 12, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/86088803609 Password: 111114

- **Session Chairs:**
  Prof. Tao Zhiyong, Guilin University of Electronic Technology, China
  Assoc. Prof. Liancheng Zhang, National Digital Switching System Engineering and Technological Research Center, China

NA11103

Invited Speech

16:10-16:35

Title: A CIDS Mode DDoS Blacklist Mechanism based on Smart Contract in SAVI-Enable IPv6 Network

Invited Speaker: Assoc. Prof. Rongfei Zeng, Northeastern University, China

Abstract: In current IPv6 networks, the increasing number of network devices also boosts the widespread DDoS attacks. Meanwhile, Intrusion Detection System (IDS) is evolved from the individual defense pattern to a distributed and collaborative mode, and Cooperative IDS (CIDS) becomes the mainstream technique. How to improve the overall defense capability through the coordination of information becomes worth studying. In this paper, we propose a DDoS blacklist mechanism with smart contract for IPv6-SAVI (Source Address Validation Improvements) network. In SAVI environment, DDoS source information detected by IDS is considered to be credible. Based on this observation, we design a dynamic update strategy for the reputation of trusted addresses based on the detection results and form a blacklist. Furthermore, we combine CIDS deployment with blockchain to design a blacklist sharing strategy based on smart contract, so that the individual IDS distributed on the chain can realize safe and reliable sharing and updating of the blacklist. Finally, extensive experiments evaluate the performance of our mechanism in terms of latency, overhead, reputation change accuracy, etc., which demonstrates that the blacklist can provide DDoS traffic filtering reference to improve the DDoS mitigation capability.

NA40376

16:35-16:50

Title: An Abnormal Traffic Detection Based on Attention-Guided Bidirectional GRU

Authors: Hao Li, Erlu He, Chunxu Kuang, Xiaopeng Yang, Xiangbo Wu and Zhe Jia
Presenter: Erlu He, Science and Technology on Communication Networks Laboratory, China

Abstract: With the development of network technology and the diversification of network applications, network environment is becoming increasingly complex which leads to various network attacks. Malicious traffic, such as DDOS and infiltration attacks, may degrade the network quality, or even block the network directly. Now, traditional network security methods are difficult to meet the needs for network security and information security. Due to the high recognition accuracy and strong generalization of deep neural network (DNN), deep learning based abnormal traffic detection methods have become a research hotspot. However, there are obvious problems containing high false positive rate poor robustness. We propose a novel abnormal traffic detection method based on attention-guided bidirectional gated recurrent unit (Att-BiGRU). Different from the traditional feature extraction methods in DNNs, we use stacked sparse Auto-encoder (SSAE) to extract traffic features for interference factors filtering. The extracted features can reproduce the original input samples as much as possible which enhances the representation of traffic features and effectively improves the robustness of anomaly detection traffic. Then, attention mechanism was introduced to optimize the traffic features. Extensive experiments on UNSW-NB15 show that the proposed scheme has the impressive performance. Compared with recent abnormal traffic detection algorithms, the proposed scheme achieves better results with 89.67% accuracy and 4.2% FAR.

NA40337

16:50-17:05

Title: QoE Oriented Adaptive Optimization for 360° Virtual Reality Videos

Authors: Rui Deng
Presenter: Rui Deng, Shaanxi Normal University, China

Abstract: Recently, the viewpoint-aware adaptive streaming methods have attracted more and more attention in the research of 360° VR video transmission over wireless networks. Therefore, in this paper, we design a reasonable and effective system framework for VR video adaptive transmission over future Mobile Edge Computing (MEC) assisted 5G heterogeneous networks. Then, by introducing the tile priority to weigh the contribution of the tile to the user′s QoE, a novel priority-based weighted QoE assessment is presented for VR video, which comprehensively considers the video quality, quality fluctuation as well as the error characteristics of the predicted viewpoint. On this basis, we formulate a novel adaptation optimization problem aiming to maximize the sum of the QoE of all users under the delay constraint. To solve it with low complexity, a heuristic algorithm based on lagrange relaxation is developed. The simulation results show that our algorithm outperforms the others and can effectively improve the overall QoE performance of all users, in terms of the video quality, the quality fluctuation and the interruption time.

NA40371

17:05-17:20

Title: An Anti-jamming Intelligent Decision-making Method for Multi-user Communication based on Deep Reinforcement Learning

Authors: Lan Zhang, Liang Ma, Feng Tian and Tianyi Liang
Presenter: Lan Zhang, Science and Technology on Communication Information Security Control Laboratory, China

Abstract: In order to effectively cope with the external malicious jamming from jammers and avoid mutual interference caused by competitive channels among users, an intelligent anti-jamming decision-making method based on deep reinforcement learning for multi-user communication is proposed in this paper. In multiple jamming modes, the base station perceives the current spectrum information of the multi-user and the jammer and makes it as the input of the deep reinforcement learning strategy neural network, then selects the joint action according to the dynamic greedy algorithm, which will help the users intelligently select the communication frequency band via the feedback from the base station. The simulation results show that the proposed method effectively overcome the communication jamming induced by external jammers and internal users. Moreover, the normalized throughput of each user in the proposed algorithm is much higher than the random frequency hopping and fixed ε deep reinforcement learning algorithm with faster convergence speed.

NA40372

17:20-17:35

Title: Design and Analysis of Inter-RBs Hopping SCMA System under Jamming Attacks

Authors: Kun Yang, Qi Zeng, Xing Liu, Ke Fang and Xianhua Niu
Presenter: Kun Yang, Sichuan University, China

Abstract: Sparse code division multiple access (SCMA) technology has superior time-frequency resource utilization, which can support a large-scale connectivity in B5G/6G cellular. However, the prototypical SCMA always transmits the non-zero code-words over the fixed resource-blocks (RBs), thus likely suffering from severe performance degradation due to the external jamming threats. To address this issue, an improved SCMA system based on inter-RBs hopping is proposed in this paper, where physical RBs utilized by codewords are randomly hopped over the RB-group (i.e., frequency-hopped (FH) subcarriers). To implement the optimal inter-RB hopping SCMA, a pseudo-random hopping strategy is designed via prime code and interleavering operations. By such a hopping strategy, the instantaneous RB of SCMA is uniformly operated over the whole RB-group. Followed by the transceiver of proposed inter-RB hopping SCMA, the signal processing is derived in details. The signal processing and simulation results show that, under the jamming scenarios, the proposed inter-RB hopping SCMA system can reduce/average the effect of jamming on bit-error-rate performance, compared to the traditional SCMA systems.

NA11091

17:35-17:50

Title: Implementing Continuous Authentication in Network Connection Based on Improved SPA

Authors: Kun Jiang, Yao Xiao, Shumei Yuan and Xuan Si
Presenter: Kun Jiang, China Telecom Research Institute, China

Abstract: Compared with traditional network boundary defense based on dedicated firewalls, Software Defined Perimeter (SDP) brings new security features and decreases cyberattacks caused by network exposure by hiding the infrastructure, applications and access controls. Single Packet Authorization (SPA) is the first step in SDP authentication. After the verification of SPA, there are some security issues still need to be improved or addressed. The primary issue is how to ensure the security of connection and timeliness of disconnection while both communication sides will stay connected until the session is finished in SDP. As the most widely used way to maintain a long-term connection between two communication parties, heartbeat mechanism can maintain the connection state with few resource consumption. However, continuous identity authentication cannot be performed during the keepalive phase since heartbeat packets are usually empty or containing fixed content. In this paper, a new scheme is proposed, where SPA is no longer only used once in the authentication phase before initial connection establishment, but also plays the role of continuous authentication in the form of heartbeat packets during the keepalive phase in sessions. Besides, the authentication information generation method in SPA module has been improved by optimizing One Time Password (OTP), in which the count of heartbeat packets is considered. Analysis shows that the proposed scheme can achieve better connection security.

NA40416

17:50-18:05

Title: Telecom Fraud Detection via Imbalanced Graph Learning

Authors: Xinxin Hu, Haotian Chen, Hongchang Chen, Shibo Zhang, Shuxin Liu and Xing Li

Presenter: Xinxin Hu, National Digital Switching System Engineering and Technological Research Center, China

Abstract: In recent years, an increasing number of telecom frauds have caused huge losses to people around the world. Graph neural network(GNN) brings new possibilities for telecom fraud detection. However, due to the existence of the imbalance problem in the graph, it is difficult for general GNN models to detect a small number of positive samples. To address this problem, we design a new GNN-based fraud detector. First, we transform the node features with a multilayer perceptron. Subsequently, a reinforcement learning-based neighbor sampling strategy is designed to balance different classes of node neighbors. Then the node features are aggregated using GNN, while the focal loss function is used to measure the model error. We conducted experiments on two real-world telecom fraud datasets, and the results show that the proposed method does have competitive performance, especially for the graph imbalance problem.

NA30236

18:05-18:20

Title: WindArms: More Efficient DGF Coverage-guided Tracing

Authors: Yunheng Luo, Jianshan Peng, Jiahan Lin

Presenter: Yunheng Luo, Information Engineering University, China

Abstract: Directed Graybox Fuzzing is an enhanced fuzzing technique that is widely used in security testing of network communication protocols, desktop software, file systems, etc. It guides the execution flow of the program to the code area of the target site by constructing specific input data, and realizes the test of the specific code area. It is usually used in scenarios such as patch testing, crash reproduction, and static analysis report verification. However, we found that coverage-guided tracing used by the existing Directed Graybox Fuzzing not only has high performance overhead but also has little value, because most test cases cannot discover new execution paths, and are even less likely to reach the target area. It doesn't make much sense to trace the coverage of these test cases. To address this challenge, we propose a new coverage-guided tracing mechanism and implement it prototype, WindArms. It will only trace the coverage of those which can discover new execution paths or reach the target area to reduce the performance overhead of those meaningless coverage-guided tracing. Our evaluation show WindArms not only significantly improves the performance of Directed Graybox Fuzzing, but also can discover security vulnerabilities in real-world software.

NA40375

18:20-18:35

Title: DNN7: an Efficient Network Intrusion Detection Model

Authors: Hao Li, Xiangbo Wu, Yangyang Zhao, Xiaopeng Yang, Erlu He and Zhe Jia

Presenter: Xiangbo Wu, Science and Technology on Communication Networks Laboratory, China

Abstract: With the explosive growth of network traffic, net-work intrusion detection has become an increasingly important part of network security field. In view of the frequent emergence of new attack types, it is necessary to design an efficient network intrusion detection system (NIDS) model. However, an realistic problem for current NIDS is the balance between the accuracy and real-time performance in massive traffic data scenarios. In this paper, we propose an improved deep neural network model named DNN7, which contains 7 hidden layers to better capture data features. Furthermore, batch normalization layer is intro-duced to reduce the change of the hidden layer data distribution and improve the stability of the network. Experiments on UNSW-NB15 indicates that DNN7 has excellent performance. Compared with the DNN3 model, the accuracy is increased by 20%. It can save a lot of time compared to other complex models with deep layers. DNN7 has a simple structure and less overhead, and is more suitable for real-time analysis and detection of massive traffic in real scenarios.

SESSION 13

Topic: Massive MIMO System and Key Technologies
Time: 16:15-18:40, Nov. 12, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/86924134522 Password: 111114

- **Session Chair: Assoc. Prof. Songting Li, National University of Defense Technology, China**

NA55022

Invited Speech

16:15-16:40

Title: Recent progreass for long-haul intermodal MIMO-free MDM transmission
Invited Speaker: Assoc. Prof. Juhao Li, Peking University, China

Abstract: In this talk the author reviews recent progress for long-haul intermodal MIMO-free MDM transmission. The weakly-coupled MDM transmission architecture based on MRC-FMF is designed. 300km 3-mode 4-wavelength realtime MDM transmission utilizing 200G single-mode transceivers are experimentally demonstrated. 1800-km LP01/LP02 multiplexed transmission and 525-km LP01/LP21/LP02 multiplexed transmission are experimentally demonstrated only adopting 2×2 or 4×4 MIMO-DSP. These works are beneficial for practical application for next-generate MDM techniques.

NA30200

16:40-16:55

Title: On the Optimization of Constellation Tilting for MU-MIMO Tomlinson-Harashima Precoding
Authors: Yifeng Liu, Xuyan Bao, Wei Tang, Siqiang Wang, Zhong Zheng, Zesong Fei
Presenter: Yifeng Liu, Beijing Institute of Technology, China

Abstract: Tomlinson-Harashima Precoding (THP), as an alternative algorithm of Dirty Paper Precoding (DPC), can effectively decrease transmitted power through modulo operation. To further reduce the power loss of THP, THP with constellation tilting (THP-CT) was considered by introducing different rotation angles into interfering data streams. In this paper, we propose methods to find the adequate tilting angles for the THP-CT algorithm, including per-stream serial optimization via convex optimization algorithm and global optimization via particle swarm algorithm. The simulation result shows that Block Error Rate (BLER) of these two proposed algorithms is 2-3dB better than that of the conventional THP without constellation tilting.

NA40356

16:55-17:10

Title: Massive MIMO Enabled Unsourced Random Access Through LDPC Coding and Random Spreading
Authors: Yiwei Su, Jianping Zheng, Zijie Liang and Jie Ni
Presenter: Yiwei Su, Xidian University, China

Abstract: In this paper, we propose a novel massive multiple-input multiple-output enabled unsourced random access scheme through low-density parity-check (LDPC) encoding and random spreading. In the proposed scheme, the pilot is modulated by spreading sequence and transmitted over the first time slot, and data are transmitted over other time slots by shorter spreading sequence, a fraction of the sequence in the first time slot, after LDPC encoding. At receiver, by utilizing received signals in pilot time slot, the covariance-based maximum likelihood detection is first used for active codeword detection and then the multiple measurement vector approximate message passing (AMP) for channel estimation. Next, data detection by generalized AMP algorithm and channel decoding by sum-product algorithm are performed subsequently. Moreover, to improve performance, iterative successive interference cancellation strategy is also employed. Finally, computer simulations are given to demonstrate the performance of the proposed scheme.

NA11080

17:10-17:25

Title: Max-Min Fairness of Multi-beam Multicast Based on MIMO-NOMA
Authors: Xin Yu, Shufeng Li, Yuwei Feng, and Zhiping Xia
Presenter: Xin Yu, Communication University of China, China

Abstract: With the help of massive multiple-input multiple-output non-orthogonal multiple access (MIMO-NOMA), multicast transmission can accommodate more users on the same spectrum resources and increase the capacity of the system. One limitation is that most studies usually focus on improving the system sum rate. However, because the quality of service of the wireless multicast group depends on the weakest user, it may cause unbearable rate loss to the weakest user. Unlike most existing literature, we focus on the rate of the weakest user to ensure successful communication and fairness of the whole system. This paper focuses on the requirement of ensuring the realizability of weak users and tries to analyze the minimum rate of the system to maximize it, by designing power allocation and digital precoding matrix, using convex optimization research to solve the problem. The simulation results show that the minimum rate of the system can be greatly improved, and the fairness of the system is better than other schemes after the beam digital precoding and power allocation. These results have great implications for our research.

NA30252

17:25-17:40

Title: Fingerprint Positioning for Massive MIMO Systems Based on Machine Learning

Authors: Xinrui Gong, Xiaofeng Liu and Xiqi Gao
Presenter: Xinrui Gong, Southeast University, China

Abstract: Fingerprint-based positioning is promising for mobile cellular systems in dense scattering environments. Massive multiple-input multiple-output (MIMO) has significant advantages in providing accurate positioning due to the high angular resolution. This paper investigates the fingerprint-based positioning problem in massive MIMO systems utilizing machine learning. Adopting a refined spatial beam-based channel model, we exploit a novel beam domain channel amplitude matrix as the locationrelated fingerprint. We transform the positioning problem into a pattern recognition problem through fingerprint information. The base station can independently classify and distinguish the position fingerprints of different mobile user terminals via machine learning. Then, we propose a classification-based positioning method by using the neural network. The performance of the proposed machine learning based fingerprint positioning method is evaluated with a geometry-based stochastic channel model. Simulation results demonstrate that the proposed positioning method can perform better than conventional approaches.

NA31098

17:40-17:55

Title: PCA-BD-Based Broadband Hybrid Precoding for Multi-User Massive MIMO Systems

Authors: Tianye Zhu, Yiwei Sun, Dongxuan He and Hua Wang
Presenter: Tianye Zhu, Beijing Institute of Technology, China

Abstract: Hybrid precoding has shown to be an effective method in massive multiple-input multiple-output (MIMO) systems.To enable the design of hybrid precoding in multi-user massive MIMO-OFDM systems, a principal component analysis (PCA) and block diagonalization (BD) based precoding method is proposed in this paper.In particular, to mitigate the frequency-selective characteristic of broadband channel and eliminate the interference in multi-user scenarios, the proposed design of hybrid precoding can be divided into two steps.First, relying on PCA, the frequency-flat universal radio frequency (RF) precoder is extracted from a set of frequency-selective RF precoders, which enables the design of RF precoder/combiner.Next, the baseband precoder/combiner is designed accordingly with the help of BD, which can eliminate interference effectively. Simulation results demonstrate the superiority of our proposed solution when compared to the state-of-the-art schemes in terms of sum spectral efficiency (SSE), bit error rate (BER) performance and the robustness to channel disturbances.

NA30257

17:55-18:10

Title: Two-user Cooperative Physical Layer Authentication in Non-Coherent Massive MIMO System

Authors: Li Yan, Junjie Wang, Teng He, Gangtao Han, Shuangzhi Li, Guangyi Liu
Presenter: Li Yan, Zhengzhou University, China

Abstract: The physical layer authentication (PLA) in the fast-varying uplink channels of massive multiple-input multiple-output (MIMO) system is considered in this paper, and a two-user

cooperative PLA scheme is proposed. In the proposed PLA scheme, the messages and embedded tags of users are transmitted in a space-time modulation model with the using of unique decomposition constellations. As a result, non-coherent signal detection is carried out at the base-station (BS). The approximate symbol error rates of message and tag for the proposed scheme are given as well as the probability of false alarm and detection probability. Simulation results show that the proposed scheme achieves high reliability with low latency while the number of BS antennas is large, and meanwhile, the cooperative authentication performance is better than that of independent scheme.

NA30278

18:10-18:25

Title: Decentralized Recursive MMSE Equalizer for Massive MIMO Systems

Authors: Kang Zheng, Gao Hao, Cui Shuai, Wang Jiaheng and Huang Yongming
Presenter: Zheng Kang, Southeast University/CMZJ, China

Abstract: In massive multiple-input multiple-output (MIMO) systems, linear equalizers such as zero-forcing (ZF) and minimum mean-square error (MMSE) equalizers are often used and implemented in a centralized way. As the antenna number increases, the centralized equalization requires a huge data exchange rate as well as intensive central processing capability. Decentralized equalization can alleviate this bottleneck by partitioning the antenna array into multiple clusters and conducting equalization separately and locally. In this paper, we design a decentralized MMSE equalizer based on the chain architecture. The proposed equalizer is conducted in a recursive manner through a chain and generates a sequence of estimated signals that converge to the MMSE solution. Furthermore, we also propose an early termination strategy according to channel quality, thus reducing complexity and data exchange rate. Simulation results illustrate that the proposed recursive MMSE equalizer outperforms the existing decentralized equalizer, and achieves the same BER performance as the centralized MMSE equalizer with a lower data exchange rate.

NA30205

18:25-18:40

Title: Deep Reinforcement Learning Based Transmission Scheme for UAV MIMO Communication

Authors: Sheng Yu, Yang Lu, Xiaofeng Tao
Presenter: Yang Lu, NARI Group Co., Ltd. State Grid Electric Power Research Institute, China

Abstract: Unmanned Aerial Vehicle (UAV) massive MIMO has been considered an important technology in 6G communications. In this paper, we propose an efficient transmission scheme based on deep reinforcement learning (DRL) for the UAV massive MIMO. Specifically, the UAV 3D trajectory design, analog beamforming and power allocation is designed to obtain a high spectral efficiency. We formulate the transmission design by a Markov decision process (MDP) framework, which is solved by the DRL based algrotihm. Considering that the action space is continuous, we use the deep deterministic policy gradient (DDPG) method to obtain the transmission scheme. The simulation results show that the proposed algorithm has a higher spectral efficiency than the previous algorithms.

3RD INTERNATIONAL WORKSHOP ON INTELLIGENT INTERNET OF VEHICLES

Time: 16:55-18:20, Nov. 12, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/86108605540 Password: 111114

- **Session Chair: Assoc. Prof. Ke Zhang, University of Electronic Science and Technology of China, China**

NA55037

Invited Speech

16:55-17:20

Title: Multi-Task Imitation Learning for Auto-Driving Robotic Vehicles
Invited Speaker: Professor Shaoen Wu, Kennesaw State University, USA

Abstract: Deep imitation learning enables robotic auto-driving to learn from expert demonstrations to perform tasks such as lane following or obstacle avoidance. However, in the traditional imitation learning framework, one model only learns one task. Thus, it cannot support a robot to perform various navigation tasks with one model in indoor environments. This talk introduces a new framework, Shared Multi-headed Imitation Learning, that allows an autonomous vehicle to perform multiple tasks with one model without switching among different models. We model each task as a sub-policy and design a multi-headed policy to learn the shared information among related tasks by summing up activations from all sub-policies. Compared to single or non-shared multi-headed policies, this framework can leverage correlated information among tasks to increase performance.

NA30283

17:20-17:35

Title: IRS-Assisted Weighted Sum-Rate Maximization Semi-persistent Scheduling in NR-V2X
Authors: Juncai Chen, Fan Wu, Ke Zhang, Xiaoyan Huang, and Supeng Leng
Presenter: Juncai Chen, University of Electronic and Science Technology of China, China

Abstract: A well-known issue in NR-V2X Mode 2 is the packet collision that results from two or more vehicles selecting the same resource block (RB) for transmission through distributed competition in the scenarios without a centralized coordinator. Consequently, it may lead to serious safety problems if the collided RB is used to send safety information by the vehicles. In this paper, we propose an intelligent reflecting surface (IRS)-assisted semi-persistent scheduling (SPS) scheme to resolve the RB conflicts by utilizing the IRS to enhance the signal reflection sent from the vehicle selected to occupy the RB. To this end, we propose a weighted sum-rate maximization model to jointly determine the vehicle selection and the IRS reflection control. In order to achieve a trade-off between the efficiency of RBs and the coordination of contending vehicles, we conceive an evaluation method to assess the transmission rate weights among the contending vehicles, which considering both wireless resource occupation and services urgency. In addition, we develop a joint conflict resolution and IRS reflection control(JCRIRC) algorithm based on DDPG to approximate the optimal solution. Simulation results verify the verify the improvement of RB utilization and take wireless resource occupation and services urgency into account.

NA11066

17:35-17:50

Title: A Joint Resource Allocation and Efficient Communication Scheme Based on FL for the Internet of Vehicles
Authors: Enchang Sun, Hui Zhang, Ruolan He, Mengsi Li, Dongying Zhang, Yanhua Zhang
Presenter: Hui Zhang, Beijing University of Technology, China

Abstract: Motivated by the rapid development of the Internet of Vehicles (IoV) and fifth-generation mobile communication technology, vehicle clients have put forward higher requirements for reducing communication overhead and enhancing data privacy. The recently emerging distributed learning method, federated learning (FL), can efficiently process data parameters while protecting clients' privacy. Therefore, we propose an FL-empowered resource allocation and communication optimization framework in the IoV. The purpose of this paper is to minimize the loss function of FL while ensuring efficient communication between vehicle devices and the BS. Based on this purpose, the problem of the uplink wireless resource

allocation and parameter quantization in the IoV is formulated. Then, the shortest path optimization algorithm is used to achieve wireless resource allocation recursively. Furthermore, an error-feedback enabled quantized stochastic gradient descent algorithm is adopted, which reduces the size of the parameters transmitted to the BS by quantifying the local parameters of the vehicle devices, and the error-feedback mechanism is used to speed up the convergence of the FL. Finally, simulation results show that the proposed scheme outperforms the comparison schemes in terms of global loss and convergence accuracy.

NA30209

17:50-18:05

Title: Communication in Autonomous Vehicles through 5G Onboard Units - Understanding the Experimental Setup

Authors: M Jalal Khan, Manzoor Ahmed Khan, Obaid Ullah, Sumbal Malik, and Hesham El-Sayed
Presenter: M Jalal Khan, United Arab Emirates University, UAE

Abstract: Currently, the vehicles connectivity in transportation industry is becoming our new normal. In this paper, we focus on discussing the enhancement required in autonomous vehicles communication. An overview of the journey from WiFi to cellular based V2X communication is provided. The communication enablers in terms of gains and adoption strategies of cellular based communication is discussed in particular. Readers are walked through the technical features and available platforms/solutions in this regard. To help comprehend better the aforementioned concepts, this work also provides details on the PC-5 and DSRC specification and its working principles. Next, we provide the practical implementation of the PC-5 and DSRC devices in lab. We believe the contents herein will equip the readers with a good start for hands-on. We also believe the configuration setup and implementation details will serve and assist the autonomous driving research and development.

NA40423

18:05-18:20

Title: Collaborative Task Offloading for Vehicular Edge Computing

Authors: Yujun Ming, Supeng Leng
Presenter: Yujun Ming, University of Electronic Science and Technology of China, China

Abstract: Vehicular edge computing is a new paradigm that overcomes the constraints of physical distances of cloud servers on system performance in the Internet of Vehicles (IoV). In order to increase resource utilization and system scalability, we present in this paper a joint communication and computational resource allocation mechanism in VEC-enhanced IoV, where automobiles and VEC servers simultaneously work as computing service nodes. Given that the offloading and resource allocation strategy depends on the changing environment state, we formulate the problem as a Markov decision process to minimize the overall system overhead. We propose dynamically adapting distributed and centralized Deep Reinforcement Learning (DRL) in response to the various task requirements and the availability of free computing resources in the service nodes. Finally, simulation experiments are conducted to compare the performance differences among the centralized, multi-agent, and proposed algorithms. Numerical results verify that our proposed scheme outperforms the baselines.

POSTER SESSION 1

Topic: Computer Information Network, Digital Image and Multimedia Technology
Time: 13:30-15:05, Nov. 12, Beijing Time, GMT+8
ZOOM Link: https://us06web.zoom.us/j/89327674351 Password: 111114

- **Session Chairs:**
  Assoc. Prof. Hanxu Hou, Dongguan University of Technology, China
  Assoc. Prof. Li Li, Southwest Jiaotong University, China

NA40434

13:30-13:35

Title: Research on IMS Packet Service Triggering Algorithm Based on Double Filtering Criterion

Authors: Ming Ma, Qing Miao, Yuan Qin, JinJin Li, TangJie Yuan
Presenter: Ning Ma, Unit 78167 of PLA, China

Abstract: The Service trigger algorithm is the core of the entire IMS system platform, which can affect the work efficiency and service quality of the entire system. In the early days, the service trigger algorithm officially defined by 3GPP can no longer meet the overall requirements of current big data and big user information services. In order to meet the Service needs of the multimedia network platform and the huge user group in the future, this paper conducts an in-depth study on the official Service trigger algorithm, and proposes an IMS packet Service trigger algorithm based on the double filter criteria. This algorithm achieves the goal of quickly processing multiple services by combining the packet Service trigger mechanism with the iFC+sFC dual service filter criteria. The simulation results show that the new service triggering algorithm can effectively reduce the overall session setup delay, improve the system throughput, and greatly improve the IMS system service triggering efficiency.

NA11034

13:35-13:40

Title: Mixed Residual Convolutions with Vision Transformer in Hyperspectral Image Classification

Authors: Ying Cao, Yang Wang, Zhijian Yin, Zhen Yang
Presenter: Ying Cao, Jiangxi Science and Technology Normal University, China

Abstract: In recent years, deep learning methods represented by convolutional neural networks (CNN) have gradually become a research focus in the field of hyperspectral image classification (HSI). Although the proposed CNN-based methods have the advantages of spatial feature extraction, they are difficult to handle the spectral feature. We propose a mixed residual convolutions with Vision Transformer model (MRViT), which uses ViT Transformer (ViT) to overcome this limitation. First, using principal component analysis (PCA) and a channel shift strategy to construct a module to process HSI data. Then, a mixed residual convolution is constructed to extract spectralspatial features. Finally, the important feature information is enhanced by the ViT model. In this paper, four datasets are used for experimental analysis, which confirms that the performance of MRViT model is superior to other HSI classification models. The research content of this paper enriches related research in HSI classification, and also provides certain reference value for subsequent research.

NA40351

13:40-13:45

Title: Joint calibration of Binocular-ToF camera and docking ring correction

Authors: Liang Hu, Dianqi Sun, Huixian Duan and Haodong Pei
Presenter: Liang Hu, Shanghai Institute of Technical Physics, China

Abstract: This paper presents the joint calibration of binocular and TOF and a simple application: docking ring correction. In the first part, a new joint calibration algorithm was proposed. Firstly, replace the traditional checkerboard calibration plate with a circular calibration plate. Secondly, the 2D-3D mapping is done via the TOF camera intensity map. The calibration results demonstrate the accuracy of the proposed method. In the second part, we first perform the extraction, reconstruction and correction of the docking ring and a scheme on how to obtain the true value of the normal vector of the docking ring was proposed. We hope that the content of this paper can provide a certain reference value for multi-sensor data fusion and other fields.

NA40326

13:45-13:50

Title: Robust Vision SLAM Based on YOLOX for Dynamic Environments

Authors: Huangbin Yan, Xin Zhou, Junya Liu, Zhijian Yin and Zhen Yang
Presenter: Huangbin Yan, Jiangxi Science and Technology Normal University, China

Abstract: Simultaneous localization and mapping (SLAM) is one of the basic functions of intelligent mobile robots. In recent, many impressive SLAM systems have been developed, and in some cases good performances have been achieved. However, some problems have not been well solved , such as how to deal with moving objects in dynamic environments and how to make robots truly understand the environment and complete advanced tasks. In this paper, we propose a robust vision SLAM for dynamic environments, called YOLOX-SLAM. In YOLOX-SLAM, four threads run in parallel: tracking, object detection, local mapping, and loop closure.YOLOX-SLAM uses YOLO object detection to eliminate dynamic feature points, which reduces the impact of dynamic objects and greatly improves positioning accuracy in dynamic environments.The public dataset TUM RGB-D is used for on our experiments, and the results show that the absolute trajectory accuracy of YOLOX-SLAM is an order of magnitude higher than that of ORB-SLAM2. It is one of the most advanced SLAM systems in a highly dynamic environment.

NA11033

13:50-13:55

Title: YOLOMask: Real-time Instance Segmentation With Integrating YOLOv5 and OrienMask

Authors: Yang Wang, Zhikui Ouyang, Runhua Han, Zhijian Yin and Zhen Yang
Presenter: Yang Wang, Jiangxi Science and Technology Normal University, China

Abstract: In this paper, we propose a real-time framework for instance segmentation, which we call YOLOMask and which builds on the real-time project OrienMask. In YOLOMask, we integrate the YOLOv5 object detection framework with the OrienMask instance segmentation framework to form a new real-time instance segmentation framework and we integrate CBAM into YOLOMask, which can help the network to find regions of interest in images with large area coverage. Using this method, our YOLOMask can achieve 47.8/44.3 msak/box AP on Pascal 2012 SBD dataset evaluated at 84.3 fps with a V100 GPU. Compared to OrienMask, YOLOMask improves box AP by about 5.8% and mask AP by 4.5%, which is encouraging and competitive. Given its simplicity and efficiency, we hope that our YOLOMask can serve as a simple but strong baseline for a variety of instance-wise prediction tasks.

NA40355

13:55-14:00

Title: A Multimodal Fusion Network Based on Hypergraph for 3D Shape Retrieval

Authors: Xiaoting Huang, Liping Nong, Wenhui Zhang
Presenter: Xiaoting Huang, Guilin University of Electronic Technology, China

Abstract: 3D shape retrieval is an important research topic in the field of modern multimedia information retrieval. Point cloud and mesh modalities are commonly used representations of 3D data and have strong shape description capabilities. However, existing multimodal 3D shape retrieval methods lack the fusion learning of these two irregular data. In this paper, we design a depthwise separable hypergraph convolution and build a multimodal fusion network base on it, which use hypergraph to model higher-order relationships between data and improve 3D shape retrieval capabily through the effective fusion of point cloud and mesh data. First, the initial feature descriptors of the point cloud and mesh modalities are extracted using a pretrained network, respectively. Next, perform channel shuffle on the initial feature descriptors to mix the mutimadal data and then use the k-Nearest Neighbour(kNN) algorithm to construct corresponding hypergraphs. Finally, depthwise separable hypergraph convolution is proposed to extract discriminative shape representations and fuse the multimodal information. During the process of network training, the fusion network is jointly constrained by the mean square error loss function and the cross entropy loss function. The proposed network is applied to the 3D shape retrieval task, and the experimental results demonstrate that the proposed method can greatly improve the retrieval accuracy.

NA30271

14:00-14:05

Title: Multi-Agent DDPG Enpowered UAV Trajectory Optimization for Computation Task Offloading

Authors: Zhijiang Chen, Lei Lei and Xiaoqin Song
Presenter: Zhijiang Chen, Nanjing University of Aeronautics and Astronautics, China

Abstract: In order to solve the problems of high cost, poor mobility and difficulty in coping with emergency in large-scale deployment of fixed edge computing nodes in mobile edge computing(MEC), an unmanned aerial vehicle(UAV)-assist task offloading algorithm is proposed to meet the need of computing-intensive and delay-sensitive mobile services. Considering constraints such as the flight range, flight speed of multiple UAVs and system fairness among users, the method aims to minimize the weighted sum of the average computing delay of users and the UAV's energy consumption. This non-convex and NP-hard problem is transformed into a partially observed Markov decision process, and we propose a multi-agent deep deterministic policy gradient algorithm to get optimal offloading decision and UAV flight trajectory. Simulation results show that the proposed algorithm outperforms the baseline algorithm in terms of fairness of mobile service terminals, average system delay and total energy consumption of multiple UAVs.

NA21021

14:05-14:10

Title: Design and Analysis of Airport Intelligent Border System Based on Zigbee Technology

Authors: Youcheng Liang, Haitao CHen

Presenter: Youcheng Liang, Guangzhou Civil Aviation College, China

Abstract: A new intelligent measurement system with ZigBee technology is designed in this paper. The measurement scheme is composed of sensing detection module and data processing module, where the main sensing detection module is the outdoor sensor probe, which is mainly composed of network controller, network management module, sensor and sensor interface. The system measurement scheme mainly adopts vibration sensors and intelligent video for the comprehensive perception of the boundary area. Through the acquisition, analysis and processing of the signals in the detection area, and then through the computer data processing to identify the invasion target, so as to realize the all-weather intelligent monitoring of the boundary area.

NA11042

14:10-14:15

Title: A Physical Encryption Scheme for OTFS System

Authors: Jilin Chen, Xinjin Lu, Wei Li, Ying Huang

Presenter: Jilin Chen, National University of Defence Technology, China

Abstract: As a special aerial communication device, unmanned aerial vehicle (UAV) is widely used in military and civilian applications. High-speed movement of the terminal and openness of the channel have caused many reliable and security problems in the UAV communication system. In this paper, a physical layer encryption scheme for orthogonal time frequency space (OTFS) systems based on constellation rotation is proposed. In the OTFS system，we extract the channel response strength in Delay Doppler (DD) channel to be the initial value of a chaotic generator，then the key is generated. The signal to be transmitted in OTFS is encrypted by constellation rotation. Theoretical analysis and algorithm simulation are carried out from both reliability and security. The results show that the scheme has strong reliable and security.

NA40323

14:15-14:20

Title: Model-Based Structured Covariance-Aided Channel Estimation for Massive MIMO Systems

Authors: Xingjian Li, Zhiqun Song, Lizhe Liu, Xuejun Sha, Yong Li and Bin Wang

Presenter: Xingjian Li, Academy for Network & Communications of CETC, China

Abstract: We consider the problem of downlink channel estimation in massive multiple-input multiple-output (MIMO) systems, where both transmitter (Tx) and receiver (Rx) are equipped with uniform planar array (UPA). The acquisition of channel state information (CSI) is important for subsequent signal detection and beamforming. To obtain the CSI accurately, the behavior of minimum mean-squared error (MMSE) channel estimator is studied, the main difficulty of which is the recovery of channel covariance matrix. In this paper, the channel covariance matrix is formulated under kronecker channel model, and the correlation of different antennas is formulated by the classical exponential model. Based on this model, the channel covariance matrix can be represented as a parameterized matrix, and the recovery of channel covariance matrix can be converted to an optimization problem of two parameters. An explicit solution is provided as channel estimator for independent identically distributed

(i.i.d.) channels, while an alternate optimization algorithm is proposed to iteratively estimate the channel covariance matrix and the channel as well for correlated channels. The proposed algorithms improve the performance in exchange of computational complexity, and do not require extra pilot overhead. Simulation results are provided to illustrate the effectiveness of our proposed methods.

NA11064

14:20-14:25

Title: Performance Analysis and Verification of Single Auxiliary Source Suppression Array Error

Authors: Chongyu Hao, Wei Shi, Baowei Wang, Junquan Deng
Presenter: Chongyu Hao, Nanjing University of Information Science and Technology, China

Abstract: Aiming at the problem that the performance of direction of arrival (DOA) estimation algorithm deteriorates when there is channel mismatch. This paper proposes the channel data pre-compensation algorithm based on a single auxiliary source. Calculate the error correction matrix based on the steering vector estimate of the auxiliary source, and error compensation for array output data. The direction of arrival of the unknown radiation source is obtained from the corrected array output matrix. The analysis of the experimental results shows that the phase correction is more important than the amplitude correction, the error compensation effect is independent of the auxiliary source angle. The algorithm can estimate the amplitude and phase errors of the linear array, and effectively improve the DOA estimation performance under the condition of channel mismatch error.

NA30250

14:25-14:30

Title: Two-dimensional DOA estimation based on non-circular signals from a tensor perspective

Authors: Hao Li, Bin Ba, Jin Zhang, Chengzhou Liu, Qiang Jin, Liye Zhang
Presenter: Hao Li, National Digital Switching System Engineering & Technological Research Center, China

Abstract: Coprime planar array (CPA) based on non-circular signals can perform direction-of-arrival (DOA) estimation with high degrees of freedom, but most of the algorithms are based on matrices, which may obscure the structural information of the data and reduce the accuracy of DOA estimation. Aiming at this problem, we propose a two-dimensional DOA estimation algorithm based on tensor, which realizes high degrees of freedom and high precision joint estimation. The algorithm models the received signal with tensors to obtain the tensor covariance with non-circular signal information. Then the structural covariance tensor is obtained by merging dimensions with the same direction factor by tensor expansion. The tensor decomposition of the structural covariance tensor is then performed to obtain a matrix factor with direction information. Finally the DOAs of the signals are obtained by searching for the spectral peak. Simulation experiments show that under the same conditions, the RMSE performance of the proposed algorithm is better than that of the comparison algorithm, and it has higher angular resolution

NA40370

14:30-14:35

Title: The Effect of Unequal Time of Rising and Falling Edge on Three Level RF-PWM Signal

Authors: JIashun Zhu, Qiang Zho, Zhang Chen, Zhanyang Xu, Siyu Zeng
Presenter: Jiashun Zhu, Nanjing University of Information Science and Technology, China

Abstract: This paper analyzes the performance of RF-PWM signal when the time of rising and falling edge is not equal. Firstly, the reason of unequal edge time is analyzed and modeled for three level pulse signals. The influence is divided into amplitude and phase distortion. Secondly, the influence of unequal time of rising and falling edge is analyzed by fast Fourier transform (FFT). Then the phenomenon of pulse swallow caused by rising and falling time is discussed. Finally, MATLAB is used to simulate and analyze the changes of the output signal in-band and out-of-band performance. Theoretical analysis and simulation results show that, the Error Vector Magnitude (EVM) and Adjacent Channel Power Ratio (ACPR) of the signal will deteriorate obviously when the time of the rising and falling edge is not equal. Moreover, the impact of pulse swallow on the signal performance is limited, when the input signal is a high peak-to-average power ratio (PAPR) signal.

NA11072

14:35-14:40

Title: Individual Recognition Method of Radiation Source Based on Deep Subdomain Adaptation Network

Authors: Zhen Tang, Tao Zhang, Xiaomeng Yang, Lei Qian
Presenter: Zhen Tang, National University of Defense Technology, China

Abstract: Aiming at the problem of the recognition accuracy degradation caused by the channel noise inconsistency between the signal of the radiation source to be identified and the trained radiation source dataset, this paper proposes an individual identification method of radiation sources based on subdomain adaptation. First, the radiation source signal is spliced into IQ images to generate a feature data set. Then the improved Resnet-50 network which has been pre-trained on the image set is utilised to extract the common characteristics of the source and target domains. Finally, the local maximum mean difference adaptive layer is added. By calculating the pseudo-labels in the target domain to match the conditional distribution distance, the difference in the characteristic distribution of sub-type radiation sources under different signal-to-noise ratio (SNR) can be reduced, and the model recognition accuracy can be improved. The experimental findings reveal that the proposed method greatly increases the accuracy of the individual radiation source identification technique based on the deep neural network. Under the condition that the SNR of the signal to be detected increases or falls by 4 dB compared to the training dataset, the identification accuracy of the approach suggested in this study improves by 11.4 percent and 12.7 percent respectively compared with the model Resnet-50.

NA11075

14:40-14:45

Title: Dynamic Gate Convolutional Networks for Speech Enhancement

Authors: Yantao Chen, Binhong Dong, Cuiting Liu and Wenhui Xiong
Presenter: Yantao Chen, University of Electronic Science and Technology of China, China

Abstract: Deep learning-based methods have become the mainstream of speech enhancement (SE). However, finding a network with high performance and low complexity is still a challenge for the speech enhancement task. In this letter, a dynamic convolutional-based multi-target learning network DGCN is proposed as a feasible solution to the above difficulties. To enhance the representation ability of the network for extracting the clean speech features, a lightweight channel dynamic convolution (CDF) module is proposed to replace the convolutional layer of the main branch in the network. In addition, we design a triple-branch encoder and decoder structure to boost the performance of the CDF module and avoid the corresponding defect in channel information exchange. Moreover, we propose an efficient multi-branch output (MBO) design to balance the tradeoff between performance and complexity. The ablation study confirms the efficiency of the proposed CDF and MBO module, and the experimental results show that the overall performance of the proposed DGCN outperforms the state-of-the-art SE methods.

NA11053

14:45-14:50

Title: Agricultural pest detection algorithm based on attention mechanism

Authors: Xiaoyu Fan, Yang Wang, Junya Liu, Zhijian Yin and Zhen Yang
Presenter: Xiaoyu Fan, Jiangxi Science and Technology Normal University Nanchang, China

Abstract: Recently, the Yolov5s algorithm in agricultural pest detection is often compromised by upsampling of information, resulting in the loss of detailed information in small target features. To solve this problem, an algorithm for agricultural pest detection in natural environment based on attenuation factors is proposed in this paper. The backbone of Yolov5s was used as a backbone network, and the attention mechanism SE was added to the bottleneck structure of the network to solve the problems such as the disappearance of the gradient in the training process and improve the detection accuracy of small targets. Experimental results show that the MAP0.5 and MAP0.5:0.95 of the improved Yolov5s in IP102 reach 58.76% and 35.53%, respectively. Compared with the original algorithm, the MAP0.5 and MAP0.5:0.95 is improved by 0.83% and 0.4%, respectively.

NA11014

14:50-14:55

Title: Fusing Transformer and YOLOX for Smoke Detection

Authors: Zhikui Ouyang, Yang Wang, Zhijian Yin and Zhen Yang
Presenter: Zhikui Ouyang, Jiangxi Science and Technology Normal University, China

Abstract: The trade-off between better accuracy and efficiency is an important problem in smoke detection. In deep networks, low-level features are generally considered to be poor in semantic information but rich in keeping geometric details, which is the opposite for high-level features. Therefore, feature fusion plays a crucial role in combining semantic and geometric information. The transformer encoder has the advantages of global computations and perfect memory that searches each element of a sequence and updates it by aggregating information from the entire sequence. In this paper, we proposed a block that combines the geometric information of the low-level features and the semantic information of the high-level features of the backbone with the transform encoder. We boost the fuse-transformer YOLOX-Nano to 44.28\% AP on VOC0712 training datasets and on VOC07 test datasets with 416 × 416 resolution, outperforming the original YOLOX-Nano 43.32\% AP. If converted to a smoke datasets which containing 9726 training images and 2320 test images. We increase the fuse transformer YOLOX-Nano to 31.48\% AP on smoke datasets with a resolution of 416 × 416, outperforming the original YOLOX-Nano by 30.9\% AP.

NA11110

14:55-15:00

Title: A Vehicle Line-pressing Detection Approach Based on YOLOv5 and DeepSort

Authors: Shuning Wu, Fen Ge, and Yi Zhang
Presenter: Shuning Wu, Nanjing University of Aeronautics and Astronautics, China

Abstract: With the increase in traffic, vehicle scratches and rear-end collision caused by vehicle line-pressing violation have brought a great threat to driving safety. A three-step approach based on YOLOv5 and DeepSort is proposed to detect vehicle line-pressing in this paper. First, the YOLOv5 network is trained on a large traffic dataset to complete the detection of vehicles, and the DeepSort algorithm is used to achieve the tracking of moving vehicles. After that, we use Hough transform to detect lane lines and obtain their position. Finally, according to the information of lane lines and the position of vehicles at different moments, we propose an algorithm to judge whether vehicles press lines. The results show that the approach has good performance and the accuracy of violation detection is 99.5%.

NA40324

15:00-15:05

Title: Geometric Feature Detection of Space Targets Based on Color Space

Authors: Dianqi Sun, Liang Hu, Huixian Duan and Haodong Pei
Presenter: Dianqi Sun, Shanghai Institute of Technical Physics, China

Abstract: The identification and estimation of space non-cooperative target is a prerequisite for space rendezvous and on-orbit service, most of which have geometric structures such as docking loops, antennas, solar panels, and the rest are covered with multiple layers of material for thermal insulation. In this paper, a color space-based method to detect space non-cooperative target geometric feature is proposed. First, we split the 3 channels of the RGB image and convert it into another format in HSV (Hue, Saturation, Value) color space. Second, by comparing the 6-channel images under different lighting conditions, it is determined that the Hue channel is used for fine identification of key features. Finally, experiments demonstrate the effectiveness of our proposed method, which applied pass-through filtering method by Hue Channel to detect geometric features under extreme lighting conditions in space.

POSTER SESSION 2

Topic: Intelligent Communication System, Simulation and Performance Optimization Calculation
Time: 15:20-17:25, Nov. 12, Beijing Time, GMT+8
ZOOM Link: https://us06web.zoom.us/j/89327674351 Password: 111114

- **Session Chair: Assoc. Prof. Jun Xu, Nanjing Normal University, China**

NA21055

15:20-15:25

Title: Resource Allocation for D2D underlaying Cellular Networks with Incomplete CSI
Authors: Jun Xu
Presenter: Jun Xu, Nanjing Normal University, China

Abstract: Device-to-device (D2D) communications support direct communications of users in proximity. It is a potential technology to improve the spectral efficiency and network capacity. Most researches on D2D resource allocation assume full Channel State Information (CSI). Considering the high overhead of obtaining full CSI, we investigate the resource allocation problem of D2D communications with incomplete CSI. Based on the Modulation and Coding Scheme (MCS), we first derive the closed-form expression of the rate selection probability with incomplete CSI by characterizing the unknown small-scale channel fading factor as Nakagami-m distribution. We then propose a bio-inspired power allocation and matching-based channel assignment strategy. Simulation results demonstrate that our algorithm outperforms the compared algorithms by achieving higher network capacities.

NA11100

15:25-15:30

Title: A Hybrid CNN Compression Approach for Hardware Acceleration
Authors: Xin Yue, Fen Ge, Fang Zhou, Ning Wu, Yi Zhang
Presenter: Xin Yue, Nanjing University of Aeronautics and Astronautics, China

Abstract: Convolutional neural networks (CNNs) have achieved remarkable achievements in the fields of artificial intelligence (AI). A large volume of weights hinder the deployment of CNNs on embedded devices. The compression of CNNs can reduce the volume of weights and facilitate the hardware acceleration. In this paper, a hybrid CNN compression approach for hardware acceleration is proposed. The approach is divided into pruning phase and quantization phase. In the first phase of pruning, we use filter pruning for the convolutional (Conv) layers with complicated computing and weight pruning for the fully connected (FC) layers with the large volume of weights. In the second phase of quantization, weights bit-widths are set to 16-bit for the Conv layers and 8-bit for the FC layers. Based on experimental verification, for VGG16, 93.05% of weights are pruned and the model is compressed by 37.88× with 1.17% accuracy loss. For ResNet18, the model is compressed by 7.27× with 0.47% accuracy loss. Experimental results show that the proposed approach can effectively reduce computational complexity and memory overhead for the implementation of CNN hardware accelerators.

NA11111

15:30-15:35

Title: Implementation of Bidirectional LSTM Accelerator Based on FPGA
Authors: Hao Wang, Danfeng Qiu, Fen Ge, Ying Yang
Presenter: Hao Wang, Nanjing University of Aeronautics and Astronautics, China

Abstract: Sentiment analysis has become a more active area of research in the past few years due to the popularity of social networks and the e-commerce economy. Bi-directional Long Short-Term Memory (Bi-LSTM) has excellent performance in sentiment analysis. In this work, we design a Bi-LSTM accelerator which is implemented on FPGA. The accelerator completes most calculations in processing engine (PE) array, and multiple PEs are arranged to calculate in parallel to accelerate the calculation. For the element-wise module in each PE, we propose a time-division multiplexing strategy, using only two multipliers and one adder to significantly reduce resource utilization. Finally, we train a small-scale Bi-LSTM model by using the amazon customer reviews dataset. The Bi-LSTM accelerator implemented on FPGA reaches 13.4× and 8.4× speedup compared to CPU and GPU, respectively. And the power consumption is only 6.3% and 7.3% of CPU and GPU. The accelerator throughput reaches 91.47 GOP/s, and the energy efficiency reaches 30.73 GOPS /w.

NA11085

15:35-15:40

Title: Research on frequency selection method for spatial terahertz communication under multiple constraints

Authors: Yuanzhi He and Chensheng Ma
Presenter: Chensheng Ma, Academy of Military Sciences, China

Abstract: The terahertz frequency band has the advantages of large bandwidth, narrow beam, strong penetration, and high security, and is an important direction for the frequency expansion of the next generation of satellite communications. In this paper, according to the satellite-ground and inter-satellite terahertz communication frequency bands divided by the International Telecommunication Union, the atmospheric transmission loss model of the satellite-ground terahertz communication link is constructed and simulated, and the key components of terahertz communication in different frequency bands are analyzed based on the research status at home and abroad. At the same time, the transmission performance comparison of satellite-ground and inter-satellite terahertz communication links in different frequency bands was carried out. Finally, through a comprehensive analysis of the transmission loss, device availability and link transmission performance of different terahertz communication frequency bands, the recommendations for the selection of frequencies for satellite-ground and inter-satellite terahertz communication.

NA11068

15:40-15:45

Title: Deep Learning-based Joint Modulation and Coding Scheme Recognition for 5G New Radio Protocols

Authors: Xiang Chen, Xinyao Wang, Hanyu Zhao, Zesong Fei
Presenter: Xiang Chen, National University of Defense Technology, China

Abstratc; Blind detection of signals is a crucial technique in the 5G/B5G wireless communication systems, especially for the cognitive spectrum radio network, where the parameters of the transmit signals working on the free spectrum can not be known by the receiver. Following the 5G New Radio (NR) protocols, we propose a joint modulation and coding scheme (M-CS) recognition framework based on the supervised learning architecture and the given candidate set of the LDPC encoder. Specifically, the framework is composed of two cascaded modules. Firstly, the type of digital modulation according to the 5G NR protocols is recognized blindly based on the proposed Res-Inception convolutional neural network (RICNN). Then, the low-density parity check (LDPC) coding scheme implemented under various bitrates is identified by exhaustively searching the validation candidate to maximize the corresponding average log-likelihood ratio (ALLR). Numerical results show the effectiveness of our proposed blind recognition framework, especially for the practical 5G NR protocols. Moreover, it is demonstrated that our proposed method can guarantee the robustness of the recognition under various channel fading model scenarios.

NA21061

15:45-15:50

Title: Implementation of Variable Rate CPM Modulator

Authors: Yuhao Chen, Penghui Lai, Shilian Wang
Presenter: Yuhao Chen, National University of Defense Technology, China

Abstract: Spectrum is a non-renewable resource, and the spectrum resources of telemetry system are increasingly scarce. However, the demand for high bit-rate transmission is increasing. Continuous phase modulation (CPM), an efficient bandwidth modulation method, can alleviate this contradiction. This paper focuses on the implementation of CPM modulation with variable rate sampling technology based on Farrow structure, and proposes a variable rate sampling method for shaped offset quadrature phase-shift keying signal(SOQPSK). When the phase correlation length is greater than 1, it is called SOQPSK-TG. SOQPSK-TG has better power spectrum characteristics. According to the SOQPSK-TG signal model, the integer rate sampling is realized by interpolating baseband and interpolating phase. Combined with the analysis of demodulation results, it is concluded that the interpolating phase has the advantages of lower demodulation error rate and less hardware implementation.

NA21070

15:50-15:55

Title: A Fair Subcarrier Activation Method for OFDM-Index Modulation System

Authors: Zhengguang Zheng, Liyan Lin, Yu Yan, Donghui Yu, Jie Zhang
Presenter: Zhengguang Zheng, China Mobile Internet Co.,Ltd., China

Abstract: In this paper, a new subcarrier activation pattern (SAP) design for orthogonal frequency multiplexing with index modulation (OFDM-IM) system is proposed. It takes fairness and error performance into consideration to make each subcarrier activation probability as equal as possible, and we call it as the fair subcarrier activation method (FSAM). Furthermore, to reduce computational complexity, we divide the signal detection into two subprocesses: SAP determination and symbol demodulation, and develop a low complexity signal detection algorithm with negligible bit error rate (BER) performance loss. The simulation results show the effectiveness of the proposed algorithm over the conventional algorithms.

NA30240

15:55-16:00

Title: The Multiple Access PSK-chirp System and the Demodulation based on FrFT

Authors: Nan Zhao, Xu Zhao, Jie Gan, Dejian Li, Yubing Zhang, Zhenghao Li, Han Liu
Presenter: Nan Zhao, Beijing Smart-Chip Microelectronics Technology Co., Ltd. Beijing, China

Abstract: With the rapid growth of wireless and mobile communication network users, a chirp system that can support multiple access is required. This paper first introduces the chirp interference system for multiple access based on matched filtering receiver. Based on the chirp multiple access interference, we can obtain multiple transmitted models of the chirp system for multiple access. To support both synchronous and asynchronous transmitted systems and to improve the performance of multiple access chirp systems, we propose a multiple access PSK-chirp (Phase Shift Keying chirp) system. The multiple access PSK-chirp system's transmitter and receiver are first described. Then, in order to enhance the system's performance, the channel estimation and demodulation method based on Fractional Fourier Transform (FrFT) at the receiver is improved. Finally, we simulate the performance comparison of the matched filtering method, the FrFT method, and the enhanced FrFT algorithm. It is seen that the performance of the improved algorithm may be increased by roughly 1 to 2.5 dB.

NA30262

16:00-16:05

Title: A Lifetime-Enhanced Genetic Clustering Method for Heterogeneous Wireless Sensor Networks

Authors: Xinting Zhang, Xiaoqin Song, Lijuan Zhang, and Lei Lei
Presenter: Xinting Zhang, Nanjing University of Aeronautics and Astronautics, China

Abstratc: To solve the problems of short lifetime and unbalanced load among clusters, the improved clustering method is proposed based on genetic algorithm (GA) for wireless static sensor networks with heterogeneous energy. In the process of mapping encoded chromosome into execution strategy, the sensor nodes whose member set is empty will be converted into membership, which is conducive to collect sensory information. Considering the constraints of single-round energy consumption, communication scheduling delay, residual energy and other factors, a novel fitness function is constructed to evaluate clustering strategy performance. Simulation results demonstrate that, the proposed method significantly outperforms existing methods in terms of network lifetime, energy consumption and the number of transmitted sensory packets.

NA21088

16:05-16:10

Title: Deep and Shallow Features Fusion Based Deep CNN for Spectrum Sensing in Cognitive Radio

Authors: Zeyu Liu, Kejun Lei, Yinhang Zhang, Changqing Xiang, Xuming Wang and Xi Yang
Presenter: Zeyu Liu, Jishou University, China

Abstratc: The powerful classification capability of deep neural network (DNN) makes the DNN-based spectrum sensing algorithms very attractive in practical applications. However, it is worth noting that most existing DNN-based spectrum sensing algorithms only utilize deep features of the received signals, which may limit the further improvement of sensing

performance of those algorithms. On the one hand, DNNs often lose most of the global information in the process of extracting deep features, resulting in that the deep features sometimes will not be the optimal choice for classification; on the other hand, shallow features will retain most of the global information, but they are hard to highlight the detailed information. In view of this, a deep and shallow features fusion based CNN (DSFF-CNN) framework is proposed for spectrum sensing. The DSFF-CNN based algorithm uses the sample covariance matrix (SCM) of the received signal as input and fuses the features of different convolutional layers, allowing to make full use of both deep and shallow features. The experimental results show that the proposed algorithm obtains higher detection probability than the classical spectrum sensing algorithm based on CNN, which verifies the effectiveness of the algorithm.

NA11002

16:10-16:15

Title: Privacy Preserving Electronic Scoring Scheme based on CKKS

Authors: Shangshang Chen, Yaqian Zhao, Ruyang Li, Xuelei Li, Jian Zhao and Kai Liu
Presenter: Shangshang Chen, Zhengzhou University, China

Abstract: Electronic voting (e-voting) is more economical and efficient than traditional voting, however, it also faces the challenges of privacy and security. Existing e-voting schemes take advantage of homomorphic encryption to solve the privacy and security issues for {0,1} type e-voting applications. Unfortunately, existing schemes cannot meet the requirements in (real number) score-type e-voting applications, e.g., in competitive competitions or satisfaction surveys. This paper focuses on solving the privacy and security issues for score-type e-voting applications based on cryptographic technology. In order to solve such issues, we propose an electronic scoring scheme based on the CKKS(Cheon-Kim-Kim-Song) homomorphic encryption algorithm. It supports floating-point computing for exploiting homomorphic encryption in scoring and evaluating procedures. In addition, the security analysis demonstrates that the proposal achieves data privacy and security protection. Furthermore, we design an electronic scoring experiment based on the CKKS scheme in the library of SEAL. The experimental results indicate that it only takes 0.42 seconds to complete the scoring evaluation for 5000 people. Finally, the comparison results show that the proposal is more efficient, flexible, and practical.

NA21079

16:15-16:20

Title: The Effect of Clock Jitter on Azimuth of DVOR and the Compensation Method

Authors: Zerong Ren, Wei Cheng, Yong Li, Xiang Gao
Presenter: Zerong Ren, Northwestern Polytechnical University, China

Abstract: IF digitization of the DVOR receiving system requires a high precision clock. In the DVOR receiving system, there will be a clock jitter with Gaussian white noise at a high carrier frequency, and the jitter will reduce the demodulation performance. In this paper, we propose a scheme for demodulating azimuth in DVOR receiving systems, and then the influence on the accuracy of bearing information is studied by using the clock jitter model commonly used in the literature. Additionally, DVOR signal clock compensation is proposed, to reduce sampling and signal processing effects caused by clock jitter. This compensation method could significantly improve the accuracy of bearing information in the receiving system.

NA30231

16:20-16:25

Title: Integrated Sensing and Communication for Ambient Backscatter Communication Systems

Authors: Tao Huang, Xinyue Xu, Xiaoyan Kuai, Ying-Chang Liang and Xu Zhao
Presenter: Tao Huang, China Telecom Research Institute, China

Abstract: This paper investigates integrated sensing and communication for an ambient backscatter communication (AmBC) system. The backscatter devices (BDs) modulate information over ambient orthogonal frequency division mul-tiplexing (OFDM) signals, and the receiver (RX) realizes joint localization and information detection of the BDs. The system model is first established and the link-layer protocol is designed. Then the discrete Fourier transform (DFT) based and compressed sensing (CS) based methods are proposed to estimate the locations of BDs. The attenuation coefficients of the paths backscattered by BDs are estimated through least square (LS) method, and finally the information transmitted by the BDs is decoded. Simulation results have verified the performance of the algorithms, and it is shown that the larger bandwidth and antenna aperture are beneficial to improving the localization accuracy.

NA21024

16:25-16:30

Title: Wideband Circularly Polarized Truncated Conical Dielectric Resonator Antenna

Authors: Lei Chang, and Ling-Lu Chen

Presenter: Lei Chang, No. 36 Research Institute of CETC, China

Abstratc: A wideband circularly polarized (CP) truncated conical dielectric resonator antenna (DRA) is proposed. The DRA is composed of a truncated conical DR, a split-ring microstrip line with six probes, and a ground plane. The single coaxial feed CP fields are achieved by using the split-ring microstrip line with six probes. The six probes placed in sequence on the split-ring microstrip line enhance the axial ratio (AR) bandwidth. The proposed antenna has an impedance bandwidth of more than 34.8% (2.04-2.9 GHz) for VSWR ≤ 2, a 3-dB AR bandwidth of 24% (2.208-2.811 GHz), and a peak gain of 9.48 dBic.

NA40391

16:30-16:35

Title: A Flexible and Foldable Frequency-Reconfigurable Antenna Based on Liquid Metal

Authors: Qian-Yu Wang, Peng Qin, Chun-Wei Li, Zhong-Shan Deng

Presenter: Qian-Yu Wang, Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, China

Abstarct: In this study, a flexible and foldable frequency-reconfigurable antenna of liquid metal with cube structure is proposed. Based on the origami theory, the operating frequency of the antenna can be changed by folding the designed antenna to make it into a cube structure. The designed antenna does not have a rigid connection structure and has two modes: planer and folded modes. The re-flection coefficient of the antenna is 8.51-8.66 GHz (resonated at 8.59 GHz) and 12.54-12.83 GHz (resonated at 12.69 GHz) in the range below -10dB in the planer state and the 90° folded state, respectively. The antenna of this design has the characteristics of omnidirectional radiation, and the peak gain is 6.53 dBi. This work solves the problem of strain caused by traditional rigid materials and provides a liquid metal reconfigurable antenna that can be easily folded and used repeatedly.

NA40350

16:35-16:40

Title: Design of a "H" type defect ground coupled feed array antenna

Authors: Zhang Xiong, Liu Ling, He Dejun

Presenter: Zhang Xiong, Wuhan Maritime Communication Research Institute Wuhan, China

Abstratc: This paper proposed an high efficient 2×2 Design scheme of broadband array antenna, which adopted "Microstrip air dielectric" coupling feeding mode. The impedance characteristics of the antenna are improved by designing an orthogonal "H" type defect ground structure on the ground, and also, the circular polarization purity and efficiency of the antenna array are improved by using continuous rotation and network optimization techniques. It is designed, analyzed and simulated by electromagnetic simulation software, and the physical prototype is made and passed the engineering test. The measured results show that the antenna has good impedance characteristics. The bandwidth of the antenna with standing wave ratio less than 1.5 can reach to 27%, the bandwidth with axial ratio less than 3dB can reach to 21.2%, the gain bandwidth can reach to 25.1% The measured results are in good agreement with the simulation results. The antenna designed in this paper has been successfully applied to a communication system, which verifies the feasibility of the design scheme.

NA21013

16:40-16:45

Title: Delay Mismatches Analysis for Multi-level Outphasing Digital Transmitters

Authors: Zhang Chen, Zhihu Wei and Jiashun Zhu

Presenter: Zhang Chen, The sixty-third Institute, National University of Defense Technology, China

Abstratc: In this paper, we make the sensitivity analysis on the RF-PWM signal performance metrics with respect to the delay mismatches. First, the delay mismatches in the five-level outphasing digital transmitter architecture are modeled and sorted into three categories. Then, a closed-form expression of the total delay mismatches among random outphasing outputs is proposed, in terms of the outphasing RF-PWM principle and digital delay line characteristic. Finally, numerical simulations in MATLAB were used to analyze the EVM,

ACPR and harmonics elimination performances affected by delay mismatches in three different scenarios. We find the EVM and the third-harmonic are very sensitive to delay mismatches, while ACPRs even perform better. Besides, we make a brief discussion on the observed asymmetry and periodicity of the simulation results in all scenes.

NA30303

16:45-16:50

Title: An HC-DVR Model for Harmonic-Cancellation Digital Predistortion

Authors: Zunyan Liu, Zhang Chen, Chen Zhao
Presenter: Zunyan Liu, NanJing University of Information Science and Technology, China

Abstract: In this paper, a novel harmonic cancellation digital predistortion(DPD) model is introduced to solve the harmonic distortion problems of the shortwave power amplifier (PA) in the high-frequency(HF) transmitter. The proposed harmonic cance-llation-decomposition vector rotation (HC-DVR) model, derived from the decomposed vector rotation (DVR) model, significantly improves harmonic cancellation performance. Through simula-tion experiments, we compare the proposed HC-DVR model with the traditional Memoryless Polynomial (MP) model. The linearization and harmonic cancellation performance of the proposed HC-DVR model is significantly better, such that the third order and fifth order harmonics are 16.41 dB and 29.15 dB lower than MLP, respectively.

NA30317

16:50-16:55

Title: Design of Free-Space Optical Wavelength-Division Demultiplexers with A Phase-Only SLM

Authors: Yue Wu, Zaichen Zhang
Presenter: Yue Wu, Southeast University, China

Abstratc: In this paper, a free-space wavelength-division demultiplexer utilizing single hologram displayed on a phase-only liquid crystal spatial light modulator is designed. The method combines different independently calculated 2π-holograms of each wavelength into a multi-level hologram utilizing the extended phase range of the spatial light modulator. The algorithm has low complexity, and can be employed to generate holograms that guide laser at different wavelengths to corresponding target devices with high speed. In combination with tracking technology, this method can be future applied in free space optics (FSO) link with wavelength division multiplexed (WDM) scheme for solving crosstalk problem.

NA11106

16:55-17:00

Title: Research and System Implementation of Flexible Spectrum Allocation for Hybrid Satellite Network of Laser and Microwave Based on OFC

Authors: Bin Wu, Chaoyue Zheng, Qingchun Zhao
Presenter: Bin Wu, Northeastern University at Qinhuangdao, China

Abstartc; A flexible spectrum allocation scheme for the hybrid satellite network of laser and microwave is proposed, and a node structure of routing and spectrum allocation is designed based on optical frequency comb. A proof-of-concept experimental system is established and the test results indicate that the proposed system can realize spectrum shifting and flexible bandwidth allocation dynamically. The bit-error rate of recovered baseband data is less than 10-9 after the signals of the laser and microwave links pass through the node. The proposed scheme can solve the problem of low spectrum utilization due to dynamic services in satellite networks, and is significantly promising for the future hybrid networks of laser and microwave.

NA30270

17:00-17:05

Title: Multi-objective optimization satellite resource allocation algorithm based on game theory

Authors: Danyang Lv, Xiaoqin Song and Lei Lei
Presenter: DanYang Lv, Nanjing University of Aeronautics and Astronautics, China

Abstract: In order to improve the utilization of resources while improving the throughput of satellite system, a multi-objective optimization resource allocation algorithm based on game theory is proposed for the joint satellite-ground link network of multi-beam high and low orbit satellites. Considering the constraints of satellite maximum bandwidth and power, beam maximum bandwidth, and user minimum rate, a resource allocation model combining bandwidth and power is established based on multi-objective optimization. Based on the constructed system potential function and the mechanism of simulated annealing, the

distributed iterative algorithm is improved to realize the joint allocation of bandwidth and power. The simulation results show that the proposed algorithm has more advantages in throughput and resource utilization, and the resource allocation is more equitable.

NA11098

17:05-17:10

Title: Comparison of mobile AdHoc network routing protocols based on NS3

Authors: Zhe Wang, Jiao Zhang, Yichi Zhang, Haitao Zhao and Jibo Wei
Presenter: Wang Zhe, National University of Defense Technology, China

Abstract: Mobile Ad Hoc Networks (MANETs) operate without fixed infrastructures or a central access point. In MANET, the nodes are constantly moving at various speeds, resulting in unpredictable network topologies and path transmission. AODV, OLSR and BATMAN protocols are frequently used for route selection in MANET. In order to compare three routing protocols, three scenarios are created by changing the pause time, moving speed, and the number of nodes. Simulation results show that BATMAN, and OLSR perform well in networks with frequent changes in network topology, AODV has great advantages in fast mobile networks, and OLSR performs well in large-scale networks. Finally, according to the experimental results, the performance of the three protocols, such as packet delivery rate (PDR), end-to-end delay, and mean hops, is evaluated and analyzed.

NA30275

17:10-17:15

Title: On the Optimization of Synchronization Efficiency in Multi-hop Ad-hoc Networks

Authors: Yuhong Bao, Lei Lei, Xiaoqin Song, Lijuan Zhang
Presenter: Yuhong Bao, Nanjing University of Aeronautics and Astronautics, China

Abstract: Time synchronization is indispensable in Unmanned Aerial Vehicle (UAV) networks. The synchronization between nodes is realized through the exchange of packets. At present, there are few protocols that provide an effective solution to the packet conflict problem in synchronization. In this paper, a contention window optimized time synchronization protocol for efficient conflict avoidance is proposed. Considering the state transition of nodes in different conflicting situations, a three-dimensional Markov chain model is used to analyze the packet transmission contention phase. The relationship between the conflict probability, synchronization time and the value of the contention window size in the network is determined by the model. Simulation results show that the proposed scheme has significant advantages in synchronization efficiency compared with other protocols.

NA30210

17:15-17:20

Title: Analysis of Phase Compensation Accuracy of Bandwidth Synthesis for Multi-Carrier-Frequency MIMO Radar

Authors: Qinyuan Zhu, Guohua Wei, Jiahao Bai and Dongping Huang
Presenter: Qinyuan Zhu, Beijing Institute of Technology, China

Abstract: As the transmitted signals used in the multi-carrier-frequency MIMO radar are of frequency diversity, the narrowband transmitted signals can be synthesized to a wideband one. Based on the envelope bandwidth synthesis processing method of multi-carrier-frequency MIMO radar with sparse array, this paper proposes a phase compensation method based on the coarse guidance information of target, and further analyzes the influence of each error term on the bandwidth synthesis performance. The relational expressions of the range resolution and the target ranging error with the guidance information error are given. These results can provide a theoretical basis for determining the accuracy of target guidance information and the phase compensation accuracy required in the pre-processing of bandwidth synthesis. Finally, the simulation results verify the effectiveness of the proposed phase compensation method and the influence of phase compensation error on the bandwidth synthesis performance.

NA30319

17:20-17:25

Title: Atmospheric two-way time transfer over kilometers free-space link with dual optical frequency comb

Authors: Wantao Huang, Changfeng Chen and Dong Hou
Presenter: Wantao Huang, Kaili University, China

Abstract: We demonstrated an optical two-way time transfer in outdoor free-space link with dual optical frequency comb (OFC). With the transfer method, we have transferred pulse time signals over kilometer-level outdoor atmospheric link. In the time transfer experiment, the time drift and time deviation for 1 km and 20 km links are measured and emulated respectively. Within 5000 seconds, the experimental result shows that the total rootmean-square (RMS) time drift for 1-km link is about 2.2 ps, with the time deviation is 2 ps at 1-s averaging time and 0.32 ps above 100-s averaging time. The emulation estimates that the RMS time drift for 20-km link is about 232 ps, with the time deviation is 115 ps at 1-s averaging time and 36 ps above 100-s averaging time. The time deviation for the optical two-way time transfer is superior to the GPS-based time transfer method, which implies the technique proposed in this paper is able to be directly used in the highprecision time transfer over atmospheric link in a long distance.

SPECIAL SESSION 2

Topic: Geometric Signal Processing and Information Geometry
Time: 17:40-18:20, Nov. 12, Beijing Time, GMT+8
ZOOM Link: https://us06web.zoom.us/j/89327674351 Password: 111114

- **Session Chair: Assistant Professor Xiaoqiang Hua, National University of Defense Technology, China**

NA21068

17:40-17:55

Title: α-MF detection based on spatial correlation of sea clutter

Authors: Hongxin Wei, Lin Zheng, Chao Yang and Zhenghong Liu
Presenter: Hongxin Wei, Guilin University of Electronic Technology, China

Abstract: In the high sea state environment, the echo of small and slow ship targets is often submerged by sea clutter, and the conventional adaptive detection often has serious missed detection phenomenon. The adaptive detector is mainly based on the different statistical distribution of the sea clutter texture. However, the spatial correlation of sea clutter has not been attracted enough attention. Considering that the texture components of sea clutter are highly correlated in adjacent range cells, this paper proposes an adaptive detector based on the spatial correlation characteristics of sea clutter. The detector performs joint generalized likelihood ratio detection on the echo vector in the cell under test (CUT) and the echo vectors in the reference cells around the CUT. By adjusting the control parameters α, the detector matches the statistical characteristics of sea clutter amplitude in the CUT. The effectiveness of the proposed detector is verified by using the real sea clutter data. The experiments show that the proposed detector has a significant improvement in detection performance, which compares with the original α matched filter (α-MF) and matched filter (MF).

NA40408

17:55-18:10

Title: Information Geometry of the Locally Most Powerful Test

Authors: Yongqiang Cheng, Xiaoqiang Hua, Hao Wu and Hongqiang Wang
Presenter: Yongqiang Cheng, National University of Defense Technology, China

Abstract: The locally most powerful (LMP) test for weak signal detection is considered from a geometric viewpoint. In particular, it is identified as the norm of natural whitened gradient on the statistical manifold of a parameterized family of probability distributions, which indicates that the LMP test pursues the steepest learning directions from the null hypothesis to the empirical distribution of the observed data on the manifold. A concrete geometric interpretation of the LMP test in the theory of information geometry is presented, which leads to an immediate extension of the LMP test to a vector valued parameter case. Example of multi-component sinusoidal signal detection under low SNR conditions confirms a practical importance of the extended test.

NA40346 (Poster)

18:10-18:15

Title: Multi-Frame Detection via Matrix Information Geometry-Based Track-Before-Detect Algorithm

Authors: Hao Wu, Yongqiang Cheng, Zheng Yang, Xiaoqiang Hua, Hongqiang Wang and Xiang Li
Presenter: Hao Wu, National University of Defense Technology, China

Abstract: To address the performance degradation resulting from the power fluctuation of targets, the matrix information geometry-based track-before-detect algorithm for multi-frame detection is proposed. The proposed method combines the performance advantages of matrix information geometry (MIG) detector and the information accumulation ability of dynamic programming, which can improve the detection performance for fluctuating target. Specifically, the multi-frame target detection is formulated as an optimization problem on the Hermitian positive-definite (HPD) manifold, and the MIG-based dynamic programming is deduced to solve it. The experiments based on real-recorded sea clutter data show that the proposed method is effective.

NA40397
(Poster)

18:15-18:20

Title: Subband Matrix Information Geometry Detector in Heterogeneous Clutter

Authors: Zheng Yang, Yongqiang Cheng, Hao Wu, Xiaoqiang Hua, Xiang Li and Hongqiang Wang
Presenter: Zheng Yang, National University of Defense Technology, China

Abstract: Matrix information geometry (MIG) detector, which converts sample data to Hermitian positive definite (HPD) matrices located on HPD matrix manifold, provides an innovative scheme for target detection. In this paper, a subband MIG detector is proposed to detect target submerged into heterogeneous clutter background with short pulses. More precisely, subband filtering is firstly performed to suppress strong clutter by designing a discrete Fourier transform modulated filter bank. Then, a set of HPD matrices are modeled by the filtered data and a HPD matrix manifold is formed. In each subband, the detection from geometric consideration on the manifold is derived. Thus, a subband MIG detector is formulated and information divergence is utilized to measure the dissimilarity of the observed data and the clutter. Finally, numerical experiments based on simulated data and real sea clutter data show that the proposed method can achieve better detection performance compared with the traditional methods.

SESSION 14

Topic: Signal Acquisition and Generation Method
Time: 13:30-15:50, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/84231845366 Password: 111114

- **Session Chair: Dr. Jie Tian, China Academey of Engineering Physics, China**

NA55007

Invited Speech

13:30-13:55

Title: Reservoir computing-based signal processing technology

Invited Speaker: Assoc. Prof. Feng Wen, University of Electronic Science and Technology of China, China

Abstract: Based on the unique amplitude- and phase-mapping capability of nonlinear optical devices, we proposed the novel nonlinear-optics driven reservoir computing scheme, enabling dealing with the optical data distorted by the fiber dispersion, the Kerr nonlinearity and the mode-coupling induced crosstalk, which could improve the signal quality as well as the system capacity. According to our analysis, the Q factor of QPSK signals was improved by 10dB through using the proposed optical reservoir, and consequently extending the effective transmission reach by over 100%.

NA11095

Invited Speech

13:55-14:20

Title: A digital noise signal synthesis method based on a combination of table look-up and transformation

Invited Speaker: Assoc. Prof. Yindong Xiao, University of Electronic Science and Technology of China, China

Abstract: The digital noise signal synthesis method has good scalability and flexibility. The table lookup-based synthesis method stores the noise data that meets the specified distribution in memory by pre-calculation, maps the uniformly distributed random numbers to actual physical addresses as address inputs, and addresses the noise data to be output by the DAC. The transformation-based synthesis method uses the transformation formula to calculate the uniformly distributed random numbers in real time, and the result of the calculation is output by the DAC to generate the noise that matches the specified distribution. However, the hardware storage depth limits the accuracy of the noise distribution output by the look-up table method, and the real-time computation speed limits the output speed of the transformation method. In this paper, we propose a new method for digital noise signal synthesis, which solves the problem that the accuracy of the output distribution of the look-up table method depends on a large storage space and improves the accuracy of the output without adding additional storage space.

NA21053

14:20-14:35

Title: The Design of a Novel Hardware Trojan without inactive signal for AES

Authors: Kaiyu Zhao, Fang Zhou, Ning Wu, Jin Zhao and Fen Ge
Presenter: Kaiyu Zhao, Nanjing University of Aeronautics and Astronautics, China

Abstract: Research on hardware Trojans (HTs) has become one of the hot spots for IC industry. The hardware Trojans relying on rare switching signals may be detected by switch probability analysis detections. Therefore, when designing a stealthy hardware Trojan, adversary should consider how to defeat these Trojan detections. In this paper, we have implemented a hardware Trojan which don′t use or generate rare switching signals, to extract the key from an Advanced Encryption Standard (AES) circuit. To achieve this objective, we designed Trojan registers in trigger part and used product of sum scheme in payload part. The least active signal in the Trojan has a higher switch probability than 50.7% of the signals of the original AES circuit. Compared with counter and LFSR, the Trojan registers have better performance in eliminating rare switching signals.

NA11061

14:35-14:50

Title: Power Allocation and Beamforming Vectors Optimization in STAR-RIS Assisted SWIPT

Authors: Pengfei Zhao, Jiakuo Zuo, and Chenchi Wen
Presenter: Pengfei Zhao, Nanjing University of Posts and Telecommunications Nanjing, China

Abstract: This paper proposes a network of simultaneously transmitting and reflecting reconfigurable intelligent surface (STAR-RIS) assisted simultaneous wireless information and power transfer (SWIPT) system, where time switching (TS) protocol is applied. The objective is to maximize the sum rate of all information decoding receivers (IDRs) via jointly optimizing the power allocation of IDRs, beamforming vectors at the STAR-RIS while taking into account the power of the IDRs and the received energy of energy harvesting receivers (EHRs). To solve the formulated non-convex problem, we first convert the problem into a standard semidefinite programming (SDP) problem, and then solve it by applying Gaussian Randomization algorithm and successive convex approximation (SCA) algorithm. Simulation results prove that the two algorithms can improve the performance of STAR-RIS.

NA21032

14:50-15:05

Title: Waveguide Invariant for Time-Frequency Intensity Striations

Authors: Shuanglan Li and Weining Mao
Presenter: Shuanglan Li, Southeast University, China

Abstract: The Waveguide Invariant (WI) has been introduced to quantify the orientation of the intensity interference patterns in a range-frequency domain. However, this range-frequency waveguide invariant can not directly quantify the orientation of the time-frequency intensity interference patterns, which is obtained from acoustic signals generated by a moving broadband source. In this paper, the waveguide invariant of the time-frequency intensity striations is proposed, the essence of waveguide invariant for the time-frequency intensity striations is revealed, and the relation between the time-frequency waveguide invariant and the source motion characteristics is studied. It is shown that the essence of waveguide invariant for the time-frequency interference pattern is the relative change ratio of the propagation time delay between the two eigenrays generating the interference. The simulation results show that the derivation for time-frequency waveguide invariant is correct, and it can describe the time-frequency interference patterns of shallow and deep water environments.

NA30206

15:05-15:20

Title: Two Simulation Methods of J Wave Signal in ECG

Authors: Xingrui Wang, Lei Sun, Anhao Wen, Yucong Leng, Xiang Lu
Presenter: Xingrui Wang, Shandong University of Science and Technology, China

Abstract: The appearance of J waves in electrocardiogram (ECG) may cause malignant arrhythmia, ventricular tachycardia and other diseases, and even bring the risk of sudden death. However, the data on J waves in the current public databases are sparse, and the hospital lacks relevant data due to the urgency of pathological J waves. To address the lack of J wave data, two methods for simulating J wave signal are proposed in this paper. First, by studying the parameter information of the ECG signal, the J wave signal is generated by the superposition of sine wave, triangle wave and sawtooth wave; Second, the inflection point position of the normal ECG signal in the public database is determined by the local transformation method, and the J waves are added to form the J wave signal. The simulation results show that both methods can realize the free adjustment of the occurrence time, duration and amplitude of J waves, which can simulate various common J wave signals. The simulated J wave signals are trained by the UNet++ model and the feasibility of the simulation method is verified, which is helpful to promote the detection of J wave by portable devices.

NA40381

15:20-15:35

Title: Recognition method of underwater acoustic bionic communication signal based on autocorrelation function

Authors: Xingyu Xiao, Bin Wang, Jian Zhang and Yuting Meng
Presenter: Xingyu Xiao, Strategic Support Force Information Engineering University, China

Abstract: Focusing on the problem of underwater acoustic bionic communication signal recognition, a recognition method based on autocorrelation function is proposed in this paper,

which takes the bionic communication signal simulated by animal whistle combined with chirp signal as the research object. This method considers the periodicity of symbol width and the strong correlation of chirp signal. Firstly, the received signal is shifted by segment spectrum at the receiving end, and then the autocorrelation function is calculated. Finally, by observing whether the autocorrelation function has periodic line spectrum characteristics, the recognition of chirp whistle-like communication signal is realized. The feasibility of the recognition method is verified by both simulation experiment and lake experiment. In the simulation experiment, the accuracy of this recognition method can reach 90% under the condition of 3dB signal-to-noise ratio.

NA21074

15:35-15:50

Title: Cooperative Caching and Beamforming for CoMP-enabled Mobile Edge Networks

Authors: Baoyi Cheng, Xiaoyan Huang, Ke Zhang, Fan Wu, Supeng Leng
Presenter: Baoyi Cheng, University of Electronic Science and Technology of China, China

Abstract: Mobile edge caching and coordinated multi-point (CoMP) joint transmission (JT) techniques are expected to further reduce content delivery delay. In this paper, we study the joint optimization of content caching, user association and beamforming coordination in CoMP-enabled mobile edge networks, aiming to minimize the weighted sum of content delivery delay. Based on double time-scale scheduling model, we formulate the joint optimization problem as a Markov decision process (MDP), and develop a deep reinforcement learning (DRL) based joint cooperative caching and beamforming coordination (JCCBC) algorithm. With the double time-scale scheduling method, decisions are made at different time-scale respectively. In the proposed JCCBC algorithm, decisions on user association and beamforming coordination are optimized in small time scale based on the time-varying available radio resources of different base stations (BSs), so as to minimize the transmission delay. Meanwhile, cooperative caching decisions are optimized in large time scale to reduce the retrieval delay according to user requests and wireless communication environment. Simulation results demonstrate that the proposed JCCBC algorithm can effectively reduce the content delivery delay, as compared to benchmark schemes.

SPECIAL SESSION 3

Topic: Recent Advancement in Radar and Sonar Signal Processing
Time: 13:30-16:10, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/81069396768 Password: 111114

- **Session Chair: Assoc. Prof. Xuebo Zhang, Northwest Normal University, China**

NA40403

13:30-13:45

Title: Radar Waveform Design Based on Time-Bandwidth Random Modulation LFM Signals

Authors: Zejia Tang, Qinglong Bao, Jiameng Pan, Huahua Dai, Weidong Jiang
Presenter: Zejia Tang, National University of Defense Technology, China

Abstract: In this paper, a low probability of intercepting radar waveform design method is proposed. The time-frequency image of the designed radar waveform is agile and random. Its time-frequency image is more complex than a chirp. This paper first determines the number of sub-pulses in a single pulse. Then find random points on the time-frequency plane of unit time and unit bandwidth. Finally, the randomly generated multi-component LFM signal is searched, and the waveform that meets the constraints, such as peak sidelobe level and main lobe width, is selected. Simulation results show that the peak sidelobe level of the waveform designed in this paper can reach as low as -23.44 dB, which is lower than the traditional chirp signal (-13.86 dB). The price is that the waveforms generated in this paper have a certain main lobe broadening compared to the traditional LFM. The simulation and analysis results show that the waveform designed in this paper is an effective low probability of intercepting radar waveform.

NA30217

13:45-14:00

Title: Identification of Active Jamming Based on Swin Transformer Model and Splitting Features

Authors: ZiJun Hu,Xinliang Chen,Zhennan Liang,Bowen Cai
Presenter: Zijun Hu,Beijing Institute of Technology Beijing,China

Abstract: With the continuous development of Digital Radio Frequency Memory (DRFM) technology, radar working condition is seriously threatened by various activate jamming, echo of true target will be mixed or covered by jamming. In this condition, splitting features extracted by modulating splitting code into the process of pulse compression present greatly difference between true target and jamming, and then this paper proposes a jamming identification method based on splitting feature and Swin Transformer (shifted window Transformer) neural network which can effectively distinguish the typical jamming, achieve classification task, and improve detection performance and recognition accuracy. Finally, the verification result of measured data shows that true target and jamming can be recognized perfectly.

NA30291

14:00-14:15

Title: Estimation of the Number of Signals in White Noise via Large-Sample and High-Dimensional Asymptotic Theory

Authors: Yao Rong, Lewen Zhang, Mengjiao Tang, and Zeqiong Zan
Presenter: Lewen Zhang, Yunnan University, China

Abstract: This paper focuses on estimating the number of source signals embedded in Gaussian white noise. We address this problem via a sequence of nested hypothesis tests, and construct variance statistics based on eigenvalues of the sample covariance for each candidate hypothesis. Then, a detailed statistical analysis of these statistics is carried out in both the large-sample and high-dimensional regimes. According to this analysis, we propose a new scheme for determining the number of source signals in both the sample-rich and sample-starved cases. Finally, numerical examples are presented to show its superiority compared to some existing estimation methods.

NA40393

14:15-14:30

Title: Research on the Imaging Method of Long-distance High-speed Targets in the Earth-Moon Space

Authors: Xue Ruyin, Yu Danru, Li Jichuan, and Zhao Chen
Presenter: Xue Ruyin, Bejing Institute of Remote Sensing Equipment, China

Abstract: Accurate monitoring and imaging of long-distance and high-speed moving targets by space platform is a long-term technical difficulty. In this paper, we analyzed and summarized classical radar imaging methods of long-range and high speed moving space targets according to the relative motion characteristics of earth-moon space target in the process of overflying, which contained Range Doppler Algorithm, w-K Algorithm, Chirp Scaling Algorithm, Back Projection Algorithm, Polar Formation Algorithm and the STFT based imaging method. We simulated the effects of range, velocity and multi-target on these imaging algorithms and compared the imaging resolution and running time of each algorithm. Simulation results were presented in the paper which confirmed that the combination of Range Doppler Algorithm of ISAR and SAR algorithms could achieve the imaging effect with stable amplitude and better resolution when the space platform imaged long-range and high-speed space targets.

NA30242

14:30-14:45

Title: Quartic Optimization for Ambiguity Function Shaping via RTR Algorithm under ADPM Framework

Authors: Haoyu Yi, Weidong Jiang, Xinyu Zhang, Kai Huo
Presenter: Haoyu Yi, National University of Defense Technology, China

Abstract: The construction of an efficient framework to synthesize the required ambiguity functions (AF) is essential for cognitive radar (CR) to improve its ability to adapt to its environment. It is equivalent to minimizing the expectation of the slow-time ambiguity function (STAF) over the range-Doppler bins. This is to optimize a non-convex quartic function with the constant modulus constraint (CMC). In this paper, we developed the Riemannian trust region (RTR) algorithm under the alternating direction penalty method (ADPM) framework to deal with this problem. Utilizing the ADPM framework, we split the original problem into two sub-problems for iteration. In the first sub-problem, we derived the closed-form solution directly, then proposed the RTR algorithm in the second sub-problem. Simulation results show that our proposed algorithm outperforms other state-of-the-art algorithms with a higher signal-to-interference ratio (SIR) value.

NA30216

14:45-15:00

Title: Digital Compensation Technique for Wideband Phased Array Radar using Nonlinear Frequency Modulation

Authors: Gang Wang, Jie Wu, Yuxian Sun, Lixiang Ren, Quanhua Liu, Zhennan Liang
Presenter: Gang Wang,Beijing Institute of Technology,China

Abstract: This paper proposes a new digital compensation method for wideband phased array radar using nonlinear frequency modulated signal, which not only reduces the sampling rate of the echo but also obtains the low sidelobe without tapering and high-resolution range profile of the target. At the same time, the time delay differences caused by different array element positions are compensated. Computational results demonstrate both the compensation accuracy and the time-sampling efficiency of the proposed method.

NA30293

15:00-15:15

Title: Adaptive CFAR Detectors for Colocated MIMO Radar in Compound Gaussian Clutter

Authors: Mengjiao Tang, Yao Rong, Sanfeng Hu, Xiaolin Du and Jianbo Li
Presenter: Yao Rong, Yunnan University, China

Abstract: This paper studies adaptive target detection in compound-Gaussian clutter for a colocated multi-input multi-output (MIMO) radar. A new one-step generalized likelihood ratio test (GLRT) is devised with all the involved unknown parameters estimated iteratively. Besides, a minor revision is made to the already existing two-step GLRT for this problem. Numerical examples show that both the two detectors are effective. For the considered simulation setup, the newly proposed detector can achieve higher detection rates than the revised one and competitors designed in Gaussian clutter scenarios.

NA30294

15:15-15:30

Title: Near-field imaging algorithm of MIMO radar with the aid of reference points

Authors: Yu Lan, Danyang Liu, Jianxiong Zhou, Ruidong Wang
Presenter: Yu Lan, National University of Defense Technology, China

Abstract: In the near field of multiple-input multiple-output (MIMO) array, the spatial phase that targets relative to MIMO array does not satisfy a linear relationship, so imaging algorithm based on fast Fourier transform (FFT) can result in high side lobes in the directional diagram. In this paper, a near-field imaging algorithm with the aid of reference points is proposed to solve this problem, and the principle of the algorithm and its applicable extent are given. Within the applicable extent, the spatial phase can be regarded to be linear approximately. A single reference point is suitable for near-field imaging in interested local area. For the need of global near-field imaging, a selection method of multiple reference points and the imaging steps are given. Simulated and measured show that this algorithm is able to suppress the high side lobes, and global near-field imaging can be achieved through a reasonable choice of reference points.

NA40413

15:30-15:45

Title: DOA Estimation with Few Snapshots Based on Iterative Adaptive Approach and Eigenvalue Decomposition

Authors: Junjie Weng, Jun Liu and Siyu Sun
Presenter: Junjie Weng, University of Science and Technology of China, China

Abstract: Direction of arrival (DOA) estimation is one of the goals of array signal processing. In this paper, we propose a new approach for DOA estimation in the scenario with only few snapshots. The DOA estimation can be considered as a sparse parameter estimation problem. In order to reduce the influence of a small number of snapshots, we calculate the covariance matrix by iterative adaptive approach (IAA). Based on the orthogonality between signal subspace and noise subspace, the eigenvalue decomposition is performed on the covariance matrix. After constructing a spectral function, the DOA of each source can be estimated from the peaks of the function. An important advantage is that, the proposed method does not need any hyperparameter. The results of numerical simulations demonstrate that the proposed method has very low and stable sidelobes, and it also obtains more accurate estimation and higher resolution than several classical algorithms.

NA40437

15:45-16:00

Title: Top-Down Detection for SAR Regular Minefield based on Faster R-CNN and CFAR

Authors: Zhang Yansong, Jin Tian, Wang Yuming
Presenter: Zhang Yansong, National University of Defense Technology, China

Abstract: The traditional minefield detection methods are based on detection of single mines, whose performance is dependent on the results of single mines. However, the minefield environment is complex and the background clutter changes greatly, which induces a lot of false alarms and missed mines. To improve the detection performance, this work proposes a top-down detection method for SAR regular minefield based on Faster R-CNN and CFAR. The candidate minefields as a whole are first detected by Faster R-CNN. Then, CFAR is applied to detect the single mines in the minefields. This top-down detection method can avoid the meaningless searching of single mines in strong clutter area. Furthermore, the distribution law of the minefield is utilized to refine the detection of single mines. As a result, the performance is improved. Measured data of the AMUSAR system validates the effectiveness of the proposed method.

NA40362 (Poster)

16:00-16:05

Title: Stationary and Small Target Detection for Millimeter-Wave Radar

Authors: Ren Shengjun, Han Siyang and Wang Baoshuai
Presenter: Wang Baoshuai, Science and Technology on Electronic Information Control Laboratory, China

Abstract: Using millimeter-wave radar to scan and detect stationary and small foreign object debris (FOD) on an airport runway surface is a popular solution in civil aviation safety. In this paper, we proposed a novel FOD detection method based on pattern classification theory using bi-spectral features. Firstly, a non-parameter weighted generalized matched filtering (WGMF) is utilized to accomplish clutter suppression with low false alarm rate. Then low

dimensional bi-spectral features are extracted from radar returns which are utilized to form the feature vector. Finally, support vector data description (SVDD) is used to accomplish FOD detection. Real airport data measured by 77GHz radar are used to validate the proposed method. Experimental results using a golf ball with a diameter of 43mm show that the proposed method can effectively detect the target with low false alarm rate.

NA30311 (Poster)

16:05-16:10

Title: An Efficient Alignment Method for Scanning Data of 77GHz mmWave Imaging Radar

Authors: Tongkai Xu, Chunling Hao, Qingshui Guo, Kun Yin, Tang Hu and Lijie Yang
Presenter: Tongkai Xu, Zhejiang Lab, China

Abstract: Millimeter-wave (mmWave) imaging is becoming more necessary in security inspection as it penetrates fabrics, leathers, and other materials and is harmless at appropriate power levels. Currently, better restoration of the original scene from the radar echoes with interference is prime attention of researchers. However, with the short wavelength of mmWave, a slight positional bias can dramatically affect the focusing performance of imaging. Notably, mechanical scanning generally obtains a large virtual aperture in near-field mmWave high-resolution imaging applications. However, the mismatch bias between automated scanning and radar parameters accumulates and aggravates the image defocus. This paper studies the scanning bias of the 77 GHz mmWave imaging system based on the 3DRIED dataset, analyze the mismatch bias in both the beginning moment and velocity, and gives the corresponding model. Meanwhile, referring to the range alignment method of ISAR, this paper presents a scanning data alignment algorithm only using MISO radar echoes. The algorithm calculates the relative bias of two adjacent scanning by comparing the data of horizontal scanning to get the spatial distribution of all sampling points. By comparing the results before and after data alignment, the algorithm shows that as a pre-processing method, it can effectively improve the focusing performance of the high-resolution scene reconstruction.

SESSION 15

Topic: UAV Cooperative Communication and System
Time: 13:30-16:15, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/81673586285 Password: 111114

- **Session Chairs:**
  Prof. Yonghua Li, Beijing University of Posts and Telecommunications, China
  Prof. Chong Shen, Hainan University, China

NA30243

Invited Speech

13:30-13:55

Title: A DNN Operation Scheme Based on IPSO for UAV-Assisted MEC Networks

Invited Speaker: Dr. Wei Yang, Beijing University of Posts and Telecommunications, China

Abstract: Applications' demands on computing resources have increased in recent years. One potential option is to offload tasks with high computational demands to edge servers. Therefore, Mobile Edge Computing (MEC) deployed on Unmanned Aerial Vehicles (UAVs) emerges as the need arises to offer task offloading for ground User Devices (UDs). However, due to the changing environment, how to offer quick decision-making solutions is still a popular research topic. In this paper, we provide a Deep Neural Network (DNN) operation scheme based on Improved Particle Swarm Optimization (IPSO), which combines a conventional heuristic approach with neural networks to give an effective operation scheme. We take into account the requirement to decrease latency and conserve energy while maintaining equity in offloading, which is formulated as a Mixed Integer Non-Linear Programming (MINLP) issue. We first use the IPSO approach to generate labeled data and then train the neural network. The well-trained neural network is utilized to generate quick decisions. Finally, simulation results reveal our scheme's advantage in terms of fast environment adaptation.

NA11055

Invited Speech

13:55-14:20

Title: Joint Computing Offloading and Trajectory for Multi-UAV Enabled MEC Systems

Invited Speaker: Professor Tiankui Zhang, Beijing University of Posts and Telecommunications, China

Abstract: The cooperation of multiple unmanned aerial vehicles (UAVs) is investigated to provide auxiliary computing services for ground users. First, the system cost is defined considering the energy consumption of the UAV, the energy consumption of the user, and the delay of the user at the same time. Take into account the dynamic allocation of bandwidth by the user and the dynamic allocation of computational resources by the UAV, the flight trajectory of UAVs, the offloading object and the offloading ratio of users are jointly optimized to minimize the system cost. Due to the dynamic and long-term feature of the problem, it is described as a Markov decision process. A joint computing offloading and trajectory algorithm is proposed based on the PPO in deep reinforcement learning. Simulation results show the convergence of the proposed algorithm. The proposed algorithm has superior performance compared with the benchmark algorithms.

NA55008

Invited Speech

14:20-14:45

Title: A Homotopy Theory based Spectrum Prediction Approach for UAV Communications

Invited Speaker: Assoc. Prof. Shan Luo, University of Electronic Science and Technology of China, China

Abstract: As unmanned aerial vehicles (UAVs) have been widely employed, the spectrum resource for UAV communication becomes scarce. The UAVs may communicate based on spectrum sharing, requiring efficient spectrum prediction to improve the performance of spectrum sensing. However, since the existing prediction methods are generally designed to predict the spectrum states in the next moment at the current location, they can not be directly applied to UAVs which rapidly move to the next location when obtaining the prediction result. In another word, the UAVs require to predict the spectrum in the next moment at the next location. This is a method which can predict spectrum in the joint temporal and spatial

dimensions. The main challenge is the historical data of the next location is usually not possible to be obtained in advance by the UAVs. This presentation introduces a new prediction approach which firstly estimates the historical data of the next location based on the homotopy theory (HT), and then performs the prediction based on the hidden Markov model (HMM), referring to the HT-HMM based prediction. Experimental results show that the HT-HMM based approach is able to efficiently predict the spectrum states of the next location.

NA40438

14:45-15:00

Title: Content Popularity Prediction with Integrated Features in UAV-Assisted Wireless Caching Networks

Authors: Kaibo Shi, Bo Li, Yonghao Wang, Bo Ran, Peng Kong, Xiao Huang, Dong Ma and Fei Liang
Presenter: Kaibo Shi, Ningxia University, China

Abstract: Mobile content service has been experiencing an explosive traffic growth in radio access networks. Due to the frequent downloads of popular content requested by multiple mobile users, most of the data traffic is caused by repetitive data transfers. Proactive content caching is an effective way to reduce the burden of backhaul link traffic and to improve the user experience. Content popularity is an important factor which influences active caching. However, content popularity is often unknown in advance. Therefore, predicting content popularity is an important challenge for content caching. It is studied that the problem of cache content popularity prediction in a unmanned aerial vehicle(UAV) assisted wireless cache network(UA-WCN) which includes a base station(BS) and multiple UAVs. A model framework and strategy for content popularity prediction based on the comprehensive characteristics of users and content are proposed to solve the popularity prediction problem. Firstly, user preference learning is applied based on considering that users prefer request the contentsthey are interested in. The users is classified by using some of the physiological characteristics of the user. Then, the weight of the user's preference for the content is learned by using Follow The Regularized Leader(FTRL) algorithm. Finally, the gradient descent algorithm is used to learn the local model parameters. The feasibility of the model is verified by the simulation results. And the proposed popularity prediction strategy can not only accurately predict the popularity of content, but also greatly reduce the computational complexity.

NA30226

15:00-15:15

Title: Cooperative Multi-UAV Dynamic Anti-Jamming Scheme with Deep Reinforcement Learning

Authors: Ruidong Wang, Shilian Wang, Wei Zhang
Presenter: Ruidong Wang, National University of Defense Technology, China

Abstract: Key challenges for manned/unmanned aerial vehicles(MAV/UAV) cooperative operation with distributed command and control (C2) structure network face are the assignment of spectrum and the resilience against interference. In response, we propose a cooperative multi-UAV dynamic anti-jamming (CMDA) approach that, in contrast to previous work, can adapt to scenario with fast channel variations due to malicious sweep jamming in highly dynamic environment. In this work, the multi-UAV anti-jamming problem is translated into a decentralized partially observable Markov decision process (Dec-POMDP), which is solved through multi-agent reinforcement learning (MARL) method. Specifically, every autonomous UAV acts based on different partial observations about the environment and updates local Q-network according to the common reward individually. The objective is to maximize the global reward and approximate the optimal power control and spectrum allocation policy without prior knowledge of the time-varying wireless channel state in jamming environments. Finally, the simulation results demonstrate that proposed scheme provides lower average packet loss rate (PLR) and better jamming resistance than previous approaches.

NA40378

15:15-15:30

Title: A Task-based Location Deployment Method for UAV-Enabled Multi-Region Network

Authors: Bo Hu, Renpeng Liu, Lingye Zhou
Presenter: Bo Hu, Beijing University of Posts and Telecommunications, China

Abstract: Due to the high mobility, flexible deployment, and adaptive altitude, unmanned aerial vehicles (UAVs) have been widely used as aerial base station (BS) to provide wireless connections in military and civilian. In this paper, we develop a wireless communication network model, where one UAV serves as the aerial BS, flying to the target region and then hovering to provide communication services for the ground terminals. Considering the onboard energy of the UAV is limited, we jointly optimize UAV Location deployment and bandwidth allocation to minimize the energy consumption with guaranteeing the minimum communication throughput. However, the formulated optimization problem is a mix-integer and non-convex optimization problem, we propose an efficient algorithm to find a suboptimal solution by applying the block coordinate descent (BCD) and successive convex approximation (SCA) methods. Specifically, UAV location deployment and bandwidth allocation are optimized alternately in each iteration, and the convergence of the algorithm is proven. Simulation results show that the proposed joint location deployment and bandwidth allocation algorithm can achieve better energy consumption performance than the benchmarks.

NA00025

15:30-15:45

Title: BETA-UAV: Blockchain-based Efficient and Trusted Authentication for UAV Communication

Authors: Sana Hafeez, Mahmoud A. Shawky, Mohammad Al-Quraan, Lina Mohjazi, Muhammad Ali Imran and Yao Sun
Presenter: Sana Hafeez, University of Glasgow, UK

Abstract: Unmanned aerial vehicles (UAV), an emerging architecture that embodies flying ad-hoc networks, face critical privacy and security challenges, mainly when engaged in data-sensitive missions. Therefore, message authentication is a crucial security feature for drone communication. This paper presents a Blockchain-based Efficient, and Trusted Authentication scheme for UAV communication BETA-UAV, which exploits the inherent properties of blockchain technology concerning memorability and immutable to record communication sessions via transaction using a smart contract. The smart contract in BETA-UAV allows participants to publish and call transactions from the blockchain network. Furthermore, the transaction addresses are proof of freshness and trustworthiness for subsequent transmissions. Furthermore, we investigate the ability to resist active attacks, e.g., impersonation, replaying, and modification. In addition, we evaluate the gas costs associated with the smart contract's functions by implementing BETA-UAV on the Ethereum public blockchain. Comparing computation and communication overheads shows that the proposed approach can save significant costs over traditional techniques.

NA40422

15:45-16:00

Title: Multi-UAV Cooperative Computational Latency Modeling and DDPG Optimization

Authors: Peng Kong, Bo Li, Yonghao Wang, Xiao Huang, Kaibo Shi, Dong Ma, Bo Ran, Jitao Huang
Presenter: Peng Kong, Ningxia University, China

Abstract: With the development of future mobile communication, how to provide better quality of service for latency-sensitive services by mobile edge computing (MEC) in unmanned aerial vehicle (UAV) is a hot issue. Therefore, this paper considers the cooperation of multi-UAV to establish a mobile edge computing network and proposes an optimized delay scheme under the cooperative computing of multi-UAV. In this network, two main works are done. The first work is to model the computational delay of the tasks after the block. The second work is to optimize the computational delay through the deep deterministic policy gradient (DDPG) algorithm. Finally, the simulation results showcase that the proposed scheme has high reliability from the reward function. When subtasks are transmitted and computed, optimal allocate bandwidth and computing resources can be obtained by minimizing the computing delay in the proposed scheme.

NA30234

16:00-16:15

Title: Energy-efficient Cooperative Multi-UAV Coverage Scheme with Limited Wireless Backhaul

Authors: Wei Chen, Wenjun Xu, Lan Lin and Chunlei Huang
Presenter: Wei Chen, Beijing University of Posts and Telecommunications, China

Abstract: In this paper, we consider a scenario where multiple unmanned aerial vehicles (UAVs) cooperatively provide ubiquitous wireless coverage to the ground user equipments (UEs). The UAV-enabled cloud radio access network (CRAN) is adopted to enhance the coverage performance. The UAVs serve as remote radio heads (RRHs) to receive the signals from ground UEs, then compress and forward them to the ground central processor (CP). We aim to minimize the average transmit power of the ground UEs by jointly optimizing the multi-UAV placements, coverage areas, and the backhaul bandwidth allocation. Due to the soft coverage nature and the limited backhaul constraint, the traditional cell-division-based UAV deployment algorithms, such as the Lloyd-type algorithm, cannot be directly applied to the considered problem. To cope with it, we propose an efficient algorithm named overlap Lloyd algorithm. The simulation results show that the proposed cooperative multi-UAV coverage scheme outperforms the cell-division-based scheme with at least 20% performance gain.

SPECIAL SESSION 1

Topic: Electromagnetics Modeling, Simulation, Optimization and Experiment
Time: 13:30-16:40, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/89549029505 Password: 111114

- **Session Chair: Prof. Shaolin Liao, Sun Yat-sen University, China**

NA21018

Invited Speech

13:30-13:55

Title: Atom-based microwave sensing over 60 dB dynamic range

Invited Speaker: Assoc. Prof. Dong Hou, University of Electronic Science and Technology of China, China

Abstract: Detection of microwave (MW) field with high accuracy is an important problem in the physical science and engineering area. In this work, we reported an atomic Rabi resonance-based MW magnetic field sensor and demonstrated its capability to continuously detect X-band MW magnetic field over a high dynamic power range of > 60 dB. The MW power frequency shift was carefully evaluated and canceled in order to support more sensitive filed measurement. A weak 9.2 GHz MW magnetic field lower than 10 nT was successful extracted from Rabi resonance line on the cesium clock transition. MW field and power detection capabilities of the presented method can be extended to cover a higher dynamic range and a wider frequency band by applying stronger excitation and exploring non-clock atomic transition. Our work enables potential applications including SI-traceable MW calibration and atomic communication.

NA31091

13:55-14:10

Title: Electromagnetic Analysis in PINMAP Assignment Optimization Based on T-matrix Method

Authors: Ruifeng Xu, Ruifeng Li, Da Li and Er-Ping Li
Presenter: Ruifeng Xu, Zhejiang University, China

Abstract: In this paper, the pin map scenario is modeled as a parallel-plate structure for electromagnetic leakage analysis by approximating the solder balls as cylinders. The boundary field and internal field distribution under multiple radiation coupling sources with different amplitudes and phases are analyzed by the T-matrix method based on virtual PMC cylinders. Simulations show that the calculation results are accurate and much faster than those obtained by the commercial software.

NA30313

14:10-14:25

Title: A Novel Metasurface-Based Decoupler for Wideband Stacked Patch Antenna Array

Authors: Wenlu Qiu, Jinxin Li, Pei Xiao and Shaolin Liao
Presenter: Wenlu Qiu, Hunan University, China

Abstract: In this paper, a novel metasurface-based decoupler is proposed to reduce mutual coupling of a wideband stacked patch array antenna. The metasurface-based decoupler consists of a metasurface made of periodic square rings and a dielectric rod array made of transparent resin. The whole structure is able to reject propagation of space coupling wave, realize wideband decoupling and partly change the coupling mode. Different from previously reported some metasurface decoupling solutions, the proposed method does not deteriorate matching condition and no need to rematch. Besides, by using dielectric rod array to complement insufficient isolation enhancement of metasurface, the metasurface-based decoupler shows a wider decoupling bandwidth compared with conventional metasurface decoupling solutions.

NA40331

14:25-14:40

Title: Power Transport Theorem (PTT)-Based Decoupling Mode Theory (DMT) for Wave-Port-Fed Transmitting Antennas

Authors: Ren-Zun Lian and Long Li
Presenter: Ren-Zun Lian, Xidian University, China

Abstract: Using the work-energy theorem based physical interpretation for characteristic mode theories (CMTs), it is exposed that: strictly speaking, the existing CMTs are the modal analysis theories for the externally-incident-field-illuminated scattering objects and the lumped-port-driven electromagnetic structures, but not for the wave-port-fed transmitting antennas, so they cannot provide an exact modal analysis to the wave-port-fed antennas. This paper will propose an effective modal analysis theory for the wave-port-fed antennas. Power transport theorem (PTT), which governs the transport process of the power-flow passing through the wave-port-fed antenna, is derived. It is found that the input power term contained in the PTT is the source to sustain the steady power transport. Under the PTT framework, a novel modal analysis theory—decoupling mode theory (DMT)—is proposed for the antenna. By diagonalizing the input power operator (IPO), the PTT-based DMT can construct a set of energy-decoupled modes (DMs) for the antenna. The DMs-based modal expansion satisfies the Parseval's theorem, and the Parseval's theorem implies that: for any mode, its time-domain, frequency-domain, and spectrum-domain energies are the same. A novel concept of "electric-magnetic energy-decoupling factor" is introduced for quantifying the decoupling degree between the modal electric and magnetic fields. A field-based definition for the modal input impedance and admittance is proposed as an alternative for the conventional circuit-based definition.

NA21060

14:40-14:55

Title: A New Method for Power-Aware Signal Integrity Analysis With Spice Model of Power Distribution Network

Authors: Hao Huang, Zhi Ye, Yang Liu and Shixiang An
Presenter: Hao Huang, Zhejiang University, China

Abstract: For high-speed digital circuit design, signal integrity(SI) and power integrity(PI) issues have gradually become two non-ignorable factors. Independent SI analysis and PI analysis have produced abundant research results, but the problems caused by them simultaneously, such as the simulation of synchronous switching noise(SSN), are still an urgent problem to be solved. In order to solve the SSN problem as much as possible in the simulation analysis stage, an accurate and general SI-PI co-simulation analysis method is necessary. In this paper, a novel SI-PI simulation analysis method using the spice model of power distribution network(PDN) is proposed. This method can be applied to almost all Printed Circuit Board(PCB) simulation analysis with certain accuracy. In order to verify the reliability of this method, we conduct a comparative experiment on an LPDDR4 system and fit the actual test results. Furthermore, an optimized example of a PDN is presented to illustrate the effectiveness of this approach.

NA30316

14:55-15:10

Title: Numerical Singular Integral Methods for Computational Electromagnetics

Authors: Kuang Luo, Lu Ou, Chuangfeng Zhang, Ming Zhang, Jinxin Li and Shaolin Liao
Presenter: Kuang Luo, Sun Yat-sen University, China

Abstract: Efficient Numerical Singular Integral (NSI) methods have been developed for both 1D and 2D electromagnetics problems, in both the Cartesian and polar coordinates. Through a special type of integration by parts, rigorous mathematics derivation has been performed to decompose the original singular integrals into sum of nonsingular integrals that can be evaluated numerically. It can be shown that it is more convenient to evaluate the linetype singularity in the Cartesian coordinate; while it is better to evaluate the point-type singularity in the polar coordinate. Also, numerical schemes to find the order of singularity has been presented. Finally, to validate the 2D numerical singular integral methods, the electromagnetic scattering problem of a 2D reflecting ellipse antenna has been simulated through the Ping-Pong algorithm developed by the authors.

NA30237

15:10-15:25

Title: Analysis of Influence of Noise Interference on Frequency Measurement Results of IFM Receiver

Authors: Chao Li, Bo Peng and Ji-Kang Sun
Presenter: Chao Li, Jiangsu Automation Research Institute, China

Abstract: With the rapid development of electronic information technology, the electromagnetic environment of modern battlefield is becoming more and more complex. Due to the characteristics of high sensitivity and wide frequency band reception, the IFM receiver

can easily detect the interference noise while detecting the target signal. However, due to the poor ability of the IFM receiver to process simultaneous arrival signals, when the receiver receives both the interference noise and the target signal at the same time, the interference noise will definitely have a serious impact on the frequency measurement results. Aiming at this problem, this paper quantitatively analyzes the influence of noise interference on the frequency measurement results of the IFM receiver. The simulation results show that the RMSE of the frequency measurement of the IFM receiver increases with the frequency difference between the interfering noise and the target signal. Moreover, the larger the jamming to signal ratio at the input end of the IFM receiver, the larger the RMSE of the frequency measurement.

NA21085

15:25-15:40

Title: Radio Wave Propagation Modeling Based on Convolutional Neural Networks

Authors: Shiqi Wang, Siyi Huang, and Xingqi Zhang
Presenter: Xingqi Zhang, University College Dublin, Ireland

Abstract: The vector parabolic equation (VPE) method is a promising tool for high-fidelity radio wave propagation modeling in large-scale guiding structures such as tunnels. However, simulation with VPE for a large distance still requires computing resources that can be practically prohibitive. This paper presents a convolutional neural network (CNN) based model that uses VPE simulations with low computing costs to provide high-fidelity received signal strength (RSS) prediction. The performance of three CNN models (i.e., basic CNN, sub-pixel CNN, and residual network) with different architectures and different upscaling methods is compared. Their accuracy and efficiency are tested in various tunnel cases.

NA40342

15:40-15:55

Title: Adaptive response surface method for antenna gain optimization of large platforms

Authors: Zhengguang Yang, Jinlong Jiao, Lang Han, Cuidong Gao and Zhijia Liu
Presenter: Zhengguang Yang, DFH SATELLITE CO. LTD, China

Abstract: The electromagnetic engineering analysis and design problem of large-scale platform is highly complex. In order to get rid of the state of analysis and design only by experience, an efficient and intelligent algorithm with good convergence is needed. Firstly, the characteristics of several intelligent algorithms are analyzed, and the adaptive response surface method is selected as the optimization algorithm. The adaptive response surface method is used to optimize the gain of a reduced dipole antenna near a metal plate on a large platform, and the results are compared with those of genetic algorithm and particle swarm optimization. The results show that the adaptive response surface method has the advantage of fast convergence when applied to the gain optimization of the platform antenna.

NA40352

15:55-16:10

Title: A Concise Formula for Backscattering Prediction of Truncated Wedge Model

Authors: Gengjiang Yao, Lijie Chen, Long Xiao, Fan He, Xiao Hu, Zhaowang Cao
Presenter: Gengjiang Yao, China Ship Development and Design Center, China

Abstract: In this paper, a concise monostatic radar cross section (RCS) expression of truncated wedge model is obtained by geometric diffraction theory (GTD). The truncated wedge model consists of two flat plates with a certain angle. The monostatic RCS expression of truncated wedge model is derived and simplified by analyzing the monostatic RCS of the flat plate. The calculated results are in good agreement with the simulation results obtained by the commercial software CST STUDIO SUITE, which verifies the accuracy of the proposed expression. The obtained concise expressions require fewer computational resources and are useful for analysis of scattering characteristic.

NA40338

16:10-16:25

Title: Methods for Suppressing the Spurious Characteristic Modes in Electromagnetic Scattering Problem

Authors: Ren-Zun Lian, Wan-Yi Cui, Yao Yao, and Long Li
Presenter: Ren-Zun Lian, Xidian University (XDU), China

Abstract: By calculating the scattering characteristic modes (CMs) of the objective scatterers, the scattering characteristic mode theory (CMT) can effectively realize the theoretical analysis and engineering design for the inherent electromagnetic scattering characteristics of

the objective scatterers. The entire-structure-oriented work-energy theorem (ES-WET)-based CMT can calculate a set of energy-decoupled CMs by diagonalizing the entire-structure-oriented driving power operator (ES-DPO). The CM computation accuracy problem and the spurious CM suppression problem are two important topics in the theoretical foundation of ES-WET-CMT. Based on some recent studies, it is found out that: the CM computation accuracy is mainly determined by the ES-DPO used to calculate the CMs; the spurious CMs originate from ignoring the dependence relationships among the currents used to formulate the ES-DPO. There have existed some different ES-DPOs, such as the JM-based, JE-based, MH-based, Poggio – Miller – Chang – Harrington – Wu – Tsai (PMCHWT)-based, and pmchwt-based ES-DPOs. There have also existed some different spurious CM suppression schemes, such as the dependent variable elimination (DVE), solution domain compression (SDC), and intermediate variable method (IVM) schemes. The various ES-DPOs and the various spurious CM suppression schemes have many different combination ways, and the different combination ways have the different numerical performances. The central purpose of this paper is to review and summarize the various combination ways, and, at the same time, provides some elementary comparisons among the various combination ways.

Title: LIPO: Local Iterative Physical Optics for Electromagnetic Scattering of Layered Media

Authors: Chuangfeng Zhang, Ming Zhang, Kuang Luo, Jinxin Li, Shaolin Liao

Presenter: Chuangfeng Zhang, Sun Yat-sen University, China

NA30314

16:25-16:40

Abstract: A novel Local Iterative Physical Optics (LIPO) algorithm for the electromagnetic scattering of layered dielectric media with rough surfaces has been developed to simulate the electromagnetic scattering of electrically large dielectric layers with relatively smooth surface variations. The LIPO algorithm iteratively corrects the equivalent local surface currents according to the conventional PO theorem to compensate for the electromagnetic field deviation across the dielectric layers' surfaces. Numerical validation has been performed with a one-layer water surface to show the performance of the proposed LIPO algorithm. The experimental result shows that it takes only a few iterations for the algorithm to increase the surface current accuracy by more than three orders of magnitude, compared to the conventional PO theorem.

SESSION 16

Topic: Image and Multimedia Technology
Time: 13:30-15:45, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/86088803609 Password: 111114

- **Session Chair: Assoc. Prof. Yujin Zhang, Shanghai University of Engineering Science, China**

NA30302

13:30-13:45

Title: Forward-Looking Imaging Method of Airborne Array Radar Based on Uniform Circular Array

Authors: Runfa Zhu, Guigeng Lu, Lu Liang and Zhenrong Zhang
Presenter: Runfa Zhu, GUANGXI FINANCIAL VOCATIONAL COLLEGE, China

Abstract: Forward-looking imaging of airborne radar has great application value in fighter reconnaissance, material airdrop and autonomous landing. In order to improve the azimuth resolution of radar forward-looking imaging, a forward looking imaging method of array radar based on uniform circular array is proposed in this paper. The uniform circular array is transformed into virtual linear array, and the covariance matrix is obtained; Then, the bicircular array is used for decoherence, the number of signal sources is calculated by using the canonical correlation technique, and the noise and signal subspaces are calculated. Finally, the spatial spectrum is estimated and the image is accumulated. This method verifies that multiple targets can be identified in the same beam, and compares with other imaging methods; At the same time, the subjective analysis and objective evaluation verify that the imaging resolution of this method is significantly improved.

NA11054

13:45-14:00

Title: A double-layer image encryption scheme based on silicon-based optical chaos

Authors: Hao Liu, Hao Cheng, Yan Wang, Zheng Peng, Xiaodong Ren, Yubei Shuai, Shengyin Zhang and Jiagui Wu
Presenter: Hao Liu, SouthWest University, China

Abstract: Image encryption using chaos has been becoming a hot topic in recent years due to its pseudo-stochastic nature and sensitive to initial conditions. This article arose a double-layer image encryption technology using silicon-based optical chaos. Silicon-based optical chaos is four-dimensional dynamic chaos generated by silicon-based monolithic optomechanical oscillator, which has significant unpredictability and extremely complex chaotic behavior. In this article, using the silicon-based optical chaos and the second silicon-based optical chaos(SBOC) generated after reinjection into the oscillator to encrypt the image, so as to promote the encryption security. Meanwhile, using DNA Algorithm and Knuth algorithm to perform bit level processing on image pixels in the stage of image confusion and diffusion. Performance analysis results indicate that our proposed scheme is an efficient encryption and decryption process, with high enough key sensitivity, key space, and differential attack resistance.

NA11017

14:00-14:15

Title: Multistage 3D Hand Pose Estimation Algorithm Based on Skeleton Points

Authors: Wenqiang Wang, Lihua Tian, Chen Li
Presenter: Wenqiang Wang, Xi′ an Jiaotong University, China

Abstract: Multi-stage 3D hand pose estimation based on RGB images is a popular research direction in the field of hand pose estimation due to its high accuracy and wide application scenarios. However, there are certain problems and difficulties in this task. Accordingly, we design a multi-stage 3D hand pose estimation network based on skeleton points. Firstly, the joint points that cannot be detected due to occlusion in the 2D hand pose estimation stage are corrected, and a time-series dilated convolutional network is constructed to return the 2D hand pose coordinates to 3D in order to solve the mapping ambiguity problem. Meanwhile, a new loss function is proposed to constrain the generated 3D hand pose coordinates. We validate the network on public datasets, demonstrating the effectiveness and state-of-the-art of our work.

NA21038

14:15-14:30

Title: Wavelength-dependent Image Defogging Method Based on Mie scattering of Fog Droplets

Authors: Lurui Yang, Kai Liu, Yongqing Huang, Xiaofeng Duan, Qi Wang, Xiaoxia Du and Xiaodong Chen
Presenter: Lurui Yang, Beijing University of Posts and Telecommunications, China

Abstract: In this paper, we present an image defogging method based on the physical process of fog altering the light passing through it, in order to restore information in degraded photos from an optical standpoint. To calculate the fog scattering components quantitatively for different wavelength ranges, we integrate the fog droplet distribution functions with Mie scattering theory. To simulate a real fog scene, the method calculates the environmental visibility by first using a droplet distribution function to determine the corresponding fog droplet size, then calculating the Mie scattering efficiency factors using the obtained droplet size, and finally determining the light attenuation coefficient in different color channels. Experiments reveal that this wavelength-dependent strategy achieves outstanding information entropy and a high proportion of visible edges while also having advantages in retrieving items concealed by dense fog.

NA30255

14:30-14:45

Title: An Implicit Salienct Guided Infrared and Visible Image Fusion Method

Authors: Zhang Qingwei, Fan Fangfang, Zhong Yiwen, Wang Changying and Xiao Zhongjie
Presenter: Zhang Qingwei, Fujian Agriculture and Forestry University, China

Abstract: The aim of image fusion is to synthesize the information from multiple images to provide richer information for understanding human image content. Since the visual saliency of the images is the basis for understanding the content of the images, understanding and emphasizing image fusion information of different modes is the key of multi-modal image fusion. In the field of infrared and visible image fusion, the fusion logic of current research relies principally on understanding the results of fusion, subjectively emphasizing the strong contrast region in the infrared image and the texture detail in the visible image. The emphais on content, based on people's subjective understanding, reflects people's demands and understanding of the fusion results, but this subjective emphasis is not sufficiently complete to pay attention to the content of the source images, and ignores certain details, which affects the fusion effect. Therefore, this article proposes to learn the human understanding of the saliency features of the image through deep neural networks to obtain more complete fusion features than subjective emphasis. These features implicitly reflect human vision's perception of the importance of different modal features in fusion. ASNet has a great performance in salient target inference from the human gaze, we therefore introduce it to obtain salient features more coherent with human visual understanding in source images, which are used as attention prior information.

NA30289

14:45-15:00

Title: Research on Image Defogging Algorithm for Power Monitoring

Authors: Li Jinag, Chaoxing Zhao
Presenter: Chaoxing Zhao, Zhengzhou University, China

Abstract: With the continuous expansion of power grid scale, smart grid has become the mainstream of power monitoring. Bad weather conditions such as smog will lead to the deterioration of the quality of captured images, which will further restrict the development of smart grid. In this paper, an image defogging algorithm is proposed according to the characteristics of power monitoring images. According to the characteristics of image regions, the image is divided into sky regions and non sky regions. For non sky regions, an improved dark channel prior algorithm is used to solve the problem of poor detail processing. For sky regions, a large number of experiments have observed that there is a linear relationship between the minimum channels of fog free images and fog images. It improves the poor segmentation effect of the conventional algorithm in the sky area, and applies the synthetic projection rate and atmospheric light to the defogging of the power monitoring image. Compared with other defogging methods, its objective indicators are improved, and the overall visual effect of the defogging image is good.

NA40395

15:00-15:15

Title: 3D Human Movement Pose Generation Based on Pre-trained AI Model with Skeleton Constraint Analysis and Intelligent Prediction

Authors: Jinwei Lin
Presenter: Jinwei Lin, Monash University, Malaysia

Abstract: This paper research will focus on the application and implementation of coordinate data transformation from 2D to 3D, in terms of the human skeleton recognition area. Then the processed 3D skeleton nodes data will be applied to control the 3D human object with auto-modeling and auto-generation, with the programming of Python. The research of this paper uses the pre-trained model of Pytorch to gain the basic 2D detection points data of the human skeleton nodes, to transform the key node 2D skeleton data to 3D skeleton data by the structural analysis of human skeleton nodes. Subsequently, processing the 3D data with the optimization algorithms by the specific skeleton-moving range constraint analysis and prediction. The research provides an available method that generates the 3D skeleton data from the 2D data with an intelligent and efficient method. The generated skeleton 3D data can be used in various 3D modeling applications, especially in the area of the human objects movements and actions design in 3D animation. The experiment result analysis and conclusion will be presented.

NA30295

15:15-15:30

Title: Shot-Based Content Adaptive Robust Digital Video Watermarking Algorithm Against Camera Recording

Authors: Jiayi Bai, Xin Wang, Yana Zhang, Cheng Yang
Presenter: Jiayi Bai, Communication University of China, China

Abstract: Digital video is one of the most important media in current communication. It is very popular for its rich content and vivid forms. With a rapid development of the Internet, the progress of computer technology makes communication more convenient, and also facilitated infringers' illegal and pirated acts. The copyright protection of digital video has become an urgent problem to be solved. Camera recording is a serious threat to the security of video content. The camera recording is not a single attack, but a combined attack in the spatio-temporal domain. It is difficult for a video watermarking algorithm to be robust to combined attacks in the spatio-temporal domain and satisfies the content adaptation. In this paper, we proposed a video watermarking algorithm based on the temporal domain, which takes the video shot as an embedding unit. We introduce a new metric called chrominance standard deviation (ST) to represent the changes in chrominance amplitude within the shots. According to the chrominance characteristics of the video, the embedding strength and period are determined adaptively, and the watermark is embedded in every frame of a shot. In the watermark extraction, we introduce geometric correction and color correction modules to correct the distorted video. The experimental results show that the proposed algorithm has high robustness not only to various single common attacks but also to mobile phone camera recording, while satisfying the imperceptibility of the watermark.

NA40420

15:30-15:45

Title: Subjective Quality Assessment of HDR Stereoscopic Omnidirectional Videos

Authors: Manman Liu, Jihao You, Ruitao Chen, Ziwei Ye and Gangyi Jiang
Presenter: Gangyi Jiang, Ningbo University, China

Abstract: High dynamic range stereoscopic omnidirectional video (HSOV) can bring wide field of view and high contrast visual experience to viewers. However, the generation, transmission and display of HSOV will inevitably cause distortions in the video. Therefore, it is important to quantify the impact of the processing of coding and tone mapping on the quality of HSOV. To this end, the subjective quality of HSOV after HEVC coding and tone mapping is evaluated in this paper. Firstly, an HSOV database namely NBU-HSOVD is constructed, which consists of 450 distorted HSOVs. Then, 34 subjects are invited to evaluate the quality of the distorted videos with absolute category rating method so that the MOS value of each video can be provided. Finally, the performance of six existing objective image or video quality assessment methods are tested on NBU-HSOVD. The constructed NBU-HSOVD database can provide reference and basis for the research of objective quality assessment of HSOV in the future.

SESSION 17

Topic: Channel Detection and Estimation
Time: 13:30-16:10, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/86924134522 Password: 111114

- **Session Chair: Prof. Hua Wang, Beijing Institute of Technology, China**

NA55023

Invited Speech

13:30-13:55

Title: Channel Estimation and Diversity Reception for RIS-Empowered Broadband Wireless Systems

Invited Speaker: Professor Miaowen Wen, South China University of Technology, China

Abstract: Channel estimation is a challenging problem for reconfigurable intelligent surface (RIS) empowered wireless communications, especially for broadband channels. In this talk, a cyclic-prefixed single-carrier (CPSC) transmission scheme with PSK signaling for this purpose is first introduced. We will see that different cyclically delayed versions of the incident signal can be created by wisely configuring the RIS according to the transmitted PSK symbols. Based on this, a practical and efficient channel estimator can be easily developed and multipath diversity can be harvested. By resorting to the concept of index modulation (IM), this talk will then introduce how to extend CPSC-RIS for improved spectral efficiency. Finally, BER results will be shown to verify the superiority of the presented scheme over the orthogonal frequency division multiplexing (OFDM) solution.

NA11083

13:55-14:10

Title: Channel Estimation of mmWave Massive MIMO System Based on Manifold Learning

Authors: Peng Gu, Yunchao Song, Chen Liu
Presenter: Peng Gu, Nanjing University of Post & Telecommunications, China

Abstract: In this paper, a channel estimation algorithm for millimeter wave communication system based on Manifold Learning Extreme Learning Machine (ML-ELM) is proposed. Particularly, the proposed algorithm uses the manifold learning to reduce the characteristic dimension of the received signal, such that the dimension of the received signal is reduced. Then, a one-shot training Extreme Learning Machine (ELM) is used to estimate the Channel State Information (CSI). Due to the low-dimensional date, the ELM can be better trained such that the channel is well estimated. Moreover, the computational complexity can also be reduced. Simulation results show that compared with LS, MMSE and Deep Neural Network (DNN) algorithms, the proposed algorithm provide a better performance, which meets the real-time requirements of the communication system.

NA11081

14:10-14:25

Title: On Capacity Achieving of Sparse Regression Code with the Row-Orthogonal Matrix

Authors: Yizhou Xu, Teng Fu, Yuhao Liu and Tianqi Hou
Presenter: Yizhou Xu, Tsinghua University, China

Abstract: This paper reports that the sparse regression code (SRC) is asymptotically capacity-achieving for the row-orthogonal matrix by the orthogonal approximate message passing decoder with the exponential power allocation. This result is inspired by Rush et al. (2017), where SRC was proved to be asymptotically capacity-achieving with i.i.d. Gaussian coding matrices. We illustrate the validity of our conclusion through theoretical analysis and numerical simulations.

NA30247

14:25-14:40

Title: Outage Performance Analysis for SWIPT Based HPTS DF Relaying Networks With Direct Link Under Channel Estimation Error

Authors: Feng Gao, Yucan Bi, Yan Chen
Presenter: Feng Gao, Jining Branch of Chinatelecom Co.LTD, China

Abstract: In this paper, the outage performance analysis for simultaneous wireless information and power transfer (SWIPT) based hybridized power-time splitting (HPTS)

decode-and-forward (DF) relaying networks with direct link under channel estimation error (CEE) is investigated. The energy-constrained relay is considered and adopts HPTS protocol to satisfy the power allocation of relay node requirement. Different from existing literatures, the network model with direct link and the effect of CEE are considered. Based on this, we obtain the expressions of the outage probability and the throughput and the approximate analytical with aid of the Gaussian-Chebyshev quadrature. The numerical results verify the analytical results and then investigate the important parameters on the outage performance. It is shown that the outage performance of the proposed network is superior to the network based time switching (TS) protocol under CEE.

NA30287

14:40-14:55

Title: Dynamic Sequential Channel Allocation in Cache-enabled Wireless Multicasting Networks

Authors: Tianyao Zhong, Ducheng Wu, Guoxin Li and Wanning Liu
Presenter: Tianyao Zhong, Army Engineering University of PLA, China

Abstract: We present a potential game-based dynamic sequential channel allocation (DSCA) optimization method to enhance the channel utilization for cache-enabled multicasting wireless networks (CMWNs). Different from the traditional fixed channel allocation scheme, we first propose a DSCA scheme, in which channels can be allocated to different content files dynamically based on current requests and the priorities of sorted files. Then, we present two special cases of potential games and better response algorithms to achieve global optimization for CMWNs by minimizing the global interference level and global collision level. From simulation results, the DSCA achieves better global performance than the traditional fixed channel allocation in CMWNs.

NA30273

14:55-15:10

Title: Joint Identification of Modulation and Channel Coding based on Deep Learning

Authors: Fang Deng, Xingrong Huang, Shujun Sun and Shengliang Peng
Presenter: Fang Deng, Huaqiao University, China

Abstract: The tasks of identifying which modulation format and channel coding scheme have been utilized by the wireless signal are crucial to intelligent communications, electronic warfare, and spectrum management. Currently, most research on these tasks digs into either modulation identification or channel coding identification, while the joint identification of modulation and channel coding has not been fully investigated. In this paper, we propose two joint identification algorithms based on deep learning to handle the tasks of modulation identification and channel coding identification simultaneously. The first algorithm adopts a successive architecture, in which two neural networks are used to handle the two identification tasks, respectively. The second algorithm exploits multi-task deep learning, with which two identification tasks can be completed using a single neural network. Experiments results show that, considering the candidate set of three modulation formats and two channel coding schemes, both algorithms achieve satisfactory identification accuracy, and the latter is superior to the former with the accuracy improvement of 10%.

NA30281

15:10-15:25

Title: Spectral Efficiency of Wireless Systems in Correlated Channels with Receive Antenna Selection

Authors: Ahmed Abualnor, Nadir A.Siddig, and Maged Fakirah
Presenter: Ahmed Abualnor, University of Sinnar, Sudan

Abstract: The multiple input-output (MIMO) wireless technology increases data capacity, especially for many transmitting and receiving antennas. The concept of antenna selection is considered a tradeoff between performance and complexity to achieve better performance. First, this work presents three-antenna selection algorithms to maximize channel capacity in correlated MIMO systems with antenna selections. In our scheme, we assume that the receiver picks the best subset antenna for given Rr receive antennas that can guarantee capacity maximization. The receiver has access to the channel state information (CSI), while the transmitter does not. Finally, the simulation outcomes prove that our scheme is practical, accurate, and achieves higher performance than other antenna selection schemes.

NA40432

15:25-15:40

Title: Joint Channel Estimation and Symbol Detection for UAV-Assisted Systems Using Tensor Framework

Authors: Heyun Lin, Zhihai Zhang, Xinhong Pan, Xin Luo, Yuan Cheng
Presenter: Xin Luo, Communication University of China, China

Abstract: In this paper, we focus on the unmanned aerial vehicle (UAV)-assisted systems and present three joint channel estimation and symbol detection algorithms using tensor framework. Specifically, the UAVs amplify and forward the received signals from the vehicle to the base station (BS) transmitted through time-varying channels, and the signals received at the BS are constructed to the PARAFAC model or the PARATUCK2 model. Then, three different algorithms are proposed to fit the tensor models, corresponding to different communication scenarios. In particular, a tensor decomposition algorithm that can convert the PARATUCK2 model to the parallel factor (PARAFAC) model is proposed. Our simulation results show that the proposed algorithm can effectively estimate channels and detect symbols.

NA40327

15:40-15:55

Title: Application of Complex Network in intra-pulse feature extraction of radar emitter signals

Authors: Yiming Ma， Taowei Chen，Huiyuan Wang
Presenter: Yiming Ma, Yunnan University of Finance and Economics, China

Abstract: Radar emitter signal identification using intra-pulse parameters plays an essential role in radar countermeasure systems. Current research has been conducted on mathematical transformation domains such as the time domain, the frequency domain, or the time-frequency domain. However, no matter how to improve the classifier model, there still exists a lower accuracy rate of deinterleaving or recognition under a complex modern radar environment. Thus, this paper proposes a feature extraction method using complex networks theory for recognition of radar emitter signals. Firstly, a dynamic segmentation model based on the BIC information criterion is introduced to construct the complex network from the signal frequency series. Secondly, the statistical dynamic characteristics which reflect topological indices of different complex networks are extracted separately. Finally, these features after principal component analysis are taken as input to the KNN model for clustering. The experimental results show that the proposed method of features extraction achieves a recognition rate of over 92% in eight typical radar emitter signals at Signal-Noise Ratios of 0dB, 10dB, 20dB

NA40427

15:55-16:10

Title: Tensor Completion-based Channel Estimation for Semi-passive RIS Assisted System

Authors: Mengyi Qi, Qi Liu, Xuan Wei and Pengpeng Lv
Presenter: Mengyi Qi, NARI Group Co., Ltd. State Grid Electric Power Research Institute, China

Abstract: Previous works mainly considered semi-passive Reconfigurable intelligent surface (RIS) design with special layout arrangements, ignoring the fact that the local observed values may not reflect the overall channel when RIS elements increase. In this paper, we design a semi-passive RIS structure with a random arrangement, and propose a tensor completion-based channel estimation algorithm to recover the whole channel from the partially observed signals. Specifically, we introduce the tensor singular value decomposition (t-svd) framework to learn the inherent low-rank representation of the observed data: the search for inherent basis representations is carried out on the t-Grassmannian manifold, and the representation of low-rank tensor under this basis has a closed-form solution. As long as the proportion of active components reaches a certain level, the proposed algorithm can work well. Simulations show that the t-svd-based tensor completion algorithm performs better than the CP decomposition-based tensor completion algorithm.

SESSION 18

Topic: Resource Management and Allocation in Communication Networks
Time: 13:30-16:05, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us06web.zoom.us/j/89327674351 Password: 111114

- **Session Chair: Professor Cui-Qin Dai, Chongqing University of Posts and Telecommunications, China**

NA11018

Invited Speech

13:30-13:55

Title: Dynamic resource allocation algorithm under visible light communication and WiFi heterogeneous network

Invited Speaker: Assoc. Prof. Liwei Yang, China Agricultural University, China

Abstract: Resource management is the key to improving the performance of visible optical communication (VLC)/WiFi heterogeneous networks. An improved dynamic proportional fairness algorithm is proposed to enhance the fairness of the system. Each round of scheduling compensates for user latency characteristics and jointly allocates resources. Simulation results show that the algorithm enhances fairness and throughput, with broader applications in heterogeneous networks.

NA55010

Invited Speech

13:55-14:20

Title: Research on intelligent scheduling of network resources for industrial Internet

Invited Speaker: Professor Dong Yang, Beijing Jiaotong University, China

Abstract: With the widespread deployment of large-scale industrial equipment and sensor nodes, the transmission and processing of massive industrial data needs to meet new requirements such as low latency and high reliability. Efficient adaptation and utilization of multi-dimensional resources such as spectrum, computation, cache, and time are critical to meeting the practical needs of diverse industrial applications. In this context, how to improve the performance and efficiency of multi-dimensional network resource joint scheduling is an urgent problem in current industrial Internet. In recent years, with the rapid development of artificial intelligence technology, intelligent algorithms based on machine learning are expected to realize a new mode of flexible adaptation and utilization of network resources. This report will focus on how to use the intelligent method to improve the flexibility and intelligence of multi-dimensional resource scheduling, and provide a new idea for realizing high-quality industrial Internet communication.

NA21036

14:20-14:35

Title: Transfer Learning Empowered Resource Allocation for Vehicular Edge Computing

Authors: Yuhan Zhang, Ke Zhang, Fan Wu
Presenter: Yuhan Zhang, University of Electronic Science and Technology of China, China

Abstract: Vehicular edge computing servers as a decentralized network extension to offer distributed and proximity services for computation-intensive vehicular applications. For some complex computing tasks, when they are offloaded from smart vehicles to edge servers, computing environment needs to be established on the servers, which requires extra computing power and brings unprecedented computation delay. To address this problem, we incorporate transfer learning into vehicular edge networks, leveraging existing knowledge and experience of similar edge services to improve the agility of environment construction. Furthermore, we investigate various knowledge transfer scenarios in terms of data source selection and knowledge preprocessing. We propose joint transfer learning and resource scheduling schemes adapted to both multi-source transfer and single-source transfer scenarios, which minimize computation delay while ensuring task computation accuracy constraints. Numerical simulations are conducted to verify the effectiveness of our proposed scheme as compared to benchmark schemes.

NA30238

14:35-14:50

Title: Joint Offloading Strategy and Resource Allocation for MIMO-based MEC Networks

Authors: Mengyu Zhu, Shaoshuai Gao, Guofang Tu and Deyuan Chen
Presenter: Mengyu Zhu, University of Chinese Academy of Sciences, China

Abstract: Integrating Multiple Input Multiple Output (MIMO) into Multi-access Edge Computing (MEC) as a new computing paradigm can provide users with higher quality of services. In this paper, a cloud-edge-end three-layer collaborative MIMO-MEC system is considered, in which multiple MEC servers can cooperate with each other. We describe the problem as a joint optimization of offloading strategy, computational resource allocation and downlink power allocation to minimize the total delay of all users. A nested algorithm is proposed to address the mixed-integer non-linear programming problem. Therein, a penalty function-based Newton method and the Lagrange multiplier method are used in the inner layer, while a heuristic algorithm is adopted in the outer layer. The results show that the proposed scheme can effectively reduce the total delay of processing tasks compared with the baseline schemes.

NA40334

14:50-15:05

Title: Resource Allocation in Underwater Wireless Optical Communication Systems

Authors: Meiyan Ju, Xuan Li, Yuyu Gan, Yueheng Li, Guoping Tan, and Ping Huang
Presenter: Xuan Li, Hohai University, China

Abstract: This paper investigates the joint relay selection and power allocation scheme based on the bit error rate (BER) performance in multi-source multi-relay underwater wireless optical communication (UWOC) systems. The joint optimization problem with relay nodes adopting decode-and-forward (DF) mode is formulated. For the tricky problem, an alternately iterative algorithm is proposed. The simulation results show that the alternately iterative algorithm has near optimal performance and is better than the other schemes based on distance and equal power in this paper.

NA40325

15:05-15:20

Title: Resource Allocation in Underlay Network with User Diversity

Authors: Jinting Liu, Chiya Zhang, Chunlong He
Presenter: Jinting Liu, Harbin Institute of Technology, Shenzhen, China

Abstract: Device-to-Device (D2D) communication can enhance the spectrum utilization rate by multiplexing downlink resources in a 5G cellular network. However, it also introduces interference. We formulate an optimization problem with the objective of optimizing the transmission total rate of the celluar users (CUs) and D2D pairs while meeting the minimum necessary rate of cellular users and D2D pairs. We approach this issue by optimizing the transmitted beamforming, and power allocation jointly. The problem is decoupled into two subproblems. To achieve the optimization objective, a RPSO (Revised Particle Swarm Optimization Algorithm) in section beamforming optimization is formulated, and in the power allocation step the companion matrix is utilized to determine the optimal power allocation. The simulation demonstrates that the suggested approach may successfully increase the sum rate while maintaining QoS.

NA21015

15:20-15:35

Title: Joint Slice Level and Base Station Level Admission Control in RAN Slicing

Authors: Shen Hong, Yukai Ye and Tiankui Zhang
Presenter: Tiankui Zhang, Beijing University of Posts and Telecommunications, China

Abstract: The slicing admission control in fifth generation (5G) radio access networks (RAN) should be considering for the service level agreement (SLA) guarantees. In this paper, we present constraints on user transmission rate quality of service (QoS) for different kinds of slice SLAs in dynamic heterogeneous RAN scenario with differentially covered RAN slicing. We model the RAN slicing admission control problem as two parts: slice-level admission control and base station (BS)-level admission control. Then, we design a user-and-slice based service request queue and propose an optimal admission control problem for RAN slicing. The problem is divided into two sub-problems. We solve the slice-level admission control sub-problem and the BS-level admission control sub-problem within each frame by using Lyapunov's optimization theory and greedy strategy respectively, and finally obtain the approximate optimal solution. The simulation results show that the proposed algorithm can

obtain the best time average profit and the best admission control decision compared with the benchmark algorithms.

NA40436

15:35-15:50

Title: Intent-driven LEO Satellite Networks Resource Management

Authors: Yuqi Wang, Kang Guo, Ningyuan Wang, Zhaotao Qin, Xiaoqing Zhong and Xiaodong Han
Presenter: Yuqi Wang, China Academy of Space Technology, China

Abstract: The development of Low-Earth-Orbit (LEO) satellite networks, which provide a novel networking paradigm for achieving full-time seamless and global coverage, has attracted considerable research attention recently. In the dynamic and complex LEO satellite networks, intelligent and efficient resource management strategies are crucial in the case of limited resources. In this paper, we focus on the resource management of LEO satellite networks. We consider combining an intent-driven network with resource management in LEO satellite networks. First, we establish a heterogeneous resource management model for LEO satellite networks. Second, we design an intent-driven resource management framework to improve the utilization of limited resources. Third, we use heterogeneous resource management strategies to solve resource management problems. Finally, we use a specific scenario to illustrate the application of this framework.

NA30272

15:50-16:05

Title: Joint Resource Allocation for Enhanced Machine-Type Communication

Authors: Yang Li, Yan Wang,Yuan Wang, Jiaheng Wang
Presenter: Yang Li, Southeast University, China

Abstract: Enhanced Machine-Type Communication (eMTC) is a bandwidth-reduced low-complexity technology introduced by the 3rd Generation Partnership Project (3GPP). Repetition is employed in eMTC to improve network coverage. For different repetition levels, the choice of the Modulation and Coding Scheme (MCS) and the resource block (RB) allocation have to be carefully designed to meet the performance requirements. Furthermore, the existing eMTC systems do not support space division multiplex (SDM) and multiple-input multiple-output (MIMO). To sufficiently exploit the space dimension resources, we consider MIMO for uplink eMTC systems, which allows multiple users to share the same resource block. In this work, we focus on the joint resource allocation for uplink eMTC taking into account MIMO and the repetition feature. We first introduce the uplink eMTC features and extension with MIMO. Next, we optimize the resource allocation in two steps. In the first step, we propose an algorithm to jointly select the optimal repetition level, MCS and the required number of physical resource blocks. In the second step, we propose an efficient physical resource block scheduling algorithm for eMTC with MIMO. Simulation results show that the proposed algorithms can allocate appropriate resources for users and significantly improve the system performance.

SESSION 19

Topic: Power Communication Technology in Smart Grid
Time: 16:05-18:20, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/84231845366 Password: 111114

- **Session Chair: Dr. Jiao Zhang, Purple Mountain Laboratories, China**

NA21029

16:05-16:20

Title: Short-term Load Forecasting Method based on ARIMA and LSTM
Authors: Shuo Chen, Rongheng Lin, Wei Zeng
Presenter: Shuo Chen, Beijing University of Posts and Telecommunications, China

Abstract: This paper explores the classic prediction algorithms such as Autoregressive Integrated Moving Average model (ARIMA) and Long Short-Term Memory Neural Network (LSTM), and combines the advantages of both, and proposes a short-term forecast method ARIMA-LSTM fusion model. This model computes the final predicted value by applying a linear correctio to the LSTM model error. Using ARIMA and LSTM as a comparison algorithm, train and predict the next day's load with ARIMA-LSTM. The root mean square error (RMSE), mean absolute percentage error (MAPE), and the worst relative error (WRE) were used to evaluate the performance of the proposed algorithm. After testing, the RMSE of the proposed model is 0.433, while ARIMA and LSTM are 0.461 and 0.445 respectively. ARIMA-LSTM also has better results and performs well on different types of power datasets.

NA30203

16:20-16:35

Title: Data cleaning technology of substation Internet of Things based on time series association
Authors: Xuefeng Ning
Presenter: Xuefeng Ning, Guangdong Power Grid Co. LTD Dongguan Power Supply Bureau Company, China

Abstract: The substation Internet of Things (iot) collects massive data in real time through various sensors, and a large amount of redundant data will seriously affect the data processing efficiency of the substation iot. In this paper, a data cleaning strategy based on association rule analysis and neural network is adopted to realize the data cleaning of substation Internet of things. Firstly, through association rule mining, a mathematical model is established to measure the correlation degree between state monitoring quantities, and time series with strong correlation are found. Then, a density-based clustering algorithm is used to detect the missing values and outliers in the sequence, and a cleaning process and rules considering sequence correlation are proposed to effectively distinguish the cleanable sensor data anomaly from the equipment status anomaly. Finally, aiming at the data points that can be cleaned, the wavelet neural network model is used to predict the missing data and correct the wrong data, and the wavelet neural network parameters and combination prediction are dynamically modified to improve the cleaning efficiency and accuracy of the network.

NA40328

16:35-16:50

Title: Delay Optimization of Power Internet of Things based on Edge-Cloud Collaboration
Authors: Julaiti Abulizi, Qingsheng Hu, Wei Wang
Presenter: Julaiti Abulizi, State Grid Electronic Power Research Institute Urumqi, China

Abstract: With the continuous development of the power Internet of Things and the emergence of multi service scenarios, real-time and high-speed process in power data services face more and more challenges. This paper presents an SDN based edge-cloud collaborative method for delay optimization. First, the delay optimization problem is formulated and transformed into a convex optimization problem further. Then a continuously variable coefficient is introduced and its optimal solution is found. Finally a valid task partition strategy that closet to the optimal solution can be found, and the system delay is minimized. Simulation results show that the reasonable loading of edge node tasks to the cloud can effectively reduce the total system delay of power business and alleviate network congestion. Compared with other conventional methods, this edge-cloud collaboration method not only has low system delay, but also makes full use of the control mechanism of SDN to coordinate

distributed environment.

NA11038

16:50-17:05

Title: Assessment of Security Index for SCADA Systems in Smart Grids

Authors: Qiaomu Jiang, Yiqin Lu, Bin Wang, Linxia Zhang, and Wen Long
Presenter: Qiaomu Jiang, South China University of Technology, Guangzhou Intelligence Communication Technology Co., Ltd., China

Abstract: This paper focuses on the security of state estimation in supervisory control and data acquisition (SCADA) system in \mbox{smart grids.} The security index has been wildly studied to evaluate the vulnerability of SCADA systems under various types of cyber attacks, e.g., the false data injection (FDI) attack and distributed denial of service (DDoS) attack. However, it is shown that the calculation of security index is an NP-hard problem. Therefore, we propose an algebraic polynomial-time algorithm to calculate the security indices iteratively based on the orthogonal projection technique. Since existing modeling methods of security index only consider the attack overhead, without considering the impact of cyber attacks on the system performance, a novel hybrid security index is constructed. In the hybrid security index, the overheads of FDI attacks, DDoS attacks, and the impact of attack on the estimation error are considered simultaneously. Numerical results show that the protection of some critical measurements can enhance the overall security of SCADA systems.

NA31099

17:05-17:20

Title: Research on power line communication path search under the background of new energy access

Authors: Zhaolei He,Mengmeng Zhu,Cong Lin,Jin Liu,Rui Fang,Lei Wan
Presenter: Zhaolei He Metering Center of Yunnan Power Grid Co., LTD Yunnan, China

Abstract: The power line communication detection device is the core equipment of the low-carbon building energy Internet. Although the power line carrier communication (HPLC) adopted by it has a fast transmission speed, its path search signaling communication reliability is low, which seriously restricts the communication performance of the relay. The two-way automatic communication system (TWACS) has high reliability, but its path search speed is slow, which seriously affects the timeliness of communication. In order to improve the coverage and reliability of power line communication detection device in energy Internet information perception, an improved multi-mode fusion communication path search algorithm based on HPLC and TWACS is proposed. The algorithm uses TWACS as the path search signaling of PLC downlink communication, uses PLC to transmit main data information, and uses TWACS to transmit broadcast information and path relay instructions

NA30288

17:20-17:35

Title: Quantum Cryptography Technology and Application in Smart Grid

Authors: Julaiti Abulizi, Hu Qingsheng, Wang Wei
Presenter: Julaiti Abulizi, State Grid Electronic Power Research Institute Urumqi, China

Abstract: Recently, more and more governments and institutions are paying attention to quantum security communication because of its strict security. In China, some significant progresses have been made in practice when the research goes deeper. This paper investigates some key technologies of quantum cryptography in smart grid of China. First, the applications and challenges of quantum communication in smart grid are depicted, then the key technologies utilized in smart grid based on quantum key distribution (QKD) are explored in tail. At last quantum secure communication, including fault locating, long distance transmission and WDM technology are discussed. Our researches on the application of quantum cryptography in smart grid are very effective and hopeful to be extended to more application fields.

NA30207

17:35-17:50

Title: Service-aware and Interference Avoiding Multi-node Parallel Resource Scheduling Algorithm for Smart Grid Networks

Authors: Chengbo Hu, Xueqiong Zhu, Yongling Lu, Zhen Wang, Jinggang Yang, Rong Sun and Hai Xue
Presenter: Xueqiong ZHU, State Grid Jiangsu Electric Power Company Ltd. Research Institute, China

Abstract: The efficiency of wireless resource scheduling is a technical challenge in the fields of smart grid networks when time slot, frequency, and channel resources are limited and transmission service requests appearing. In this paper, a novel multi-node cooperative parallel resource scheduling scheme is proposed to solve this problem. Based on the perception of global network transmission services and the topology of scheduling services, multi-node cooperative parallel resource scheduling is performed. The computer simulation verifies that the proposed algorithm can maximize the number of parallel business data streams, satisfy the QoS quality of power services, and save network resources.

NA40400

17:50-18:05

Title: MADDPG Based RAN Network Slicing for Smart Grid with NOMA

Authors: Yuwei Wang, Jie Wang, Jiamin Li, Pengcheng Zhu, Dongming Wang, Xiaohu You
Presenter: Yuwei Wang, Southeast University, China

Abstract: In the fifth generation (5G) wireless communication network, to better offer service for different vertical industry applications, network slicing is needed to meet the differential requirements. In this paper, we study the joint problem of radio resource allocation and power resource allocation in the radio access network (RAN) to improve the radio resource utilization with multi-user demands in smart grid scenario. Different with conventional single-agent algorithm, we propose a non-orthogonal multiple access (NOMA) based multi-agent deep deterministic policy gradient (MADDPG) algorithm to solve this dynamic optimization problem. The scheme determines the remote radio unit (RRU) and physical resource block (PRB) allocation for each user, and updates the neural network to dynamically adjust the resource allocation strategy to maximize the long-term rate of network slices. The reliability and latency requirements of network slicing are guaranteed as well. Simulation results show the convergence and efficiency of the proposed algorithm.

NA40367

18:05-18:20

Title: Critical Nodes Identification for Power Communication Network Under Electrical Interdependent Effects of Smart Grid

Authors: Quanming Zhang, Shiying Yao, Qing Zhao, Min Zhang, Ruiguang Ma, and Zhichao Ren
Presenter: Qing Zhao, University of Science and Technology Beijing, China

Abstract: As smart grid is evolving into an interdependent system that tightly couples power communication network (PCN) with power grid, any node failure in one side network maybe triggers the failure of its interdependent node in the other side, and further results in the cascading failures of smart grid. Hence, it is vital to identify critical nodes within either of the interdependent networks for smart grid before hardening them to prevent power outages. Obviously, the identification of critical nodes in PCN should take into account not only its own topological structure, but also the interdependent influences in terms of the power grid topology and its electrical characteristics. To this end, we proposed a method to identify critical nodes in PCN under the electrical interdependent effects of smart grid. Firstly, the method defined two indices, i.e., a topological vulnerability index of PCN and an electrical interdependent influence index from the power grid. Then, the criticality of every PCN node is evaluated by the two indices. Based on the evaluated values, we can identify critical nodes of PCN. After some performance validations under several different cases of smart grids, the results show that our proposed method can identify critical nodes more accurately than traditional methods, which provide much more helpful information for hardening and protecting power communication networks.

SESSION 20

Topic: Electronics and Communication Engineering
Time: 16:25-18:25, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/81069396768 Password: 111114

- **Session Chair: Assoc. Prof. Ping Su, Tsinghua University, China**

NA11045

16:25-16:40

Title: Research on Terminal Fingerprint Extraction and Temperature Adaptability Based on CAN Bus

Authors: Wei Fang, Jiabao Yu, Yanjun Ding, Xiaozhong Hu, Sheng Li, Aiqun Hu
Presenter: Wei Fang, Southeast University, China

Abstract: Controller Area Network (CAN) is a bus standard commonly used in the automotive industry. A large number of researches have been carried out on the identity authentication and intrusion detection technology of the in-vehicle network for attacks.This paper presents a method to extract the voltage of CAN bus terminal to obtain the equipment fingerprint. The method identifies different ECUs by measuring the voltage difference on the vehicle network, selects features only from the time domain and detects based on a single frame. This paper mainly focuses on the influence of temperature on the fingerprint of CAN bus terminal. By using a high and low temperature test chamber to simulate different temperature environments during vehicle operation, a large number of CAN frames have been collected for fingerprint extraction. By studying the relationship between temperature and CAN bus terminal fingerprint, the influence of temperature on fingerprint has been compensated. After temperature linear compensation, the recognition rate of voltage-based CAN bus terminal fingerprint extraction increases from 71.2% to 87.6% at 0-80 ℃.

NA21037

16:40-16:55

Title: Deep Learning-Based Joint Detector for Cooperative Communication

Authors: Ling Jiang, Ruosong Shi, Lianhan Chen, Zhiyong Liu
Presenter: Ruosong Shi, Harbin Institute of Technology (Weihai), China

Abstract: In this paper, we propose a deep learning-based joint detector (DL-JD) for cooperative communication. This detector takes advantage of the nonlinear processing ability of deep neural networks. In the detector, the combination of the two branch signals from the source node and the relay node and the detection of each branch are jointly implemented based on the proposed deep learning algorithm. The simulation results demonstrate that the DL-JD can achieve superior performance than the existing approaches.

NA21016

16:55-17:10

Title: Joint Receiver Design with Natural Redundancy

Authors: Zhaorui Zhu, Hongyi Yu, Zhenyu Wang
Presenter: Zhaorui Zhu, Information Engineering University, China

Abstract: A high-speed information transmission system demands a more powerful communication receiver. In this paper, we integrate deep learning algorithms into constructing waveform level receiver, which is capable of harnessing natural redundancy (NR) in raw message sources. Owing to end-to-end learning paradigm of neural network (NN), the proposed NN receiver can accomplish joint symbol timing synchronization and demodulation based on oversampled waveform sequences directly. The prevalent Transformer structures, suitable for excavating sequential correlation of complex sources and waveform sequences, are considered as the backbone of NN receivers. Under the cases of clean label and noisy label, we conceive two novel training algorithms and interpret their principles in theory. The clean label bits are accessible from original source encoding schemes, while noisy label bits are available from the decision results of canonical receivers with independently noised waveform sequences. When noisy labels possess sufficiently small error rates, optimized NN receiver is competitive with that adopting the accurate labels. As for natural language text sources, simulation results show that the proposed NN receivers' performances are superior to the classical receivers without a priori knowledge, especially when high spectral efficiency modulation schemes are encountered and random noise is significant.

NA30230

17:10-17:25

Title: DPD and Compensation under RF Impairments in the Hardware by BiLSTM

Authors: Yihao He, Yan Li and Gang Wu
Presenter: Yihao He, University of Electronic Science and Technology of China, China

Abstract: In higher-order modulation and mm-Wave communications, radio frequency (RF) impairments, including amplifier nonlinearity, IQ imbalance, and phase noise, need to be better addressed. The article attempts to deal with RF impairments by Bi-directional Long Short-Term Memory (BiLSTM), including the improvements in digital pre-distortion (DPD) in the transmitter and compensation in the receiver. During designing, characteristics of the RF device are considered to extract hidden laws and information in the fluctuation of RF devices, and the complexity is discussed. The simulation results show that the performance of the BiLSTM-based DPD and compensation for RF impairments are better than the traditional estimation. The data of DPD is collected from a universal software radio peripheral (USRP) with a 30 MHz bandwidth for authenticity.

NA30249

17:25-17:40

Title: Low-power Double-edge Triggered D Flip-flop Based On The Conditional Discharge Technique

Authors: Siyue Qiu, Maoqun Yao, Zhiqiang Liu
Presenter: Siyue Qiu, Hangzhou Normal University, China

Abstract: In this paper, a high speed and low power double-edge triggered D flip-flop based on conditional discharge technique is proposed. By applying a scheme in the conditional discharge path, which takes the voltage difference between the internal node and the output node as the conduction condition, the circuit not only improves the circuit structure, but also reduces the power dissipation and the total power delay product. The simulation results show that the proposed D flip-flop has the correct logic function and is superior to other literatures in terms of power dissipation, delay and cost at the working frequency of 250MHz.

NA21051

17:40-17:55

Title: Flattening design and simulations to the metamaterial-based hyperbolic reflector

Authors: Xudong Pang, Beibei Cao, Liping Wu and Shouzheng Zhu
Presenter: Xudong Pang, Shanghai Publishing and Printing College, China

Abstract: The two-dimensional planar hyperbolic reflector, which is designed with coordinate transformation method, shows the same scattering characteristic as the hyperbolic reflector while maintains a flat structure. In this paper, the scattering performance of the planar hyperbolic reflector is simulated and the distributions along each direction of the required rectangle metamaterials are given. The variations of each constitutive parameter extremum and the normalized distributions of the required rectangle metamaterials are further analyzed with different eccentricies of the hyperbolic reflectors, which can provide some guidance and suggestions for the practical fabrication work.

NA30223

17:55-18:10

Title: Attention-CNN-Aided Specific Emitter Identification Method with Limited Radio Frequency Dataset

Authors: Shufei Wang, Yibin Zhang, Jinlong Sun, Tomoaki Ohtsuki, and Guan Gui
Presenter: Shufei Wang, Nanjing University of Posts and Telecommunications, China

Abstract: Specific emitter identification (SEI) plays a more and more important role to recognize unknown radio frequency (RF) devices in the field of physical layer security. Existing deep learning (DL)-based SEI methods have been proposed for solving problems that enough RF dataset can be obtained at the model training stage. In many real application scenarios, however, only the limited dataset can be collected which causes the conventional DL methods unstable. To solve this problem, in this paper, we propose a robust SEI method using a self-attention mechanism and convolutional neural network (attention-CNN). To be specific, we collect a real RF dataset from the automatic dependent surveillance-broadcast (ADS-B) signal. Here, the ADS-B dataset is limited in some special cases and data augmentation is used to improve the features of the dataset. Simulation results show that the proposed method achieves better identification performance than the benchmark.

Title: Frequency Measurement for Laser Stabilization Based on the Beat-sampling Method

Authors: Yanbin Shui, Zhongtao Shen, Xuan Wang, Changqing Feng, Shubin Liu
Presenter: Yanbin Shui, State Key Laboratory of Particle Detection and Electronics, University of Science and Technology of China, China

NA21052

18:10-18:25

Abstract: Frequency measurement is one of the important parts of the laser frequency stabilization system. In this paper, a novel high-precision frequency measurement technique based on the beat-sampling method is presented. The input signal is beat sampled with a 1-bit ADC to reduce the frequency, thereby improving measurement accuracy within the same measurement time. Two sampling sub-channels are designed to confirm the exact value of the input signal frequency. Besides, a prototype is implemented to verify the proposed method. The prototype is a digital control system supported by a field programmable gate array (FPGA). Compared to the traditional beat-frequency circuits, the prototype consists of simpler circuits and enables a higher grade of flexibility. The results obtained demonstrated that signals with a frequency of 100MHz could be measured within 1s at an accuracy of mHz.

SESSION 21

Topic: Intelligent Image Detection and Application
Time: 16:30-18:45, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/81673586285 Password: 111114

- **Session Chair: Prof. Xiaosi Tan, Southeast University, China**

NA40392

16:30-16:45

Title: Accurate and Fast Mask Recognition Based on Multiple Color Areas Detection and Face Landmarks Locating

Authors: Jinwei Lin
Presenter: Jinwei Lin, Monash University, Malaysia

Abstract: Using deep learning technologies to assist mask recognition in personal healthy activities detection is recommended. However, there are some disadvantages in directly using deep learning to make the mask recognition, such as the low recognition rate in detecting the blurry human faces far away or detecting the masks from the human side faces. For the fast moving human faces, the mask detection also has the challenge. In this paper, a novel idea about using the color analysis from the special area of the human face to detect the mask wearing, which combines the face landmarks detection, location and color detection. Using the special color analysis to detect the mask wearing will save more computed resources and get fast performance. What more, for the human face far away, this method still remains a good performance compared with the pure learning mask detection. A novel multiple areas detection and comparison method that performed well is proposed in this paper. The related code is open source in GitHub.

NA11052

16:45-17:00

Title: Fast registration algorithm of MVCT and KVCT based on mutual information

Authors: Ziting Fan, Yuxin Lei, Jun Zhang, Ruijie Yang and Junhai Wen
Presenter: Ziting Fan, Beijing Institute of Technology, China

Abstract: Mutual information-based image registration is a common method for placement registration in radiotherapy. This paper uses the ART (Algebraic Reconstruction Technology) algorithm to reconstruct the electronic portal imaging device (EPID) field images obtained during low-dose radiotherapy. The reconstructed results MVCT and planned KVCT are used for maximum mutual information registration. The mutual information registration algorithm proposed in this paper combines gray level compression and area search, which greatly improves the speed of maximum mutual information registration. The feasibility of the algorithm is verified by experiments, which are divided into eight groups of different phantom placement and one group of phantom deformation to explore the low-dose rigid registration ability and the ability to resist cross-period lesion changes of the algorithm.

NA30211

17:00-17:15

Title: Vehicle tracking from Bird-Eye view

Authors: Kai Tian, Yun Li, Shanlin Sun, Biaohang Sun
Presenter: Kai Tian, Guilin University of Electronic Technology, China

Abstract: Perception algorithms in 3D space are key research contents in the fields of autonomous vehicles and robots. 3D perception in a bird's-eye view (BEV) has attracted a lot of attention in recent years, because the BEV's representation of traffic scenes contains abundant target depth information and dimensional information, and the detection results can be directly applied to downstream tasks such as trajectory tracking, path planning, etc. Motivated by this observation, We propose a tracking module based on bird's-eye view and a target correlation method optimized for tracking tasks. The method we propose has advantages over other algorithms in performance on the Nuscenes dataset and the KITTI dataset. We further demonstrate that by projecting 3D objects under the bird's-eye view, we can achieve significant improvements in monocular 3D perception tasks, including detection and tracking.

NA31094

17:15-17:30

Title: Research on cable aging and joint state detection technology under the effect of multi-physical field coupling

Authors: Fanbin Meng, Gang Zheng, Yu Nan, and Jiangtao Li
Presenter: Fanbin Meng, State Grid Henan Electric Power Company Kaifeng Power Supply Company, China

Abstract: Operating cables will inevitably undergo insulation aging due to the influence of electric field, magnetic field, heat, light, moisture and other factors, and the insulation performance will be significantly reduced. Statistics show that cable joint failure is one of the important causes of cable failure. The multi-physical field coupling model adopts a variety of physical field interfaces such as electric and acoustic coupling to simulate the discharge waveforms and waveform propagation forms generated by cable joint defects. Firstly, the relationship between voltage and insulation fault is established, and the cable insulation fault is diagnosed by the electric field characteristics. In addition, the electric field characteristics are used to reflect the location of charge agglomeration area, and then the discharge signal at this location is detected to diagnose the deterioration degree of insulation materials.

NA40410

17:30-17:45

Title: Lane Detection Method Based on Color Feature

Authors: Yimin Yang
Presenter: Yimin Yang, Xiamen Institute of Technology, China

Abstract: Lane detection technology is the basic module of safe and intelligent driving. It is conducive to lane path planning, determine the reasonable driving range, to ensure driving safety. Current research generally adopts machine vision to detect lane lines. Firstly, the region of interest (ROI) is separated from the collected image, and the detection area of the image is reduced. Secondly, HSV color space is used to extract specific color pixels by using the obvious color features of road lane lines. Then, the Laplacian of Gaussian (LOG) filtering method is used to remove the noise and ensure the precision of edge detection. Finally, the algorithm of Hough transform is optimized, and the experimental results show that the method can effectively locate the lane line.

NA40411

17:45-18:00

Title: Infrared-RGB image registration for power thermal fault detection based on gradient hash matching

Authors: Yingnan Geng, Weixuan Diao, Yan Zhao
Presenter: Weixuan Diao, Jilin Institute of Chemical Technology, China

Abstract: Infrared-RGB image registration plays an important role in thermal fault detection for monitoring transformer substation, because infrared thermal (IT) image can detect temperature difference information between normal and fault power equipment, and RGB image can detect detail information. But some challenges exist due to different representation of pixels in IT and RGB images. To solve these problems, a new gradient hash matching (GHM) model is proposed. First, image patches for IT and RGB images can be obtained, and thermal fault patch can be found in IT image. Then, pixel character can be described by horizontal and vertical gradient in all image patches. Third, discrete cosine transform (DCT) is used to turn patches from spatial domain to frequency domain. After extracting main character information in frequency domain for IT and RGB images, Hamming distance can be computed between corresponding patches. The proposed algorithm was tested on more than 20 patches of actual images for power equipment of transformer substation, which shows GHM algorithm can obtain correct matching in real scenes.

NA30308

18:00-18:15

Title: Life detection based on UAVs - thermal images in search and rescue operation

Authors: Byukusenge Pascaline, Yihong Zhang
Presenter: Byukusenge Pascaline, Donghua University, China

Abstract: Disasters arise frequently on a global scale and not only seize human lives but also create difficulties to rescue workers, some factors that affect a victim's chances for rescue is the speed in which they are located and dug out. The rescue team work hard to save people by using methods such as trained dogs and robotics, but the resources and time required to deploy a rescue team remain a major issue that reduces people's chances of survival. In recent years, some systems have been developed to speed up the detection of people in

disaster scenarios. Today, UAVs are widely deployed in search operations, as they can seize and control a huge region in a period of time. Moreover, with a base in the sky, UAVs can quickly detect disaster-stricken areas to rescue people. Thus, the accurate detection of individuals in images or videos obtained by drones is a well-suited tool to aid in search and rescue (SAR) missions. Therefore, this research explores the reliability of the yolov4 detection model with the collection of thermal images dataset to address the challenge of bad weather conditions, given that thermal images are not impacted by light or bad weather.

NA40396

18:15-18:30

Title: Multi-area Target Individual Detection with Free Drawing on Video

Authors: Jinwei Lin
Presenter: Jinwei Lin, Monash University, Malaysia

Abstract: This paper has provided a novel design idea and some implementation methods to make a real time detection of multi-areas with multiple detecting areas that are generated by the real time drawing on the screen display of the video. The drawing on the video will remain the output as polylines, and the colors of the outlines will change when the stage of drawing or detecting is changed. The shape of the drawn area is free to be customized and real-time effective. The configuration of the drawn areas can be renewed and the detecting areas are working individually. The detection result should be shown with a GUI designed by Tkinter. The object recognition model was developed on YOLOv5 but can be changed to others, which means the core design and implementation idea of this paper is model-independent. With PIL and OpenCV and Tkinter, the drawing effect is real time and efficient. The design and code of this research is basic and can be extended to be implemented in numerous monitoring and detecting situations.

NA40428

18:30-18:45

Title: Millimeter-wave Radar Target Detection Based On Inter-frame DBSCAN Clustering

Authors: Siyi Xie, Chaofeng Wang, Xiaohua Yang, Yaping Wan, Tiejun Zeng, Zhenghai Liu
Presenter: Siyi Xie, University of South China, China

Abstract: High-resolution millimeter wave radar sensor plays an important role in the process of detecting and classifying targets in complex environments. To process the radar data, clustering is often used to group the measured data. However, due to the different numbers and densities of available target points in different scenarios, data with high sparsity characteristics can cause incomplete target detection in the process of classifying targets, which is very challenging. Therefore, this study introduces a target detection method based on inter-frame DBSCAN clustering. In order to improve the accuracy of target detection, we employ a modified DBSCAN algorithm to cluster the inter-frame data by fusing Doppler features. The method uses a multi-frame merging process to improve the single-frame clustering accuracy, and uses frame sequence features to solve the multi-target noise problem. The effectiveness of the proposed method is verified using real-world dataset, as the clustering accuracy is improved compared to other methods, indicating the advantages of the proposed method.

SESSION 22

Topic: Speech Communication and Speech Recognition
Time: 16:00-18:05, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/86088803609 Password: 111114

- **Session Chair: Prof. Yuxiang Fu, Nanjing University, China**

NA55024

Invited Speech

16:00-16:25

Title: Semantic Communication for Future Wireless Connectivity
Invited Speaker: Assistant Professor Yao Sun, University of Glasgow, UK

Abstract: To cope with the ever-increasing request for higher data rates, it is foreseeable that available resources like spectrum or energy will gradually become scarce in traditional communication networks. Combined with the almost insurmountable Shannon limit, these destined bottlenecks are, therefore, motivating us to hunt for bold changes in the new design of future networks, i.e., making a paradigm shift from bit-based traditional communication to context-based semantic communication. This talk will first introduce the basis of semantic communications and its superiorities on future wireless communication systems. Then, several technical problems in semantic communication system would like to be investigated. Last, some future research directions along with challenges should be discussed in this talk.

NA11028

Invited Speech

16:25-16:50

Title: A dual-channel speech encryption scheme based on silicon photonic microcavity (SPM) chaos and dynamic DNA encoding
Invited Speaker: Professor Jiagui Wu, Southwest University, China

Abstract: We proposed a novel dual-channel speech encryption scheme based on silicon photonic microcavity (SPM) chaos. The encryption is divided into four parts: cross transform, cyclic shift, dynamic DNA encoding, and block-based DNA computing. The proposed scheme uses three sets of different control parameters, which were applied to the three different processes of the scheme, and the keyspace of the proposed scheme is "2" ^"677" . Additionally, a prominent feature of this scheme is that we used two channels of voice during confusion and diffusion. We evaluate the security of the algorithm through various performance indicators. The results show that the average value of unified average changing intensity (UACI) is 33.31%, the number of samples change rate (NSCR) is 99.9992%, and the correlation coefficient can reach 0.000141, which proves that the scheme has a strong ability to resist brute force attacks.

NA11007

16:50-17:05

Title: IMAGE APPROACH TO UZBEK SPEECH RECOGNITION
Authors: Mukhammadjon Musaev, Malika Abdullaeva and Bobur Turaev
Presenter: Malika Abdullaeva, Tashkent University of Information Technologies named after Muhammad Al-Khwarizmi, Uzbekistan

Abstract: This paper proposes the method to extract the features of speech signal from its spectrograms by applying a twodimensional discrete-cosine transform over them. The calculated informative features are classified by three machine learning algorithms with a teacher, i.e. KNN, RF and SVM. As part of the scientific research, a database of Uzbek syllables, words and sentences is formed. Experiments have shown that when the proposed method is applied in combination with KNN classification method, the recognition accuracy of syllables, words and sentences together averaged 98,6%, thus outperforming RF (91,2%) and SVM (94,5%) algorithms.

NA21066

17:05-17:20

Title: Multi-scale Generative Adversarial Network for Speech Bandwidth Extension
Authors: Haosen Lin, Junmei Yang and Xikun Chen
Presenter: Haosen Lin, South China University of Technology, China

Abstract: The purpose of speech bandwidth extension is to recover the high frequency information missing in narrowband speech signal. In recent years, with the introduction of neural networks, the research of speech bandwidth extension has been greatly developed. In this paper, we propose a new speech bandwidth extension method, which increases the sampling rate of speech signal from 8kHz to 16kHz and 48kHz respectively. The model

architecture is based on a multi-scale generative adversarial network (MSGan) with multiple discriminators in both time and frequency domains, and is trained using time domain loss, frequency domain loss, adversarial loss and feature matching loss of the discriminators. The multi-scale waveform discriminators are able to improve the naturalness and clarity of speech. In addition, the combination of time domain and frequency domain can stabilize the training and balance the weights of different perceptual quality factors, thereby improving the perceptual quality of wideband speech. We compare our method with several baseline methods. The results show that our method outperforms other baseline methods on Log-Spectral Distance (LSD) and High-Frequency Log-Spectral Distance (HFLSD), achieving a good balance between time-domain metrics and frequency-domain metrics.

NA30260

17:20-17:35

Title: Feeling the Groove: Identification of Bass patterns from polyphonic audio

Authors: Himadri Mukherjee, Matteo Marciano, Ankita Dhar and Kaushik Roy
Presenter: Himadri Mukherjee, West Bengal State University, India

Abstract: Technology has found its way into disparate spheres of music, from production to performance. Researchers have attempted to automate multitudinous aspects in this domain. One of the interests has been towards the automated generation of music pieces itself. Bass grooves are an integral part of most music pieces. It makes a piece sound complete and bridges the gap between the percussion and melody sections. Thus, it is essential for machines to understand bass grooves for automated music analysis and production. Automatically distinguishing bass grooves is difficult and it aggravates even more for polyphonic music. In polyphonic music, the bass grooves tend to be at a lower volume and its frequency range has profound overlap with the percussion section which contributes to the complexity of identification. In this paper, a system is presented to distinguish bass grooves in the presence of drums. Experiments were performed with 7 grooves totaling 4473 clips which were modeled using MFCC-based features. The highest accuracy of 97.38% was obtained using multi-layer perceptron (MLP) - based classification.

NA30284

17:35-17:50

Title: A GRU-Based Late Reverberation Suppression Method for Single-Channel Speech Dereverberation

Authors: Nuo Li, Wancheng Zhang, Zunwen He, Yan Zhang
Presenter: Nuo Li, Beijing Institute of Technology, China

Abstract: Room reverberation can lead to a decrease in the intelligibility and recognizability of speech. Especially under long reverberation time, the reverberation can be an obstacle to many speech-related tasks. In this paper, a Gate Recurrent Unit (GRU) network based dereverberation method is proposed to suppress late reverberation. By testing in different scenarios, the effectiveness and robustness of the proposed algorithm have been verified. Compared with traditional algorithms that try to suppress the late reverberation, the processed speech of the proposed algorithm has been improved in a bunch of speech quality related evaluation metrics.

NA30276

17:50-18:05

Title: HKSR:A Research of Code-switching Hong Kong Cantonese Speech Recognition based on Multi-Task Rescoring strategy

Authors: Yuting Huang, Bi Zeng, Zhentao Lin and Jia Cai
Presenter: Yuting Huang, Guangdong University of Technology, China

Abstract: Hong Kong Cantonese blends Cantonese and English due to its specific historical background and regional circumstance. This paper studies code-switching in Hong Kong-style Cantonese and proposes a Hong Kong Cantonese Speech Recognition (HKSR) method based on a multi-task rescoring strategy. Firstly, this work innovatively develops the Cantonese-English difference modelling unit to narrow modeling discrepancies between Cantonese and English, and simultaneously alleviate insufficient vocabulary issue caused by the lack of English in the data. Secondly, to better distinguish Cantonese from English, we construct a language identification(LID) subtask. Finally, to jointly train the LID and Automatic Speech Recognition(ASR), this paper develops a multi-task bilingual rescoring module based on U2 end-to-end model. We also investigate the impact of five different rescoring strategies, including multi-task bilingual rescoring, on Hong Kong Cantonese speech recognition. The experimental results demonstrate that HKSR combined with the multi-task bilingual rescoring strategy improves accuracy by 10%-49%.

SESSION 23

Topic: Communication Protocol Design and Standards
Time: 16:25-18:25, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/86924134522 Password: 111114

- **Session Chair: Prof. Qingshui Xue, Shanghai Institute of Technology, China**
  Dr. You You, Purple Mountain Laboratories, China

NA21067

16:25-16:40

Title: Bisers: An Efficient DHCPv6 Bounding Solution

Authors: Quan Zhang, Yi Guo, Baolei Mao, Liancheng Zhang, Hongtao Zhang and Mengfan Liu
Presenter: Quan Zhang, Zhengzhou University, China

Abstract: Network scanning is essential to penetration testing, but the IPv6 network is difficult to scan because of the ample address space. For IPv6 networks managed using DHCPv6, detecting a precise range of DHCPv6 server assigned addresses helps narrow the scope of network scanning. For a DHCPv6 server that uses a continuous address allocation strategy, the boundary of this range is the first and last address it allocates; For a DHCPv6 server that uses a random address allocation strategy, this range is its address pool. We call the process of finding this range the DHCPv6 bounding. In this paper, we propose Bisers, an efficient DHCPv6 bounding solution that can quickly and accurately implement DHCPv6 bounding and effectively help scan IPv6 networks managed using DHCPv6.

NA30214

16:40-16:55

Title: A Time Variant Fluid Model for DCQCN Congestion Control Protocol

Authors: Xinghua Zhao, Junwei Liu, Jun Yao, Yajun Yang, Jilei Chen and Jun Xu
Presenter: Xinghua Zhao, China Mobile(SuZhou)Software Technology Co.,Ltd, China

Abstract: The development of datacenter applications leads to the need for high throughput and ultra-low latency from the network. Remote Direct Memory Access (RDMA), which is becoming prevalent in datacenter networks in recent years， is capable to provide ultra-low latency and high throughput with less CPU utilization. Congestion control is of great importance for RDMA for its lossless feature. Datacenter QCN (DCQCN) is the most commonly used congestion control mechanism and is deployed in large-scale datacenter networks. To ensure the stability and performance of DCQCN, a fluid model is essential. However, due to neglecting time variant factors in the queue dynamic, the existing fluid model is not precise enough. In this paper, we propose a time variant fluid model which can be more effective to evaluate the stability and performance of DCQCN. In this model, the variation of the queue delay and system cut-off frequency is considered. As a result, the non-monotonic stability behavior is eliminated and a more reasonable and accurate evaluation of the congestion control system is acquired.

NA30296

16:55-17:10

Title: 6FloodDetector: An IPv6 Flooding Behaviors Detection Technology Based on Eigenvalues and Thresholds

Authors: Liancheng Zhang, Wenhao Xia, Weibin Huang, Wenwen Du, Yi Guo and Lanxin Cheng
Presenter: Wenhao Xia, Zhengzhou University, China

Abstract: With the rapid deployment and application of IPv6, IPv6 network security incidents and threats are on the rise. Flooding is one of many serious security threats, which makes the victims losing their normal service abilities by sending a large number of malicious packets. While the IPv6 protocol is much more secure than the IPv4 protocol, there are still effective flooding attacks. Therefore, how to detect flooding attacks in IPv6 networks has become an urgent problem. Currently, IPv6 flooding attack detection tools include Suricata, 6shield and others, but only a small number of flooding attacks can be detected. Based on the analysis of 12 flooding attack behaviors in the THC-IPv6 toolkit, an IPv6 flooding behaviors detection technology based on eigenvalues and thresholds is proposed and a corresponding tool 6FloodDetector is designed. When tested in the IPv6 network environment, the

6FloodDetector tool is able to detect all 12 types of flooding attacks in the THC-IPv6 toolkit, while only 3 types can be detected by the 6shield tool.

NA40387

17:10-17:25

Title: Research and Application of Three Protocols Based on AUTOSAR

Authors: Ying Wang, Bo Gao, Bo Niu

Presenter: Ying Wang, Xi'an Aeronautics Computing Technique Research Institute, AVIC Xi′an, China

Abstract: The AUTOSAR (Automotive Open System Architecture) standard includes a set of specifications that describe software architecture, application programming interfaces and methods, in which the layered software architecture enables the development of software components to be carried out independently. The article focuses on the communication in the AUTOSAR architecture, including three buses: the LIN, the J1939 and the FlexRay. Firstly, it introduces the characteristics of these three bus protocols, and then the application of the LIN, the implementation of the J1939 and the key points in the realization of the FlexRay are studied and analyzed in depth. Through its application and software implementation, these three types of bus structures are comprehensively analyzed, which makes the application and implementation of communication in the AUTOSAR architecture more accurate. Especially through the implementation part of this paper, the implementation of communication in this architecture is easier to grasp.

NA11107

17:25-17:40

Title: Hostname Correlation based IPv6 Address Fast Scanning Technology of Windows Nodes

Authors: Ming Hu, Liancheng Zhang, Yi Guo, Lanxin Cheng, Wenwen Du, and Xupan Ma
Presenter: Ming Hu, Zhengzhou University, China

Abstract: Rapid and accurate scanning of alive addresses within the IPv6 intranet is the basis and premise of IPv6 network asset management and security maintenance. Although existing IPv6 address scanning technologies are able to detect some IPv6 global unicast addresses and link-local addresses of Windows nodes, there are still some deficiencies, such as the incomplete scanning results of Windows nodes and the low hit rates. Aims at solving the above deficiencies, this paper explores a new idea to improve the IPv6 address scanning effectiveness based on the correlation of IPv4/IPv6 dual-stack nodes for the first time. A hostname correlation-based IPv6 address fast scanning technology of Windows nodes is proposed, which firstly obtains IPv4 alive addresses via the ARP scanning, then uses NBNS protocol to obtain hostnames of these IPv4 hosts, and finally queries their IPv6 addresses corresponding to these hostnames through the mDNS protocol. A typical IPv6 intranet environment composed of 4 different OS-version Windows nodes (including Windows 11 and Windows Server 2019) is built for testing. Compared with the 4 Nmap scripts of IPv6 intranet address scanning, the LinkScan6, which is implemented by using this proposed technology, can detect at least 6 more IPv6 addresses than Nmap scripts, and increase at least 2 more IPv6 address types on a single node than Nmap scripts. Moreover, the number of Windows versions obtained by the LinkScan6 is 4 more than 3 out of 4 Nmap scripts.

NA21081

17:40-17:55

Title: A Differentiated Identity Authentication Protocol for VANETs Based on Safety Level

Authors: Yinzhu Yu, Xiaoyan Huang, Ke Zhang, Fan Wu, Supeng Leng
Presenter: Yinzhu Yu, University of Electronic Science and Technology of China, China

Abstract: In Vehicular Ad Hoc Networks (VANETs), authentication is a crucial security service for both inter-vehicle and vehicle-roadside unit communications. Most of traditional protocols do not consider the impact of vehicular safety on authentication efficiency, thus implementing the same authentication process for all vehicles, which leads to large overhead and inflexible authentication. In this paper, we propose a differentiated identity authentication protocol based on vehicular safety level to reduce the authentication overhead and increase flexibility. In the proposed protocol, Roadside Unit (RSU) can choose appropriate authentication method for vehicle according to its safety level, which is evaluated by hardware safety and behavior safety. In addition, anonymous mutual authentication with key agreement is enabled by exploiting the trapdoor collision property of chameleon hash functions, thus the proposed

protocol can effectively avoid the communication overhead caused by the transmission of certificates, and there is no key escrow problem. At the same time, combined with Physical

Unclonable Functions (PUFs) technology, the proposed protocol can resist physical attacks. Simulation results demonstrate that the proposed protocol can not only effectively improve the flexibility of vehicular authentication, but also have advantages in reducing computation delay and communication overhead.

NA11108

17:55-18:10

Title: CGA Configuration Detection Method of IPv6 Nodes by Combining Active Probing with Passive Sniffing

Authors: Liancheng Zhang, Jianping Sun, Juwei Yan, Yi Guo, Lanxin Cheng, and Wenwen Du
Presenter: Liancheng Zhang, National Digital Switching System Engineering and Technological Research Center, China

Abstract: To ensure the security of neighbor discovery messages and processes, IPv6 subnets are increasingly deploying secure neighbor discovery (SEND) mechanisms. Although the cryptographically generated address (CGA) mechanism is the operating basis of the SEND mechanism, there is currently no technology or method for CGA configuration detection. To this end, the difficult problems lacking of CGA configuration detection method (such as the constraints caused by built-in neighbor discovery mechanism, identification of different SEND transition scenes, IPv6 address transformation) are analyzed through the in-depth analysis of the SEND mechanism and the CGA mechanism. Moreover, a CGA configuration detection method of IPv6 nodes by combining active probing and passive sniffing (CCD6-APPS) is proposed. Based on active probing and passive sniffing of active IPv6 nodes in the target IPv6 subnet, the proposed CCD6-APPS method can learn the SEND implementation methods and CGA configuration parameters of IPv6 nodes, and finally detect the coverage of SEND nodes in the target IPv6 subnet. By setting up a typical IPv6 neighbor discovery experimental environment and conducting targeted tests, the experimental results prove the effectiveness of the SSD6-APPS method, and the additional impact on the target IPv6 subnet is very small.

NA11109

18:10-18:25

Title: A Packet Fields Authenticity Check based Detection Technology of IPv6 Spoofing Behaviors

Authors: Liancheng Zhang, Wenhao Xia, Xinyu Song, Lanxin Cheng, Wenwen Du, and Xupan Ma
Presenter: Wenhao Xia, Zhengzhou University, China

Abstract: With the increasing popularity of IPv6 network deployment and application, more and more security problems of the IPv6 protocol mechanism and protocol stack are exposed. Among them, IPv6 network spoofing attacks are not only easy to implement, but also extremely harmful. However, current mainstream IPv6 intrusion detection tools (such as Suricata and 6shield) can only detect a small amount of IPv6 network spoofing behaviors. It is necessary and urgent to improve the effectiveness and accuracy of IPv6 network spoofing behaviors detection technologies. By the behavior characteristics analysis of typical IPv6 network spoofing attack tools in thc-ipv6 and ipv6toolkit, a packet fields authenticity check based detection technology of IPv6 spoofing behaviors is proposed. 6FakeDetector, an IPv6 network spoofing behaviors detection tool, is designed and implemented as well. The comparative test results between 6FakeDetector and 6shield show that in a typical IPv6 network testing environment, 6FakeDetector can detect 7 more types of IPv6 network spoofing attacks, such as fake DHCPv6 server attack.

SESSION 24

Topic: Coding and Modulation Technology
Time: 16:20-18:20, Nov. 13, Beijing Time, GMT+8
ZOOM Link: https://us06web.zoom.us/j/89327674351 Password: 111114

- **Session Chairs:**
  Assoc. Prof. Shunwai Zhang, Nanjing University of Posts and Telecommunications, China
  Assoc. Prof. Deyuan Chen, University of Chinese Academy of Sciences, China

NA11101

16:20-16:35

Title: Hybrid Decoding of BP and ADMM for LDPC codes
Authors: Dong Wang, Zhiping Shi, Li Deng
Presenter: Dong Wang, University of Electronic Science and Technology of China, China

Abstract: The alternating direction method of multipliers (ADMM) algorithm has been used in the linear programming decoding of low-density parity-check (LDPC) codes in recent years. The ADMM has similar complexity with the belief propagation (BP) algorithm and better performance under some conditions. In this paper, we propose a hybrid decoder based on BP and ADMM-penalized decoder, which is called BP-ADMM decoder. In order to reduce the undetectable error of probability (UEP) after BP decoding as much as possible, we add cyclic redundancy check (CRC) before LDPC encoding. Before the output of the hybrid decoder, we add a Hamming distance comparison decision, and select the codeword with a smaller Hamming distance from the initial hard decision as the output.

NA21089

16:35-16:50

Title: Low Complexity Scaling Factor Aided Decoder for Double Binary Convolutional Turbo Codes
Authors: Jie Gan, Qihua Huang, Yongli Chen, Sishan Chen and Huan Li
Presenter: Sishan Chen, Beijing Institute of Technology, China

Abstract: Double binary convolutional turbo code (DB-CTC) has been utilized in communication systems since its outstanding performance, but it has high decoding complexity and latency. In this paper, we design efficient DB-CTC decoding scheme to improve the decoding performance and complexity in hardware implementation. We firstly analyze the influence of scaling factor for extrinsic information of DB-CTC decoders. Then, the optimized scaling factor is searched and applied for various types of decoders to reduce the decoding complexity and latency. Moreover, we simulate the performance of the proposed scaling factor aided (SF) decoders under integral operations, which is able to show the performance of decoders on hardware implementations more precisely. Simulation results validate the effectiveness of scaling factor for different code lengths and code rates. In addition, the scaling factor aided parallel DB-CTC decoder outperforms the max-log-MAP decoder, and approaches the performance of the optimal log-MAP decoder with much lower decoding complexity and latency.

NA21033

16:50-17:05

Title: Research on Autoencoders for Higher Order Modulation
Authors: Qiaoshou Liu, Gancheng Yu, Junjie Liu, Xiong Zhou
Presenter: Qiaoshou Liu, Chongqing University of Posts and Telecommunications, China

Abstract: Aiming at the problem that previous autoencoders (AEs) were generally unable to handle higher-order modulated signals with a input encoded by one-hot, a strategy of segmented encoding of the input data and a parallel-convolutional neural network (PCNN) model are used to apply the AE to high order modulation. The simulation results show that the proposed scheme can handle 4096QAM signals and has an acceptable classification accuracy which is beyond the traditional algorithm. In addition, the Gate Recurrent Unit (GRU) layers are introduced into autoencoder for channel coding and result a huge gain.

NA30256

17:05-17:20

Title: ADMM-Induced Low-Complexity Precoder Design Algorithm for Rate-Splitting Multiple Access

Authors: Guo Li, Chao Wang and Haibin Zhang
Presenter: Guo Li, Xidian university, China

Abstract: Rate splitting multiple access (RSMA) has emerged as a promising technique in multi-antenna downlink transmissions, which jointly encodes the private and common messages into a common stream for removing part of interference incurred by signal multiplexing and improving the spectral efficiency. Due to the decodability constraint of the common message at each user, the precoder optimization is non-convex, which lacks efficient algorithms. For facilitating the practical implementation of RSMA in future wireless networks, e.g., massive multiple-input multiple-output (MIMO), we propose an alternating direction method of multipliers (ADMM)-induced iterative algorithm to optimize the precoder, where the precoder is optimized for maximizing the sum rate at multiple users under the decodability constraint of the common message. Specifically, we first employ the weighted minimum mean square error (WMMSE) algorithm to transform the non-convex problem into a sequence of convex problems, and then the ADMM algorithm is adopted to decouple the optimization variables and obtain solutions of each subproblem in closed form. Numerical results demonstrate that the proposed algorithm not only can achieve almost the same performance as existing WMMSE-based algorithms, but also has a faster convergence rate and lower computational complexity.

NA30301

17:20-17:35

Title: A Low-Complexity Analysis of Finite-Length LT Codes Based on Degree Distribution Evolution

Authors: Zhongyi Wang, Jin Shang, Yimeng Zhang, Fengyu Wang and Wenjun Xu
Presenter: Zhongyi Wang, Beijing University of Posts and Telecommunications, China

Abstract: Luby Transform (LT) codes are key technologies to solve multiple access in future 6G wireless networks, and performance analysis is a significant part of such multiple access schemes. In this paper, we present a low-complexity performance analysis scheme for finite-length LT codes. First, matrix model is proposed to describe LT encode and belief-propagation (BP) decoder. Then, the degree distribution change during decoding is investigated based on the matrix model and the low-complexity performance analysis scheme is proposed. Numerical results show that the proposed analysis scheme significantly outperforms other schemes with low data length and precisely predicts the error probability of LT codes under the large or small overhead with high data length.

NA30221

17:35-17:50

Title: Design and analysis for Physical-layer Network Coding with Reconfigurable Superposition Mapping

Authors: Jiaqi Li, Meng Tang, Hao Wang, Jianhua Chen, Yongtao Yu
Presenter: Jiaqi Li, Yunnan University, China

Abstract: For Physical-layer Network Coding (PNC) with high-order modulation, the problem of ambiguity mapping is a focus field. In this paper, we present a PNC with Reconfigurable Superposition Mapping (RSM-PNC) scheme. Based on this scheme, a two-way relay communication system model consisting of the source and relay nodes using 16QAM modulation is constructed. In addition, the PNC demodulation and mapping rule at the relay node is displayed, the decoding rule at source node is redesigned, and the calculation formula of relay symbol error rate (SER) under Additive White Gaussian Noise (AWGN) is derived as well. The simulation results show that the proposed RSM-PNC scheme not only solves the problem of ambiguity mapping, but also has more advantages compared with PNC using Hierarchical Modulation scheme.

NA40366

17:50-18:05

Title: MIMO Transmit Precoding Design with Variable Precision Computing: Performance vs Complexity

Authors: Kaixuan Bao, Wei Xu, Jiehao Miao, Jingrui Li, Jizhou Bai, and Bingbin Huang
Presenter: Kaixuan Bao, Southeast University, China

Abstract: The trade-off between performance and complexity is a frequently discussed topic in wireless communication, as the dimension of signal processing scales up dramatically with the use of massive multiple-input-multiple-output (MIMO). With existing works the trade-off is made with algorithm specific approaches. However, the precision of computing, which is directly related to both performance and complexity, is another dimension to the problem which is seldom considered. In this paper, we established a framework of variable precision computing (VPC) which enables each step of calculation to be processed with its own optimal precision. We first analysis the propagation of relative error with finite precision arithmetics and establish the optimization problem to trade-off between performance and complexity. Then two feasible solutions to solve the optimization problem, namely Online VPC and Offline VPC, are introduced. Finally, a case study of multi-user zero-forcing (ZF) precoding using the proposed VPC is presented which exhibits huge advantage over traditional fixed length computing on both performance and complexity.

NA30282

18:05-18:20

Title: Background Knowledge Aware Semantic Coding Model Selection

Authors: Fangzhou Zhao, Yao Sun, Runze Cheng, Muhammad Ali Imran
Presenter: Fangzhou Zhao, University of Glasgow, Glasgow, UK

Abstract: Semantic communication is deemed to break Shannon channel capacity by transmitting extracted semantics rather than all binary bits. One critical challenge in semantic communication system is how to select a matching semantic coding model (SCM) in light of complicated source information, diversified user background knowledge (BK) and dynamic wireless channel. In this paper, we mathematically model the relationship among different BKs by using graph theory, and introduce a metric to evaluate SCMs performance as per BK relationships. Then, we propose a Background knowledge Aware SCM SElection (BASE) scheme, where a deep learning algorithm is exploited to accurately predict SCM performance in context of the modeled BK, guiding the SCM selection. Numerical simulation results show that the BASE has superiorities in information recovery accuracy along with the probability of selecting the optimal SCM when compared with other benchmarks.

SESSION 25

Topic: Electromagnetic Theory and Antenna Design
Time: 9:00-11:20, Nov. 14, Beijing Time, GMT+8
ZOOM Link: https://us02web.zoom.us/j/84231845366 Password: 111114

- **Session Chair: Prof. Falin Liu, University of Science and Technology of China, China**

NA55020

Invited Speech

9:00-9:25

Title: AI-CEM: Artificial Intelligence assisted Computational Electromagnetics
Invited Speaker: Prof. Shaolin Liao, Sun Yat-sen University, China

Abstract: AI-CEM makes full use of Artificial Intelligence (AI) to boost the performance of the CEM simulation of large-scale electromagnetics scattering and design problems. It has great potential applications in next-generation wireless communication such as 5G beyond (5GB) and even 6G, including but not limited to modelling, simulation and design of massive MIMO (Multiple Inputs Multiple Outputs) antennas and arrays, RIS (Reconfigurable Intelligent Surfaces), radar sensing & imaging and so on. Our group been working on efficient CEM algorithms since 2005 and so far has developed multiple algorithms that are 10-100 times as fast than most conventional CEM algorithms: for example, our Ping-Pong algorithm is 10 times as fast as the conventional Method of Moments (MoM); our LIPO (Local Iterative Physical Optics) is 100 times as fast as the MoM; and the Taylor-FFT algorithm is 100 as fast as the dyadic Green′ s function convolution method. This talk will cover these efficient CEM algorithms, as well as our recent effort in developing AI assisted CEM algorithms for arbitrary complex electromagnetics problems.

NA40353

Invited Speech

9:25-9:50

Title: Bit Error Rate Analysis of Mechanical Antenna Based on Frequency Modulation
Invited Speaker: Assoc. Prof. Xuebo Zhang, Northwest Normal University, China

Abstract: At present, in the field of communication, there is little research on the bit error rate of mechanical antenna transmission based on frequency modulation. However, the study of BER under specific conditions is of great significance to enhance the performance of communication systems and improve the quality of data transmission. In the process of frequency modulation of mechanical antenna, the continuity of motor speed regulation will affect the continuity of signal frequency and amplitude generated by the system, which will eventually lead to high bit error rate of the system. In this paper, a mechanical antenna communication system is established to generate symbol signals of different periods. By observing the eye diagram of the baseband signal after demodulation and the relationship between SNR and BER of the mechanical antenna and the electrical antenna, the reasons for the high bit error rate of the communication system are analyzed, and the corresponding solutions are proposed.

NA21058

9:50-10:05

Title: Simulation of Electromagnetic Metamaterial Carpet for Ground Target Radar Stealth
Authors: Xudong Pang, Liping Wu, Beibei Cao, and Shouzheng Zhu
Presenter: Xudong Pang, Shanghai Publishing and Printing College, China

Abstract: In this paper the theoretical basis of the electromagnetic metamaterial stealth carpet is introduced. Then the electromagnetic scattering performance of the designed stealth carpet is simulated and verified by the finite element method simulation software and the metamaterial parameter distributions of each direction are given. Through the analysis of the carpet shaped cloaking equipment, the possible radar stealth applications for special ground targets or ship-borne equipments are proposed, which has a potential military value for protecting important sites or equipments of national defense systems.

NA21030

10:05-10:20

Title: A Wideband MNG-TL Planar Microstrip Antenna for WLAN Applications

Authors: Shumin Liao, Hui Lin, Heng Guo, Yixiang Song and Wei Liu
Presenter: Shumin Liao, Lenovo Group Ltd., China

Abstract: A novel wideband planar microstrip antenna with stable omnidirectional radiation characteristics is proposed. The antenna is composed of a series of sections of microstrip line distributed on top and bottom layers alternately. Periodical capacitive loading is realized by dividing the microstrip radiators into many disconnected strips with gradient length, which works as the artificial mu-negative (MNG) transmission line (TL). The MNG-TL has a unique property to support a zero propagation constant, thus resulting a more consistent current distribution on the TL. An Impedance bandwidth of 31.9% is achieved, and good horizontally omnidirectional radiation performance is realized while the realized gain of more than 3dBi is obtained in the whole wideband. Thus, the proposed antenna is good candidate for 5-GHz wireless local area network applications.

NA30268

10:20-10:35

Title: A Compact Multi Antenna Design with High Isolation in 5G Full Screen Mobile Phone

Authors: Longjie Yu, Xinrong An
Presenter: Longjie Yu, TCL Communication (Ningbo) Co., Ltd, China

Abstract: A compact three antenna design scheme with high isolation is proposed. These three adjacent antennas are located at the bottom of mobile phone, with total size of 75.0mm by 32.0mm, the bottom clearance and side clearance of the mobile phone are 3.5mm and 1.3mm respectively. Seen from the back of mobile phone, antenna 1 (A1), antenna 2 (A2) and antenna 3 (A3) are arranged in order from left to right. These three antennas adopt injection molding process, and each antenna is radiated by metal frame and laser direct structuring (LDS). The antenna type of A1, A2 and A3 is inverted F antenna (IFA) and parasitic antenna, loop and parasitic antenna, IFA respectively. All three antennas support middle band and high band, while frequency range of middle band and high band are 1.71GHz – 2.2GHz, 2.3GHz – 2.69GHz respectively. The measured results show that, the passive efficiency in free space of A1, A2 and A3 are -5.5dB, -5.1dB and -5.1dB respectively. Compared with free space, there are at least one or two antennas whose attenuation are less than 4dB in the mode of head and hand. Two wide common ground design is applied to improve three antennas′ isolation, corresponding isolation are -10dB, -15dB and -21dB. As A2 is the transmitting antenna, the measured SAR values of A2 are within the safety range specified by Federal Communications Commission (FCC). A 5G mobile phone equipped with these three antenna has been mass produced and shipped.

NA30285

10:35-10:50

Title: Stable and Robust Improvement of AMP for Supporting Massive Connectivity

Authors: Xinpei Zhou, Yingchun Yang, Jie Zhang, Yanyan Wang and Li Li
Presenter: Xinpei Zhou, Southwest Jiaotong University, China

Abstract: Compressive sensing techniques are widely leveraged to realize the active user detection of grant-free access in massive machine-type communications (mMTC). As a class of efficient data reconstruction methods, approximate message passing (AMP) algorithm and their varieties have attracted considerable attentions. However, as a multiple measurement vector (MMV) problem, AMP based active user detection in multi-antennas systems is difficult to converge, especially when the antenna number of base station (BS) and signal-to-noise ratio (SNR) grow to large value. In order to overcome this drawback of existed MMV-AMP algorithm, we develop an enhanced MMV-AMP algorithm that employs an adaptive iteration stopping criterion and a damping operation. Furthermore, deterministic sequences with low coherence are proposed to replace ordinary random preamble sequences, which could further improve the performance of enhanced MMV-AMP. Simulation results confirm that the proposed scheme efficiently improves robustness and stability of MMV-AMP method.

NA30253

10:50-11:05

Title: A supplementary antenna alignment method based on Terahertz communication between LEO-LEO

Authors: Dongnuan Cui, Weiqian Duan, Shutian Song, Ruiliang Song, Niefeng Sun, Ning Liu
Presenter: Dongnuan Cui, The 54th Research Institute of China Electronics Technology Group Corporation (CETC54), China

Abstract: The space application of terahertz wave is focused on the communication in the Low orbit satellite (LEO) inter-satellite links. Two small satellites do not have antenna servo systems, the optimum alignment state of the antenna is determined by fine-tuning the satellite's posture and supplementing it with software. The satellite's fine-tuning posture uses the "+" scanning mode. The test data performs a series of operations (such as filtering, fast Fourier transform, down-sampling, etc) on the ground and the satellite. The receiving satellite processes the data and loads the time information into frames for downloading, matches the remote control and telemetry information downloaded to the ground, finds out the corresponding two-star attitude of the strongest signal point, passes this attitude information to the satellite control center, adjusts the satellite control center to the best attitude of the satellite, and then switches the terahertz load to the normal communication state, completes one-way information transmission of the terahertz load between the two satellites.

NA40405

11:05-11:20

Title: Improving Separation Performance of Wireless Communication Signals with Antenna Angle Adjustment

Authors: Miaomiao Gu, Pengcheng Guo, and Miao Yu
Presenter: Miaomiao Gu, Army Engineering University of PLA, China

Abstract: Blind source separation (BSS) is a research hotspot in signal processing and neural networks. Based on its inherent advantages, BSS has become a promising approach to realize spectrum utilization and interference cancellation simultaneously. However, BSS encounters the robustness problems in practice. In order to improve the blind separation performance of wireless communication signals, we propose a BSS method with antenna angle adjustment at the receive end. The main idea is to change the mixing situation by adjusting the angle based on the characteristic that the antenna gain is affected by the angle. According to the position information of transmitted signals and receiving antennas, we can find the optimal angle where the output signal to interference ratio (SIR) achieves the maximum. The simulation results show that the proposed method can improve the separation performance significantly.

SESSION 26

Topic: Artificial Intelligence Algorithm and Data Model
Time: 9:00-12:10, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/81069396768 Password: 111114

- **Session Chairs:**
  Prof. Qiao Liu, University of Science and Technology of China, China
  Assoc. Prof. Qiuming Zhu, Nanjing University of Aeronautics and Astronautics, China

NA11056

Invited Speech

9:00-9:25

Title: Identification of Wellbore Flow Abnormal Working Conditions Based on Deep Learning

Invited Speaker: Professor Yonghua Li, Beijing University of Posts and Telecommunications, China

Abstract: Artificial intelligence is widely used in the oil industry. During the process of oil production, the parameters of oil wells will change under different working conditions, which may lead to abnormal operation of oil wells. Once the abnormal operation occurs, the whole production of the oil field will be affected, so it is very important to identify the abnormal operation of the production wellbore flow. To address this problem, an end-to-end deep learning fusion (EDF) model is proposed in this paper, which combines the advantages of deep neural network (DNN), convolutional neural network (CNN), and long short-term memory (LSTM) models to identify abnormal wellbore flow conditions. The experimental results show that the EDF model has higher accuracy and area under curve (AUC) value for identifying the abnormal working conditions of wellbore flow, which can perform the task of identifying the abnormal working conditions well.

NA11093

Invited Speech

9:25-9:50

Title: An Energy-Constrained Optimization-Based Structured Pruning Method for Deep Neural Network Compression

Invited Speaker: Professor Qiang Li, Southwest University of Science and Technology, China

Abstract: Deep neural networks are widely used in modern intelligent applications due to their superior ability to express reality, and these intelligent applications run on highly energyconstrained edge devices. Neural network structured pruning is an efficient method to reduce the energy consumption of neural networks. This paper proposes an energy-constrained optimization-based structured pruning method to compress deep neural network. This method uses the energy budget provided by edge devices as a constraint for neural network pruning. The key idea is to formulate deep neural network structured pruning as an optimization problem, in which the energy estimate of each layer is used as the Frobenius norm optimization constraint for the convolution kernel weights. Then the importance of all convolution kernels in the network can be evaluated, thereby the neural network structure can be pruned according to the importance to reduce the energy consumption and memory size of the neural network. Compared with traditional heuristic structured pruning methods, our proposal enables neural networks to achieve higher accuracy with the same or lower energy budget.

NA11082

Invited Speech

9:50-10:15

Title: Malware classification based on GAF visualization of dynamic API call sequence

Invited Speaker: Professor Hongmei Zhang, Guilin University of Electronic Technology, China

Abstract: Due to the constant updates of malware and its variants and the continuous development of malware obfuscation techniques. Malware intrusions targeting Windows hosts are also on the rise. Traditional static analysis methods such as signature matching mechanisms have been difficult to adapt to the detection of new malware. Therefore, this paper proposes a novel visual detection method of malware. We propose a first-time method to convert the Windows API call sequence with sequential nature into feature images based on the Gramian Angular Field (GAF) idea, and train a neural network to identify malware. The experimental results demonstrate the effectiveness of our proposed method. For the binary

classification of malware, the GAF visualization image of the API call sequence is compared with its original sequence. After GAF visualization, the classification accuracy of the classic machine learning model MLP is improved by 9.64%, and the classification accuracy of the deep learning model CNN is improved by 4.82%. Furthermore, our experiments show that the proposed method is also feasible and effective for the multi-class classification of malware.

NA55030

Invited Speech

10:15-10:40

Title: Big Time Series Data: Management, Governance and Analytics

Invited Speaker: Professor Hongzhi Wang, Harbin Institute of Technology, China

Abstract: Time series is crucial in many applications in various aspects of modern society including manufactory, finance, smart city and online education. The effective management, governce and analytics of big time series data play important roles in modern society, which also bring the challenges of strong co-relationship, continues data types and ordered time window. In this talk, I will introduce the applications of time series, the challenges of big time series data management and analytics as well as our research results in this area including time series database, various kinds of time series analytics algorithms and time series cleaning algorithms and systems.

NA40406

10:40-10:55

Title: Performance evaluation of prediction methods of social statistics for nighttime light data

Authors: Xiaomin Du, Feng Li and Jing Tong
Presenter: Xiaomin Du, China Aero Geophysical Survey and Remote Sensing Center for Natural Resources, Beijing, China

Abstract: The observed brightness of satellite nighttime lights (NThe observed brightness of satellite nighttime lights (NThe observed brightness of satellite nighttime lights (NTL) is often considered as a proxy measure for large-scale socio-economic indicators, such as population, gross domestic product (GDP), and energy consumption. However, few studies have explored and compared the correlation between NTL data and socioeconomic indicators from a grid scale and further analyzed their correlations. Aiming at the uncertainty problem in the method of social statistic prediction of NTL, based on DMSP-OLS, NPP-VIIRS NTL data and social statistics (GDP, population and energy consumption) of Beijing-Tianjin-Hebei Counties in 2013, five regression models including linear, quadratic, power, least-squares support vector machine (LSSVM) and BP neural network (BPNN) were used to predict social statistics at the scales of 500 m, 1 km and 2 km respectively and evaluate the predicted results. The results indicate that the accuracy of NPP-VIIRS data in predicting social-economic indicators was significantly higher than that of DMSP-OLS data; the BPNN model predicted the best social statistics while the power model predicted the worst; The accuracy of social statistics predicted by two NTL data on three scales is basically the same. The research results provide new insights into the use of data to estimate and forecast population, GDP and energy consumption.TL) is often considered as a proxy measure for large-scale socio-economic indicators, such as population, gross domestic product (GDP), and energy consumption. However, few studies have explored and compared the correlation between NTL data and socioeconomic indicators from a grid scale and further analyzed their correlations. Aiming at the uncertainty problem in the method of social statistic prediction of NTL, based on DMSP-OLS, NPP-VIIRS NTL data and social statistics (GDP, population and energy consumption) of Beijing-Tianjin-Hebei Counties in 2013, five regression models including linear, quadratic, power, least-squares support vector machine (LSSVM) and BP neural network (BPNN) were used to predict social statistics at the scales of 500 m, 1 km and 2 km respectively and evaluate the predicted results. The results indicate that the accuracy of NPP-VIIRS data in predicting social-economic indicators was significantly higher than that of DMSP-OLS data; the BPNN model predicted the best social statistics while the power model predicted the worst; The accuracy of social statistics predicted by two NTL data on three scales is basically the same. The research results provide new insights into the use of data to estimate and forecast population, GDP and energy consumption.TL) is often considered as a proxy measure for large-scale socio-economic indicators, such as population, gross domestic product (GDP), and energy consumption. However, few studies have explored and compared the correlation between NTL data and socioeconomic indicators from a grid scale and further analyzed their correlations. Aiming at the uncertainty problem in the method of social statistic prediction of NTL, based on DMSP-OLS, NPP-VIIRS NTL data and social statistics (GDP, population and energy consumption) of Beijing-Tianjin-Hebei Counties in 2013, five regression

models including linear, quadratic, power, least-squares support vector machine (LSSVM) and BP neural network (BPNN) were used to predict social statistics at the scales of 500 m, 1 km and 2 km respectively and evaluate the predicted results. The results indicate that the accuracy of NPP-VIIRS data in predicting social-economic indicators was significantly higher than that of DMSP-OLS data; the BPNN model predicted the best social statistics while the power model predicted the worst; The accuracy of social statistics predicted by two NTL data on three scales is basically the same. The research results provide new insights into the use of data to estimate and forecast population, GDP and energy consumption.

NA21078

10:55-11:10

Title: Multi-Model Bus Arrival Time Prediction using Real-Time Online Information

Authors: Zihao Yang, Chan-Tong Lam and Benjamin K. Ng
Presenter: Zihao Yang, Macao Polytechnic University, China

Abstract: Precise bus arrival time prediction can attract more passengers to take public transportation. In this paper, we propose a multi-model bus arrival time prediction approach using real-time online information, by decomposing the travel time into the sum of dwell time and link time, which are predicted separately and then summed to obtain the predicted trip time between adjacent bus stops. Four prediction models, namely Simple Moving Average (SMA), Artificial Neural Network (ANN), Long Short Term Memory (LSTM) and Hybrid Model (SMA and LSTM), are used to evaluate and compare the performance of the proposed multi-model prediction approach. Using the proposed hybrid multi-model, it was found that the average MAPE% among SMA, ANN, LSTM and Hybrid Model are 33.56%, 32.15%, 26.76% and 23.45%, respectively. The proposed hybrid multi-model with SMA and LSTM gives the best performance, with a MAPE improvement of about 3.3%.

NA40345

11:10-11:25

Title: Power Domain Named Entity Recognition Based on Rules and Dictionaries

Authors: Jue Jiang, Rongheng Lin, Hua Zou
Presenter: Jue Jiang, Beijing University of Posts and Telecommunications, China

Abstract: There are massive electricity data in the daily management, normalization operation, troubleshooting and other aspects of the power domain, but these professional and accurate data have not been fully mined and used. Constructing a power domain knowledge map can not only help power grid companies tap the value of these massive data and realize the integration of power knowledge, but also greatly facilitate the staff's query and acquisition of power information, and improve the work efficiency of the power industry. NER (name entity recognition) is the basis for constructing knowledge graph. This paper studies name entity recognition based on dictionaries and rules. It can standardize and accurately extract electricity from unstructured text through three methods: power entity dictionary, feature character rule matching, and part-of-speech combination rule matching. Related entities provide high-quality and high-precision entities for the construction of power domain knowledge graph.

NA40382

11:25-11:40

Title: Continuous-Graph Attentional Neural Networks for Temporal Link Prediction

Authors: Jiawei Shi and Jian Shu
Presenter: Jiawei Shi, Nanchang Hangkong University, China

Abstract: Link prediction on temporal networks is a hot issue in the research of network evolution. Existing works typically employ graph neural networks and a temporal feature extractor to build prediction model. However, such methods are facing two problems: 1) the over smoothing becomes a challenge when considering capturing deeper spatiotemporal dependence. 2) temporal feature extraction is still a challenge. In this research, we introduce a novel link prediction model named Continuous-graph attentional neural networks for temporal link prediction (LP-CGA). The model is based on an improved Auto-Encoder, which not only embeds structure information of temporal networks but also considers the evolution trend. Then, the deeper spatiotemporal information is mined through an attention-based ordinary differential equation (ODE). Two real dynamic network datasets, ITC and Infocom06, are used for experiments. The experimental results show that the proposed model is more accurate compared to other baseline methods.

NA11097

11:40-11:55

Title: A New Blind Equalization Algorithm Based on Data Reusing

Authors: Liang Wang and Hewen Wei
Presenter: Liang Wang, PLA Strategic Support Force Information Engineering University, China

Abstract: Soft Decision Adjusted Modulus Algorithm (SDAMA) is a new blind equalization algorithm with high performance which introduces soft decision to reduce misestimation while maintaining low residual error. However, the convergence rate is not fast when dealing the burst signals and time-varying channel signals. In addition, SDAMA not only fails to correct the phase deflections in the received signals but also generates additional errors. In this paper, we construct a new data reusing algorithm to further improve the convergence rate of the equalization algorithm, and combine decision directed (DD) scheme to correct the phase deflection.

NA00008

11:55-12:10

Title: Anomaly Detection Method For Interactive Data Of Third-Party Load Aggregation Platform Based On Multidimensional Feature Information Fusion

Authors: Zhang Xiao, Zheng Chenghao, Wu Xianglong, Wang Tianpeng, Gao Hailong, Guo Jing
Presenter: Xiao Zhang, Xuzhou Power Supply Company of State Grid Jiangsu Electric Power Co, China

Abstract: With the development and using of clean energy, more and more distributed generations including photovoltaic panels, which can generate the power by consuming the new and renewable energy are connected to the system. However, the power grid system is vulnerable to attack due to the greater load pressure and security risks. This paper presents a third-party load aggregation platform interactive data anomaly detection method based on multi-dimensional feature information fusion and deep residual network analysis in a comprehensive energy scenario. The method we proposed can collect, extract and analyze the interactive data of the third-party load aggregation platform, and then analyze and detect the anomaly of the load data collected by the platform from the perspective of multi-dimensional feature fusion analysis. Specifically, by extracting the initial data features of the multi-dimensional third-party load platform, this paper adopts wavelet transform and spectral clustering technology to denoise, filter pseudo data features and perform feature clustering analysis due to the magnanimity and dynamic acquisition characteristics of power load data; Then, by using the cross layer direct connected edge characteristics of the depth residual network, the error back propagation attenuation in the depth learning is constructed, and the depth network model of abnormal data detection is trained to achieve the task of abnormal data detection of the third-party load aggregation platform interactive data. The main contribution of this paper is that the method of the third-party load aggregation platform interactive data anomaly detection based on multi-dimensional feature information fusion and deep residual network is presented, and the test results have shown the efficient of the method.

SESSION 27

Topic: Communication Aware Computing in Wireless Systems
Time: 9:00-11:20, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/81673586285 Password: 111114

- **Session Chair: Assoc. Prof. Zhen Chen, South China University of Technology, China**

NA55015

Invited Speech

9:00-9:25

Title: Physical Layer Security in Integrated Sensing and Communication systems
Invited Speaker: Professor Zesong Fei, Beijing Institute of Technology (BIT), China

Abstract: Facing the scarcity of spectrum resources, Integrated Sensing and Communication systems (ISAC) has received great attention as a potential solution. The ISAC system achieves communication and sensing capabilities through an integrated waveform and hardware platform, which can effectively save costs and spectrum resources. However, the inclusion of information signaling in the probing waveform brings new challenges to communication security. The physical layer security (PLS) technique utilizes the channel randomness of the transmission medium to achieve secure communication, and the sensing capability provides new opportunities for the realization of PLS.

NA55014

Invited Speech

9:25-9:50

Title: On the Design of Optimal One-Shot Distributed Combining for Cooperative Multi-TRP Systems
Invited Speaker: Assoc. Prof. Zhong Zheng, Beijing Institute of Technology, China

Abstract: Multi-Transmission and Reception Point (TRP) networks will become one of the key components of future mobile communication systems in order to improve reliability, coverage, and capacity performance through flexible deployment scenarios. The key feature of multi-TRP is to provide joint scheduling and transmissions/receptions via dynamic coordination. However, the coordination between TRPs requires the exchange of high-volume channel state information (CSI) and a large amount of signaling, which incurs unpredictable delays and performance loss. This paper tackles this issue by considering the multi-user signal detection at the multi-TRP network, where the uplink signals of multiple ground users are cooperatively recovered. In particular, to reduce the signaling exchange and the coordination latency, a two-stage distributed minimum mean squared error (MMSE) detection is proposed for the multi-TRP network, which merges the local MMSE detections at each TRP with one-shot weighted combining at a central station. The combining weights only depend on the long-term statistical CSIs and therefore, are suitable for distributed network with limited signaling exchange. Numerical results show that the proposed distributed MMSE detection achieves similar performance to the centralized MMSE detection.

NA30307

9:50-10:05

Title: Optimization of Decode-and-Forward Relaying and RIS Aided MISO System
Authors: Jinqiu Zhao, Zhiquan Bai, Yueying Cai, Shuaishuai Guo, and Kyungsup Kwak
Presenter: Jinqiu Zhao, Shandong University, China

Abstract: This paper proposes a decode-and-forward (DF) and reconfigurable intelligent surface (RIS) aided multipleinput single-output (MISO) (DF-RIS MISO) system to avoid the "double fading" effect introduced by RIS. The closed-form average bit error rate (ABER) of the DF-RIS MISO system is derived and the joint optimization of the active and passive beamforming and power allocation is presented to maximize the system achievable rate. Numerical simulations verify that the proposed DF-RIS MISO system enables RIS and DF to work complementary and avoid the "double fading" effect significantly. Meanwhile, the proposed system with joint beamforming and power allocation optimization achieves better achievable rate and ABER performance compared with the typical systems. Furthermore, we have discussed the best relay location in this paper as well.

NA21076

10:05-10:20

Title: Research on UAV Cooperative Task Assignment Based on Dynamic Multi-objective Evolutionary Algorithm

Authors: Menggang Sheng, Zeyang Zhang, Min Deng, and Zhiqiang Yao
Presenter: Zeyang Zhang, Xiangtan University, China

Abstract: In recent years, more and more attention has been paid to the research of unmanned aerial vehicle (UAV) cooperative task assignment. In order to complete the task with the lowest cost, some researchers use multi-objective to optimize the assignment. But few of them consider the complex dynamic scenarios. According to the coordinated task assignment problem of scheduling jammer and attack UAV resources to targets, a dynamic multi-objective optimization cooperative task assignment model is established. It takes the scheduling cost, path cost, risk cost and total task time cost as the optimization objectives. To solve this model, this paper proposes an improved dynamic multi-objective adaptive weighted particle swarm algorithm. In the initialization stage, a heuristic method is used to increase the effectiveness of the solution. Besides, the adaptive mutation and subgroup methods are adopted to improve the diversity of the solution. Then, an effective environment change detection and environment change response strategy are designed to deal with dynamic scene changes. Finally, the Hypervolume (HV) metric is calculated in the experiments in different instances. Compared with the popular and classic dynamic multi-objective algorithms, the simulation results verify that the proposed algorithm is effective and can cope with the changes of the environment better in solving the problem of UAV collaborative task assignment.

NA30279

10:20-10:35

Title: Task-Aware Multi-UAV Cooperative Computing: A Learning-Based Trajectory and Resource Optimization

Authors: Zewu Li, Chen Xu, Zhanpeng Zhang, Runze Wu
Presenter: Zewu Li, North China Electric Power University, China

Abstract: Aerial computing is an important form of mobile edge computing (MEC) to enhance network coverage. In this paper, we focus on a massive access scenario where ground devices with different types of tasks are not in service area of communication infrastructure. Therefore, we propose a task-aware multiple unmanned aerial vehicles (UAV) cooperative computing scheme that each UAV stores the program for executing a certain type of tasks. To minimize the completion time of all tasks, we formulate a problem that jointly considers trajectory design and computation resource allocation for multiple UAVs, as well as user access decision, while guaranteeing quality of services. As the problem is a mixed-integer non-convex optimization which is difficult to solve, we propose a multi-agent deep reinforcement learning-based approach, where the multi-agent deep deterministic policy gradient (MADDPG) algorithm is applied. Considering the high-dimensional continuous action space, a particle swarm optimization (PSO) algorithm for access decision and resource allocation is introduced to reduce the complexity. Simulation results show that the proposed multi-UAV cooperative computing method has a better effect than baseline approaches on reducing the total completion time.

NA40374

10:35-10:50

Title: NB-Radar: An Effective Method for Detecting Local Network Behaviors

Authors: Yihang Hao, Ting Wu, Lizhi Peng and Bo Yang
Presenter: Yihang Hao, University of Jinan, China

Abstract: The last decade has witnessed the increasingly rapid advances of high-speed network for both of the infrastructures and applications. Especially the booming of network applications constantly produces various and complicated network behaviors, which calls more complicated measurements with high accuracy and lower latency. In this paper, we propose a novel method, namely, NB-Radar (Network Behavior Radar), to take snapshots for the target network environment as network situation awareness result. The major objective of NB-Radar is to accelerate the measurement and to facilitate the perception, as a result, the capabilities of the network operation and maintenance personnel will be improved. Compared to studies that mostly focus on flow level analysis, NB-Radar simply operates optimized time-frequency analysis at traffic level (with no flow-grouping), making it possible to work on high-speed network environments with lower computational capability. In addition, in order to verify the performance of NB-Radar, we execute a set of validating experiments, and results show that NB-Radar is promising for network behavior perception.

NA40431

10:50-11:05

Title: Energy Consumption Optimization of Joint Offloading Computation Based on MD-mUA V-mBS

Authors: Xiao Huang, Bo Li, Yonghao Wang, Peng Kong, Kaibo Shi, Dong Ma, Bo Ran and Bo Fan
Presenter: Xiao Huang, Ningxia University, China

Abstract: Cloud-side-device collaborative network is the trend of B5G. Using different types of server-terminal heterogeneous networks to process terminal tasks can effectively improve network service quality, which causes to consume a quantity of energy. In order to meet the KPI requirements of future green communication, a multi-device (MD), multi-unmanned aerial ve- hicle (mUA V), and multi-base station (mBS) collaborative offload- ing computing framework is first proposed, which can jointly provide communication and computing services to users. Then, a related energy consumption model for offloading computing network is established. Next, deep deterministic policy gradient (DDPG) algorithm is explored to learn the dynamically changing wireless network information, the location for task execution, and network resources to minimize system energy consumption. Finally, the simulation results showcase the feasibility of the model. Comparisons with the system energy consumption of two benchmark strategies prove that our proposed model is effective and outperforms both benchmark strategies. The influence of different learning rates on the performance of the DDPG algo- rithm is further analyzed. And it can be concluded that the actor learning rate $\alpha\pi$ has a great influence on the convergence trend of the energy consumption model for offloading collaborative computing.

NA11060

11:05-11:20

Title: Adaptive Evolution Algorithm Based on Hypervolume Awareness for Controller Placement

Authors: Tingting Chen, Zhanqi Xu, Fan Yang and Yunbo Li
Presenter: Tingting Chen, Xidian University, China

Abstract: Multi-controller SDN realizes logically centralized control by deploying multiple controllers in the network. A reasonable number of controllers and suitable deployment locations are beneficial for optimizing the performance of the entire network. Compared with the single-objective model, the multi-objective optimization model can obtain a set of controller deployment solutions through the multi-objective optimization algorithm, thus providing more comprehensive solutions. In this paper, an actual many-objective model is built to optimize controller deployment by considering the propagation delay between controllers and switching nodes, propagation delay between controllers, controller load difference, reliability of the control network, and deployment cost. To solve this model, we propose an algorithm by specially designing the hybrid initialization method to generate an initial population that balances diversity and convergence. After that, we design the recall mechanism based on hypervolume awareness, the deduplication elite archive storage mechanism, the adaptive evolution mechanism, and the opposition-based learning strategy. These mechanisms are particularly constructed for the proposed algorithm to solve the problems in the evolution process and to improve the global search ability of the algorithm for obtaining superior non-dominated solution sets. Finally, we validate the effectiveness and generality of the proposed algorithm by comparing its non-dominated solution with those of other algorithms in the Cogentco network from various aspects.

SESSION 28

Topic: Intelligent Communication Equipment and System
Time: 9:00-11:25, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/89549029505 Password: 111114

- **Session Chair: Prof. Dong Yang, Beijing Jiaotong University, China**

NA11043

Invited Speech

9:00-9:25

Title: Research on Trajectory Smoothing Optimization Algorithm of Underwater Long Baseline Positioning System

Invited Speaker: Prof. Kun Zhang, Hainan Normal University, China

Abstract: With the development of economy and military in today's era, more and more fields have higher and higher requirements for the positioning accuracy of underwater vehicles.However, so far, the main way of underwater positioning still depends on the underwater acoustic positioning method under the background of geometric principle.At the same time, according to the size of different receiving acoustic array, it can be divided into the following three categories: long baseline positioning technology (LBL), short baseline positioning technology (SBL) and ultra short baseline positioning technology (USBL). The positioning system used in this paper is based on the long baseline positioning system.

NA11059

9:25-9:40

Title: The TDOA-based Kalman Filter for trajecory tracking

Authors: Shunyu Yao, Qiao Meng, Chenye Zhou, Gaojing Li and Shaocong Guo
Presenter: Shunyu Yao, Southeast Uniersity, China

Abstract: The TDOA-based location methods are widely used in the passive source location (PSL). The Kalman Filter (KF) is a general technology to filter the noise and track the target in PSL systems. However, the KF following the position estimation will reduce the tracking accuracy because of the correlated noise in the estimated coordinates. In this paper, a TDOA-based Kalman Filter is proposed, which uses the measured TDOAs as the input parameters. In this way, the TDOA information is fully utilized and the correlated noise in the estimated position can be avoided. The simulation results show that the root mean square error (RMSE) of the TDOA-based KF is reduced to less than 40% of the traditional localization method with no filter. And it performs better than the general KF following the position estimation step.

NA31096

9:40-9:55

Title: A 56-to-66 GHz In-phase Injection-coupled Quadrature Voltage-controlled Oscillator With Low Phase-noise in 65nm CMOS

Authors: Xiaoming Fan, Chengzhi Jiang, Wenmiao Li, Jiaqi Zhang, Jiaji Fan and Lei Chai
Presenter: Chengzhi Jiang, China Academy of Space Technology, China

Abstract: An in-phase injection-coupled quadrature voltage controlled oscillator (IPIC-QVCO) [1] whose symmetric coupling structure is composed of four diode-connected transistors is implemented to optimize both phase noise and phase error in this paper used for the 60GHz direct-conversion transceiver. Besides, a new feedback is designed in the IPIC-QVCO to reduce phase noise while the obtained oscillation frequency range remain unchanged. The proposed system is designed with TSMC65nm LP CMOS technology and the QCVO achieves a wide measured tuning range of 16.39% from 56GHz to 66GHz with a phase noise of -97dBc/Hz at 1MHz offset while consuming 12mW from a 1.2 V supply.

NA21043

9:55-10:10

Title: Reconfigurable Intelligent Surface Assisted Communications Using Dynamic Rotations

Authors: Ke Wang, Chan-Tong Lam, and Benjamin K. Ng
Presenter: Ke Wang, Macao Polytechnic University, China

Abstract: In this paper, we propose a rotatable reconfigurable intelligent surface (RIS) assisted system to enhance the transmission quality of wireless communications. The RIS is able to rotate for maximizing the cascaded channel gain dynamically. In particular, we first introduce a

continuous-time propagation model for the rotatable RIS-aided communication system. Then, a rotation angle optimization problem is formulated and solved, which boosts the channel gain of the cascaded link. Besides, we derive the expression of the spectral efficiency for the proposed system. Numerical evaluations reveal that the dynamic rotation strategy can not only enhance spectral efficiency and reduce delay spread but is still effective when rotation errors exist.

NA30239

10:10-10:25

Title: Performance Analysis and Optimization for RIS-Aided Communication Systems

Authors: Hao Liu, Yaxuan Liu, Wei Xun, Zhuoran XU
Presenter: Hao Liu, Nanjing University of Posts and Telecommunications, China

Abstract: Reconfigurable Intelligent Surface (RIS) stands out for its unique low-cost and low-energy characteristics, which is expected to break through the uncontrollability of wireless channels and build an intelligent programmable wireless environment. In this paper, we consider a RIS-aided downlink communication system including one access point serving a user terminal and derive closed-form expressions of ergodic achievable rate and outage probability. Then, we analyze the ergodic achievable rate in terms of high signal-to-noise ratio slope and power offset. A phase shift optimization scheme is also proposed to improve the ergodic achievable rate. Finally, simulation results are conducted to validate the accuracy of the analytical results. According to the simulation results, the proposed phase shift optimization scheme can improve the system performance, compared to the random phase shift scheme.

NA40336

10:25-10:40

Title: Min-Max Latency Optimization for Intelligent Reflecting Surface-Assisted Mobile Edge Computing

Authors: Runxiang Li, Wanming Hao, Fang Wang and Shouyi Yang
Presenter: Runxiang Li, Zhengzhou University, China

Abstract: Computation offloading has been regarded as an effective scheme to reduce the latency in mobile edge computing (MEC) system. However, the offloading latency will be extremely increased when the propagation link is poor. To improve the offloading performance, we apply the intelligent reflecting surface (IRS) to the MEC system, and propose an IRS-assisted MEC system. We formulate a min-max user latency problem by jointly optimization of offloading strategy, computing resources and IRS phase shift. To solve the non-convex problem, we propose an alternate iterative algorithm to decouple it into two subproblems. In particular, the successive convex approximation and semidefinite relaxation techniques are exploited to solve the two subproblems, respectively. The simulation results show that, compared with the traditional scheme, the proposed scheme can effectively improve user's fairness and reduce the user's latency.

NA30251

10:40-10:55

Title: Cross-layer Dynamic Subcarrier Allocation with Adaptive Service Rate Control in SC-FDMA System

Authors: Xu Zhang, Pan Liu, Tengfei Hui, Jiahong Li, Xiongfei Li
Presenter: Xu Zhang, China Academy of Space Technology,China

Abstract: The adaptive service rate constraint (ASRC) algorithm was proposed for single carrier frequency division multiple access (SC-FDMA) system. With the objective of eliminating the service rate waste and improving the spectral efficiency in heterogeneous traffic environment, the ASRC algorithm was designed by integrating the concept of adaptive admission control (AC) for reasonable scheduling priority provision. Furthermore, in order to meet the realistic transmission conditions, a first in first out (FIFO) queuing model with finite space was established on the cross-layer scheduling framework. Simulation results indicated that by taking the adaptive service rate constraint as the necessary condition for optimality, the ASRC algorithm improved the quality of service (QoS) performance and transmission throughput by contributing an attractive performance trade-off between real-time and non-real-time applications and eliminating the service rate waste effectively. The loss probability of ASRC was 4.32% and 2.68% lower than proportional fair (PF) and modified largest weighted delay first (M-LWDF) algorithm respectively, meanwhile the transmission throughput was 114.12% higher than the max-delay-utility (MDU) algorithm.

NA40394

10:55-11:10

Title: Intelligent Adaptive Mechanism of Handover Parameters in High-Speed Railway Communication Network Based on Generative Adversarial Network

Authors: Qi Wang, Cheng Wu, Jie Sheng
Presenter: Qi Wang, Soochow University, China

Abstract: With the increasing intelligence level of the High-Speed Railways (HSR), it is necessary to develop adaptive special mobile communication technologies for the HSR that are adapted to the highly dynamic and complex scenarios. The existing Long Term Evolution for Railway (LTE-R) handover algorithms often rely on limited discrete scene field measurements, making it difficult to cope with the highly dynamic and variable scene characteristics. In this paper, we proposed an adaptive optimization decision mechanism for the handover parameters of LTE-R communication systems based on the Generative Adversarial Networks (GAN) theory. We first established a discrete situation awareness mechanism, where the UE senses and acquires the real-time discrete handover situation of the HSR operating environment through collaborative interaction with the eNodeB. Then, we used the GAN to learn discrete handover situation samples and trained the network to generate continuous handover situation, so as to realize the selection of optimal handover parameters and implement the handover of the terminals. Finally, the successful situation samples would be fed back to the GAN to help improving the optimization performance of the GAN. The experimental results showed that the GAN based handover parameter prediction algorithm can find the optimal handover parameters and improve the LTE-R system performance.

NA40341

11:10-11:25

Title: Low Complexity Wiener Filter Based Channel Estimation in Pilot Aided OFDM Systems

Authors: Gil Naveh
Presenter: Gil Naveh, DSP CTO, Huawei Technologies Tel-Aviv Research center, Israel

Abstract: A reduced complexity, Wiener filter based, channel estimation algorithm for OFDM systems is presented. The algorithm applies to pilot-aided OFDM systems and suites frequency-domain channel estimation-and-interpolation in the frequency direction as well as in the time direction. The algorithm leverages symmetry properties of the Wiener filter coefficients that are valid in common pilot allocation structures, like comb structure, and leads to 50% complexity reduction as compared to the direct implementation scheme of Wiener filter. In this paper, we derive the relationships between the pilot allocation and the symmetric characteristics of the Wiener filter coefficients, and show how this symmetry is leveraged toward significant reduction in the computational load of the channel estimation.

SESSION 29

Topic: Energy Management in Internet of Things and Wireless Communication System
Time: 9:00-11:40, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/86088803609 Password: 111114

- **Session Chairs:**
  Assoc. Prof. Liwei Yang, China Agricultural University, China
  Assoc. Prof. Jian Yuan,
  Qilu University of Technology (Shandong Academy of Sciences), China

NA11026

Invited Speech

9:00-9:25

Title: Characterizations on Non-Stationary Channel Statistics for High-Speed Train Communications

Invited Speaker: Assoc. Prof. Yan Zhang, Beijing Institute of Technology, China

Abstract: In this paper, results for non-stationary channel statistics based on the wideband high-speed-train (HST) channel measurement in the rich-scattering viaduct scenario are presented. Due to the fast movement of the train, both the fading characteristics and the Doppler-delay statistics change rapidly with time. The measurement campaign is implemented on the Guangzhou-Shenzhen passenger-dedicated railway at a central frequency of 2.4 GHz. The parameters of multi-path components (MPCs) are estimated by the Subspace-Alternating Generalized Expectation-maximization (SAGE) algorithm. The large-scale fading properties and the small-scale Doppler-delay statistics, including path loss, shadow fading, Rician K factor, number of MPCs, root-mean-square (RMS) delay spread, RMS angular spread, power-delay profile (PDP), and Doppler-power spectrum are analyzed. The non-stationary statistical models of the above parameters are given based on the measured results. The correlation property is characterized by the correlation matrix distance (CMD). It is shown that the HST channel in the rich-scattering viaduct scenario has strong non-stationarity characteristics. This work provides references for the design of HST communication systems and promotes technical developments.

NA31090

Invited Speech

9:25-9:50

Title: Augmented Twin Empowered Intelligence for Lightweight Device in Internet of Things

Invited Speaker: Assoc. Prof. Yunkai Wei, University of Electronic Science and Techonlogy of China, China

Abstract: Lightweight devices are widely used in the Internet of Things (IoT). Due to the limited computation and communication resources, lightweight devices can only conduct simple actions and will thereby hinder the intelligent cooperation of the devices in IoT. Such situation will last long since currently it is hard to replace all lightweight devices with intelligent ones. To address this issue and improve the integrated intelligence of IoT, we propose an augmented digital twin empowered intelligence for lightweight devices in IoT. The augmented digital twin, or shorten as augmented twin (AT), is a virtual entity built for a given lightweight device, which can be constructed on some resource-rich devices such as a gateway or an edge server. Based on the resources in its carrier, AT can not only clone all functions of the lightweight device, but also extend some intelligent analysis and cooperation abilities for this device. We first propose the architecture of AT for lightweight device in IoT. Then, to achieve the most effective AT carrier selection of the lightweight device, we formulate an optimization problem and present a self-initialized genetic algorithm to solve this problem. Simulations are conducted to evaluate the cost in constructing the ATs of the lightweight devices, as well as the performance promotion when AT is used in an IoT network. Compared to the benchmark schemes, AT can decrease the scheduling latency and energy consumption by 60.38% and 32.16% respectively than normal digital twin with reasonable constructing cost.

NA55026

Invited Speech

9:50-10:15

Title: Key Techniques and On-Orbit Verification for Space-based IoT System

Invited Speaker: Assoc. Prof. Songting Li, National University of Defense Technology, China

Abstract: The Space-based Internet of Things (SIoT) is an effective supplement and extension of the ground-based IoT, and it is a basic technical means to build the interconnection of all things and ubiquitous perception. This paper takes the SIoT integrated in Tiantuo-5 as an example, aims at the application requirements of multi-domain and multi-scenario covering land, sea and air, focuses on solving the high-reliability detection of the signals of Automatic Identification System (AIS), Automatic Dependent Surveillance-Broadcast (ADS-B) system and the multiple access of Data Collection System (DCS), achieves real-time supervision of navigation and aviation goals and the global layout of extremely massive narrowband IoT sensor terminals, and provide regerence solutions for the demonstration, construction, development and scale application of our country' s SIoT.

NA55033

Invited Speech

10:15-10:40

Title: Pricing and Charging Scheduling for Electric Vehicle Charging Stations

Invited Speaker: Assistant Professor Xiaoying Tang, The Chinese University of Hong Kong (Shenzhen), and the Shenzhen Institute of Artificial Intelligence and Robotics for Society, China

Abstract: The rapid adoption of electric vehicles (EVs) stimulates the proliferation of charging stations (CSs), motivating the cooperative management of growing CSs. However, cooperative CS management still remains an open problem, due to the uncertain user behavior and heterogeneous service capabilities. To capture the CS dynamics caused by uncertain user behavior, we propose a deep reinforcement learning (DRL)-based cooperative method for multiple CSs, towards maximizing the total profit. The proposed method determines pricing and charging scheduling decisions for CSs, considering stochastic CSs selection and its impact on CSs energy supply. In order to reduce the computational burden of dimensions caused by the time-varying decisions, we design a discretization strategy for action space, based on the current market rule of tiered pricing and CS types. The simulations using real data demonstrate that our proposed method can obtain higher profit than the independent operation and benchmark cooperative algorithms such as Q-learning.

NA40435

10:40-10:55

Title: Cost Modeling and Optimization of Solar-Grid-Battery Hybrid Power Supply under Green Base Station

Authors: Bo Ran, Bo Li, Dong Ma, Kaibo Shi, Yonghao Wang, Xiao Huang, Peng Kong and Bo Fan

Presenter: Bo Ran, Ningxia University, China

Abstract: With the increasing load traffic of base stations, the power supply cost of base stations has become the focus of operators. Low-cost and clean renewable energy such as solar energy is considered as an effective way to solve the power supply of base stations in the future. In order to meet the demand of green base station, a power supply framework with renewable energy as the main power supply and traditional power grid as the auxiliary power supply is proposed. Firstly, the Solar-BatteryGrid hybrid power supply system is designed to meet the power supply needs under different climate conditions. On this basis, the power and cost model of Solar-Battery-Grid hybrid power supply system is established. Then, the improved genetic algorithm is proposed to design the optimal configuration of the hybrid power supply system. Its purpose is to minimize the total cost of the base station. Finally, the simulation results showcase the feasibility of the hybrid power supply system. The effectiveness of the hybrid power supply system is proved by comparing with the traditional grid power supply system. In addition, the superiority of the improved genetic algorithm is verified by comparing with the benchmark algorithm.

NA30318

10:55-11:10

Title: Improving User Data Rate Performance for Hybrid RF/VLC Outdoor Vehicular Communications

Authors: Maged Fakirah, Supeng Leng, Mohammad A.B.Mohammad, Ahmed Abualnor and Mesfin Leranso Betalo
Presenter: Maged Fakirah, UESTC University, China

Abstract: Vehicle traffic has increased dramatically in recent years, particularly in major metropolitan areas, negatively impacting the number of traffic collisions and property destruction. In this paper, we design a hybrid RF/VLC system that uses a set of visible light communication (VLC) and radio frequency (RF) access points (APs) to exchange information between the vehicles traversing the roundabout and roadside units (RSUs) in the vehicle-to-infrastructure (V2I) mode. We aim to maximize the capacity of the network and maintain a low outage probability while preserving the transmission reliability of the vehicles. Analysis and simulation results demonstrate the outperformance of the hybrid system over the standalone VLC system under different scenarios. Therefore, it can be adopted to prevent potential collisions at roundabouts.

NA30269

11:10-11:25

Title: A Low-complexity MMSE-HIC Scheme for NOMA-Based LEO Satellite IoT Systems

Authors: Weizong Sun, Dewei Yang, Jingming Kuang, Dong Chen, and Zheren Long
Presenter: Weizong Sun, Beijing Institute of Technology, China

Abstract: A low-complexity minimum mean square error (MMSE) equalizer with hybrid interference cancellation (HIC) for non-orthogonal multiple access (NOMA) based Low Earth Orbit (LEO) satellite Internet of Things (IoT) systems is presented in this paper. First, a HIC grouping strategy is proposed with the signal-to-interference-plus-noise ratio (SINR) threshold, which can effectively reduce the number of iteration and decoding times. Besides, a reduced-complexity MMSE equalizer based on the matrix expansion and Greville criterion is adopted to avoid the direct computation of matrix inversion. The results show that our proposed scheme can significantly reduce the overhead and processing delay while preserving a good performance.

NA40424

11:25-11:40

Title: GCD Optimization and Intelligent Management for Green Base Station with Battery Control

Authors: Dong Ma, Bo Li, Yonghao Wang, Bo Ran, Peng Kong, Xiao Huang, Kaibo Shi, Wei Li
Presenter: Dong Ma, Ningxia University, China

Abstract: With the development of 6G to higher frequency bands and the awareness of the environmental pollution caused by carbon emissions, green and low carbon has become a key performance indicator (KPI) for mobile communications. To meet the demand, a deep reinforcement learning (DRL) framework for hybrid energy supply based on intelligent battery charge/discharge management is proposed. Firstly, hybrid renewable-grid-batteries energy is designed to power a new generation of green base stations (BSs). On this basis, the grid-connected depth (GCD) model and battery charging/discharging model of heterogeneous BSs under the hybrid energy supply mode are established. Then, a deep Q-learning (DQL) algorithm is employed to learn the time-varying energy harvesting (EH) information, local load information, and battery status information to optimize the GCD. In addition, an intelligent management strategy of GCD under hybrid energy power supply is proposed. Finally, simulation results showcase that better base station(BS) battery state detection without predicting causal information and real-time energy sharing can effectively minimize GCD. This confirms the feasibility of the proposed scheme and strategy.

SESSION 30

Topic: Satellite Communication Network and Space Communication
Time: 9:00-11:35, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/86924134522 Password: 111114

- **Session Chair: Assoc. Prof. Enchang Sun, Beijing University of Technology, China**

NA11036

Invited Speech

9:00-9:25

Title: Invulnerability-based Constellation Design in LEO Satellite Networks

Invited Speaker: Professor Cui-Qin Dai, Chongqing University of Posts and Telecommunications, China

Abstract: The low earth orbit (LEO) satellite networks have received increasing attention because of wider coverage, lower latency, and cost-efficient networking capabilities. However, satellite nodes or links may be attacked and invalidated, and the failure of nodes and link poses performance loss to the LEO satellite networking. To address such challenges, in this paper, an invulnerability-based LEO satellite constellation is designed to achieve higher invulnerability and lower cost. Firstly, a LEO satellite network model is established and the build link probability is derived after analyzing the dynamic network topology. Then, the invulnerability benefit is defined by quantifying complete invulnerability and cost, and the problem of LEO satellite constellation design is formulated to maximize the invulnerability benefit. Following that, a tabu search genetic algorithm combined with opposite-based learning strategy (OBL-TSGA) is proposed to obtain reasonable satellite constellation orbit parameter with the best invulnerability benefit. Simulation results show that the designed satellite constellation can obtain higher invulnerability at a lower cost.

NA55028

Invited Speech

9:25-9:50

Title: Energy Efficient Offloading and Trajectory Scheduling of Rechargeable Aerial Edge Networks

Invited Speaker: Assoc. Prof. Ke Zhang, University of Electronic Science and Technology of China

Abstract: Aerial Edge Networks (AENs) that provide task processing in infrastructure-less areas have emerged as a promising paradigm in the near future. However, the flight endurance of Unmanned Aerial Vehicle (UAV) always suffers from constrained onboard battery capacity. Therefore, energy efficiency has become a key issue in the implementation of AENs. In this talk, we focus on green mobile edge computing of rechargeable UAVs, and propose an AEN aided by distributed charging services. We formulate an energy minimization problem that jointly considers aerial edge resource allocation, UAV trajectory planning and battery charging scheduling as well as task delay constraint. Due to the non-convexity and the coupled optimization variables of the problem, we take a deep reinforcement learning approach to design an intelligent iterative algorithm to obtain energy efficient aerial edge strategies. Numerical results demonstrate the effectiveness of our proposed scheme as compared to benchmark schemes.

NA40335

9:50-10:05

Title: An Energy Consumption Minimization Optimization Scheme for HAP-Satellites Edge Computing

Authors: Chengli Mei, Cheng Gao, Yanxia Xing, Xilin Bian, Bo Hu
Presenter: Chengli Mei, Chinatelecom Research Institute, China

Abstract: Low-earth orbit (LEO) satellites can provide computing services for ground users by carrying mobile edge computing servers. However, due to the high altitude of LEO satellite, ground users need to consume a lot of energy to communicate with them. So we leverage high altitude platform (HAP) to cooperate with LEO satellites, called HAP-Satellites edge computing, and jointly provide computing services for ground users. An optimization problem is formulated to minimize the sum weighted energy consumption of all devices for HAPSatellites edge computing. This is a mixed integer non-linear programming problem that is difficult to solve. So, we propose an intelligent heuristic algorithm to optimize tasks offloading and resources allocation. Simulation results demonstrate that the proposed scheme outperforms the other benchmark schemes in terms of weighted sum energy consumption

NA11088

10:05-10:20

Title: Simulation evaluation of delay tolerance network performance in air-ground cooperative scenarios

Authors: Qihang Chen, Chunyuan Tian, Dawei Ma and Shuangze Yang
Presenter: Qihang Chen, Army Engineering University Communication Sergeant School, China

Abstract: With the development of unmanned aerial vehicle (UAV), the air-ground collaborative communication network which composed of UAV and ground base stations has also been developed and innovated. It can improve the performance of a delay tolerant network (DTN) consisted by a single network node. In this paper, we conduct a comprehensive evaluation and analysis of the performance of DTN air-ground cooperative networking through various features, such as UAV′ s the movement mode, movement speed, node cache, message survival time, network node density, routing protocol and others. The results show that the addition of UAV relay nodes can effectively improve the information transmission efficiency of DTN. In the scenario of large-scale node air-ground cooperative networking, air-ground cooperative networking is suitable for time-sensitive services and can improve the message delivery rate by 75% in a low message survival time.

NA31092

10:20-10:35

Title: Low Latency MCS Design for LEO Satellite Communication Based on 5G

Authors: Zuolin Jin, Dechao Chen, Jinxuan Huang
Presenter: Zuolin Jin, Beijing Institute of Technology, China

Abstract: With the development of mobile communication, satellite communication technology has met new opportunities. In the future, the joint development of satellite and 5th Generation (5G) is the general trend. However, the characteristics of the low earth orbit (LEO) satellite and the different transmission environment will bring huge challenges to the current 5G technical standards. In this paper, we first carry out link budget for LEO satellite under Non-Terrestrial Network (NTN) channel. Then, we design a 21 level Modulation and Coding Scheme (MCS) combined of modulation mode of Digital Video Broadcasting (DVB) and the encoding mode of 5G. Inspired by the analysis of retransmission times and initial block error rate (BLER), we simulate signal noise ratio (SNR) thresholds under different target BLER and obtain a MCS table with target BLER of 10%, 1% and 0.1%. Subsequently, the retransmission times and throughput of the MCS table are simulated. Simulation results show that the designed MCS tables have better reliability and lower feedback delay, which improves throughput for LEO communication system.

NA30264

10:35-10:50

Title: Local State Routing for Satellite Constellation Networks

Authors: Xin Xu, Jun Cai, Aijun Liu and Dongming Bian
Presenter: Xin Xu, Army Engineering University of PLA, China

Abstract: Local state routing methods are usually used in large-scale satellite constellation networks due to the difficulty of obtaining state information. These routing methods use a diverse range of local states and give these states different weights. This paper discusses this problem from the complex network perspective. A local state routing model with tunable parameters for satellite constellation networks is proposed. The model can generalize the characteristics of current various local state routing mechanisms. By using this model, the impact of the range and the weight of state information in routing methods are analyzed. Furthermore, the routing robustness is also discussed by defining a new robustness metric. Experimental results show that it is enough to achieve a satisfactory performance by maintaining a certain state awareness capability and obtaining the states from a limited range of neighbor nodes in satellite constellation network routing. In addition, the network robustness against congestion improves with better state awareness capability and a wider range of state information. The proposed routing model is a promising tool for routing design in satellite constellation networks.

NA30254

10:50-11:05

Title: High Altitude Platform (HAP) Communication System Based on Satellite Communication Theory

Authors: Jingyu Zhao, Jianxiao Zou, Zhangping Li, Li Ding, Shanglin Liu and Yiming Liao
Presenter: Jingyu Zhao, Shenzhen Institute for Advanced Study, University of Electronic Science and Technology of China, China

Abstract: This paper presents a high altitude platform (HAP) communication system which applies the idea of satellite communication technology to it. The communication platform can offer extensive circular coverage on the ground when the base station and antenna are deployed on a high-altitude platform with a fixed height of 20 kilometers. The platform uses the theoretical concept of satellite communication to transfer the issues with air equipment to the ground in order to solve them because the current HAP communication system model will face significant challenges in its actual implementation, which will be primarily focused on the air base station side. By using merely a circularly polarized microstrip patch antenna, the antenna on the air base station side is made simpler. The ground terminal side adopts a combination of a small parabolic antenna and power amplifier (the power amplifier includes the downlink low-noise amplifier function, similar to the very small aperture terminal (VSAT)), which greatly reduces the size of the terminal antenna and is easy to operate and carry. At the same time, because the terminal side has a strong receiving capacity, it can ensure long-distance communication with high-altitude base stations.

NA40330

11:05-11:20

Title: OTFS-based Communication and Navigation Integrated Signal Transmission for LEO Satellites

Authors: Yue Li, Guomei Zhang, Jiayue Yu, Guobing Li and Yiheng Li
Presenter: Yue Li, Xi'an Jiaotong University, China

Abstract: In order to get higher utilization efficiency of spectrum and orbits in low earth orbit (LEO) satellite system, satellite communication and navigation integration has become a search hotspot recently. Because orthogonal time frequency space (OTFS) modulation can reduce the effect of time-frequency doubly selective channels between the LEO satellite and earth, an OTFS-based communication and navigation integrated scheme is studied in this paper. First, a hybrid modulation constellation by superimposing quadrature amplitude modulation (QAM) and dual-code alternating binary offset carrier (AltBOC) modulation is proposed to realize signal integration of two systems. Second, a serial interference cancellation (SIC) detector is designed to separate two signals. In addition, a direct path time delay estimator based on pseudo-range code measurement is designed. What′ s more, the BER performance of the integrated signal is derived. Simulation results demonstrates that the proposed scheme has the lower bit-error-rate (BER) and the higher localization accuracy than the baseline method under a LEO scenario with doubly selective channel.

NA40433

11:20-11:35

Title: Optimization Design and Application of Positioning Search Technology Based on Satellite Navigation System

Authors: Junqi Pang, Wenyi Liu, Haifeng Hu, Ruixuan Yang, Ruixing Cao, Zhongliang Zhao
Presenter: Junqi Pang, North University of China, China

Abstract: In order to realize the target positioning and search without mobile network in aviation, aerospace and other fields, a highly reliable wireless positioning and search system is proposed in this paper. The system includes positioning device and ground search device, avoids the risk of single point failure of communication by means of BeiDou Navigation Satellite System (BDS) / Global Positioning System (GPS) dual-mode Satellite positioning communication , proposes an innovative design of positioning device combined with microwave network, which expands a single group of antennas into an array antenna system, and improves the antenna transmission direction dimension to 360° at the expense of controllable signal transmission power. The system transmits target location information and equipment status through BDS short message service, and adopts time-sharing multiplexing and redundant framing technology to improve the comprehensive positioning frequency, which is more than 5 times of the original mode. In the actual test application, the average acquisition frequency of short message positioning information is less than 6s, and the measured average positioning error is about 5m.

SESSION 31

Topic: Cognitive radio and wireless sensor networks
Time: 9:00-11:20, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us06web.zoom.us/j/89327674351 Password: 111114

- **Session Chair: Prof. Jian Dang, Southeast University, China**

NA55001

Invited Speech

9:00-9:25

Title: Printable Photodetectors Toward Easy-to-Fabricate Wearable Color Sensors
Invited Speaker: Professor Vincenzo Pecunia, Simon Fraser University, Canada

Abstract: Easy-to-fabricate, low-cost color sensors and imagers are in high demand for emerging applications in wearable electronics, machine vision, and smart devices for the Internet of Things [1], [2]. Organic photodetectors are uniquely positioned in this regard, given their facile processing via printing and coating and compatibility with flexible/stretchable substrates [3]. Moreover, the spectral tunability of organic semiconductors via chemical tailoring enables filter-free color detection, which paves the way for color sensor/imagers with simpler architectures and higher performance compared to conventional, silicon-based technologies [1], [3]. After introducing the capabilities and potential of wavelength-selective organic photodetectors for wearable color sensors, we will present our recent breakthroughs in this area. We will first discuss printable red- and green-selective photodetectors with cutting-edge performance in terms of photoconversion efficiency and specific detectivity [4]. Moreover, we will present the first-ever monolithic integration of a vertically stacked photodetector architecture based on printable semiconductors, which enables filter-free multicolor light sensing [5]. Building on these results, we will discuss the future potential of wavelength-selective organic photodetectors for wearable color sensors and imagers.

NA55035

Invited Speech

9:25-9:50

Title: Cross-Layer Performance Analysis for AmBC Enabling Symbiotic Radio Network
Invited Speaker: Assoc. Prof. Shiying Han, Nankai University, China

Abstract: Enabled by ambient backscatter communication (AmBC) technique, symbiotic radio network (SRN) can provide internet-of-things (IoT) services with ultra-low power and spectrum consumption. In this talk, we provide a framework of performance analysis for the SRN from the cross-layer perspective, by exploring the deep interaction between the passive IoT and the ambient system in the PHY-layer signal transmission and MAC-layer channel access. We firstly establish the framework for the SRN where the ambient system adopts CSMA/CA MAC protocol by solving the problem that how to quantify the interaction between the PHY and MAC layer. Then the framework is extended to the SRN where the ambient system adopting CSMA/CN MAC protocol. Considering the spectrum sensing is perfect and imperfect respectively, we solve the problems that how to reduce the channel waste due to packet collision and how to quantify the impact of sensing error on the network performance. Simulation results will be shown to verify our theoretical analysis.

NA40409

9:50-10:05

Title: DRED: A DRL-based Energy-Efficient Data Collection Scheme for UAV-assisted WSNs
Authors: Jianxin Liao, Chao Sun, Jiangong Zheng, Xiaotong Guo, Tongyu Song, Jing Ren, Ping Zhang, and Siyang Liu
Presenter: Jianxin Liao, University of Electronic Science and Technology of China, China

Abstract: In Wireless Sensor Networks (WSNs), sensors collect and transmit information to the sink node through single-hop or multi-hop wireless communication links. However, the traditional static sink node solution will cause the hotspot problem due to the energy limitation of sensor nodes. To alleviate the above problem, the Unmanned Aerial Vehicle (UAV)-assisted WSNs, which employs a UAV as the sink node, is proposed to flexibly adjust the routing scheme and prolong the lifetime of sensor nodes. However, the movement of the UAV needs to adapt to the sensor nodes' energy consumption during the transmission in the WSNs, which is a challenging task. Therefore, we propose DRED, an energy-efficient data collection scheme for UAV-assisted WSNs, to control the dynamic routing and the movement of the UAV based on Deep Reinforcement Learning (DRL). The simulation results show that DRED can achieve high network performance in terms of network lifetime.

NA11001

10:05-10:20

Title: WiFi FingerprintMulti-user Localization for Smart Home by WiFi Sensing

Authors: Jianyang Ding, Yong Wang, Shaozhong Fu, Haiming Chen, Wendong Xie, and Yunsong Liu
Presenter: Jianyang Ding, Xidian University, China

Abstract: Device-free and passive indoor localization based on WiFi channel state information (CSI) has attracted a great deal of research interest and yielded a broad range of related applications. However, most of existing approaches are influenced heavily by random noises, and also they fail in the presence of multiple users in the same area. In this paper, we present an accurate indoor localization scheme for multiple users using BP neural network deployed on commodity WiFi. To this end, this proposed approach mainly exploits three key techniques. Firstly, we carry out data preprocessing to obtain informative signal and then eliminate the random noises present in CSI measurements. Secondly, feature extraction is conducted to characterize multi-user profiles through combining data fusion and singular value decomposition (SVD) methods. Finally, BP neural networks is introduced to learn these features extracted and realizes the goal of multi-user localization. Furthermore, we implement the proposed approach on a set of WiFi devices and further evaluate it in typical indoor scenario. The experimental results relying on real-world data show that this approach can achieve a satisfactory performance in multi-user localization compared with existing approaches.

NA21049

10:20-10:35

Title: Health Risk Assessment and Monitoring System Based on Multi-Sensor Information Fusion and Contrast Learning

Authors: Nannan Chong, Kunpeng Chen, Dehao Kong
Presenter: Nannan Chong, Tianjin Renai College, China

Abstract: The number of solitaries is on the rise worldwide. In order to improve the risk resistance ability of loners to unexpected events, and to evaluate their life and health status in real-time and automatically warn their risks, a health risk assessment and monitoring system based on multi-sensor information fusion based on comparative self-supervised learning are proposed. The scheme predicts the vital signs and safety level of the solitary person by observing and calculating the preset multi-modal sensor information, integrates the information， identifies the routine, risk, emergency, and other states. The model was trained, verified， and tested by the physical signs data of 143 anonymous volunteers. The results show that the health risk assessment and monitoring system can effectively filter the errors of sensor information data, and the steady-state error is less than 5%, which has higher accuracy and efficiency than other recent information fusion methods. The model trained with sufficient historical data can significantly improve the ability of loners to cope with unexpected events.

NA40384

10:35-10:50

Title: MARTO: A Multi-Agent Deep Reinforcement Learning Based Online Topology Optimization Scheme for Wireless Sensor Network

Authors: Jiangong Zheng, Xiaotong Guo, Jianxin Liao, Chao Sun, Tongyu Song, Jing Ren, Ping Zhang, Siyang Liu
Presenter: Jiangong Zheng, University of Electronic Science and Technology of China, China

Abstract: Wireless sensor networks (WSNs) have been widely used as a potential network paradigm for the ubiquitous interconnection of devices. However, due to the property of limited energy resources, an energy-efficient routing algorithm is urgently needed to prolong the network lifetime. To tackle this issue, we propose MARTO, a Multi-Agent Deep Reinforcement Learning (MADRL) based scheme to provide online topology optimization, after modeling the WSN lifetime maximization problem as a Decentralized Partially Observable Markov Decision Process (Dec-POMDP). Additionally, a loop-free topology generation algorithm is given which can completely avoid routing loops to assist the decision-making of RL agents.Experimental results show that MARTO outperforms several heuristic algorithms and has high energy efficiency which can effectively prolong the lifetime of WSNs.

NA11073

10:50-11:05

Title: STAR-RIS Enhanced Cognitive Radio Networks

Authors: Chenchi Wen, Jiakuo Zuo and Pengfei Zhao
Presenter: Chenchi Wen, Nanjing University of Posts and Telecommunications Nanjing, China

Abstract: This work exploits the potential of a novel simultaneous transmission and reflection reconfigurable intelligent surface (STAR-RIS) in improving the communication quality in a cognitive radio (CR) network. The STAR-RIS employs the time switching (TS) protocol. The objective is to minimize the total power consumption of the secondary users (SUs) by jointly optimizing the power allocation at the SUs and STAR-beamforming vectors at the STAR-RIS. To solve the formulated non-convex problem, we first transform the problem into a semi-definite program (SDP). Then, we propose Gaussian randomization and successive convex approximation (SCA) methods to obtain rank one solutions to the problem. The simulation results validate that the total power consumption of the SUs is dramatically decreased by our proposed algorithms.

NA30292

11:05-11:20

Title: Deadline-Constrained Random Access in Cognitive Radio Networks with Multiple-Packet Reception

Authors: Chengran Li, Yidong Guo, Yuan Shen, Ting Fang, Aoyu Gong and Yijin Zhang
Presenter: Chengran Li, Nanjing University of Science and Technology, China

Abstract: Deadline-constrained random access plays an essential role in cognitive radio networks (CRNs) where secondary users (SUs) opportunistically access the licensed spectrum unoccupied by primary users (PUs) to transmit packets for real-time services. In this paper, we focus on the frame-synchronized traffic under multiple-packet reception that allows more than one packet to be successfully received simultaneously. A basic protocol structure of dynamic slotted-ALOHA that jointly accounts for the current delivery urgency, the local knowledge of contention intensity, the MPR capability and the PUs activity is presented. Assuming always incompletely known contention intensity, in order to maximize the timely delivery ratio (TDR), we formulate this access problem as a partially observable Markov decision process (POMDP), and design two low-complexity suboptimal policies based on this POMDP formulation. Simulation results verify the TDR advantage of the proposed policies, and show that the myopic policy is in general not optimal.

SESSION 32

Topic: Modern Cryptography and Encryption Technology
Time: 13:30-15:40, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/84231845366 Password: 111114

- **Session Chair: Assoc. Prof. Peng Zhang, Shenzhen University, China**

NA55036

Invited Speech

13:30-13:55

Title: Hybrid Chaotic Encrption ASIC with Dynamic Precision for IoT

Invited Speaker: Assoc. Prof. Junchao Wang, Chongqing University, China

Abstract: IoT information transmission requires a highly secure encryption algorithm to ensure that information is not hacked. However, due to the limitation of hardware resources, the encryption algorithm has the limitation of quantization accuracy, which leads to the decrease of system security. The Lyapunov factor fails in the quantization system, which cannot evaluate the randomness between different quantization accuracy. At the same time, the complex encryption algorithm requires large hardware resource overhead and high power consumption, while simple algorithms such as single chaotic logistic algorithm encryption security is not high, both of which can not take into account the high security and low power consumption requirements of the Internet of Things information transmission.

In this regard, we first carry out quantitative analysis, propose spectral entropy analysis and NIST randomness test to evaluate the security of the system under different quantization accuracy. Secondly, the correlation between implementation accuracy and theoretical hardware complexity is established to evaluate the hardware overhead of the system under different accuracy. Then a hybrid chaotic encryption with dynamic precision scheme is proposed to improve the chaotic characteristics of the system by random perturbation strategy. Finally, a unified architecture for hybrid chaotic encryption with dynamic precision is constructed, and different precision choices are realized by hardware reuse.

Quantitative analysis and hardware complexity analysis show that the system accuracy is reduced, the required hardware resources are reduced, but the encryption security is also reduced. The security of the proposed encryption scheme is evaluated. The evaluation results show that the encryption security of the scheme is greatly improved compared with the single chaotic encryption scheme under low precision conditions. The hardware implementation and synthesis of the proposed encryption scheme are carried out. The report results show that the proposed architecture can achieve different precision encryption, meanwhile, as the precision decreases, the power consumption is significantly reduced. It has the advantages of high security and high resource utilization, and adapts to the multi-scene application requirements of the Internet of Things.

NA11012

13:55-14:10

Title: Design of Hybrid Encryption for Multi-relay Physical-layer Network Coding System

Authors: Yanru Yang, Meng Tang, Haihua Li, Guofeng Zeng, Jianhua Chen, and Yongtao Yu
Presenter: Yanru Yang, Yunnan University, China

Abstract: This paper proposes a hybrid encryption scheme for multi-relay (MR) physical-layer network coding (PNC). Based on the three-relay (3R) bidirectional communication model, first, we discuss the throughput performance of the PNC compared with the traditional scheme (TS) and network coding (NC) system. Through the analysis of transmission efficiency, the superior throughput of the PNC system is demonstrated. Then, to further improve the security of the communication system, we give a scheme of advanced encryption standard (AES) and Rivest-Shamir-Adleman (RSA) hybrid encryption, namely AR hybrid encryption. Finally, we embed the AR hybrid encryption into the multi-relay PNC communication system. At relay nodes of the AR-PNC system, we focus on solving the problem of signal mapping. In the meantime, to reduce the performance loss caused by the increase of relay nodes, we exploit Low-Density Parity-Check (LDPC) code to enhance the decoding accuracy. The experimental results and security analysis show that the proposed scheme can boost the system throughput and transmission dependability and stronger the security of the communication system.

NA11015

14:10-14:25

Title: Public-key Turbo-polar Codes as a Candidate for Post-Quantum Cryptography

Authors: Ziwei Chen, Deyuan Chen, Can Zhang and Shaoshuai Gao
Presenter: Ziwei Chen, University of Chinese Academy of Sciences, China

Abstract: In order to improve the security of digital data communication, an asymmetric cryptographic algorithm based on turbo-polar code is proposed in this paper. On the encoding side, the system uses the interleaving of information bits and the puncturing of parity bits to encrypt with the private key. The public key is composed of interleavers, systematic polar code encoders, and puncturers. Generalized logistic map (GLM) is selected to reduce the private key storage space. The security of public-key turbo-polar codes (PKTPC) is analyzed at the end of this paper. Simulation results show the SNR of PKTPC is only 0.1 higher than the SNR of parallel concatenated systematic polar code (PCSP) with the same frames error rates.

NA30228

14:25-14:40

Title: Attribute-based keyword searchable encryption scheme for multi-authority in cloud storage

Authors: YaLian Wu, XinYu Li, Zheng Liu
Presenter: XinYu Li, Xiangtan University, China

Abstract: Based on the problem of the key escrow problem of one single authority in cloud storage and the low search efficiency when users search the required data, a multi-authority attribute-based keyword searchable encryption scheme was proposed. The proposed method adopted distributed key generation technology and was integrated to realize the threshold generation mechanism of the user′ s private key, and the right of each authority was weakened. In addition, the attribute-based keyword searchable encryption method based on ciphertext structure provided a fine-grained access control function for encrypted data and, at the same time, used aggregation technology to effectively improve the search efficiency of users. The experimental result shows that the proposed scheme can ensure the privacy of users and access policies and has low computational, which is more suitable for resource-constrained devices in cloud storage

NA40339

14:40-14:55

Title: Secrecy Performance of MISO Fluctuating Two-Ray Fading Channels

Authors: Xiang Gao, Rui Zhao, Hongxin Lin and Xi Luo
Presenter: Xiang Gao, Huaqiao University, China

Abstract: In the fluctuating two-ray (FTR) fading channel, we analyze the physical layer security performance of the multiple-input single-output (MISO) millimeter wave communication system in the presence of an eavesdropper. In order to get physical and technical insights into the effect of the channel parameters on the secrecy performance, we first derive analytical expressions for physical layer security metrics, such as the average secrecy capacity and the secrecy outage probability. Then we derive the lower bound of secrecy outage probability and the probability of strictly positive secrecy capacity. The theoretical results are corroborated by Monte Carlo simulations.

NA40379

14:55-15:10

Title: Deciding complete integer lattices via localization

Authors: Yue Cao, BaoSheng Huang
Presenter: Yue Cao, Science and Technology on Communication Security, China

Abstract: Transition to quantum-safe cryptogrpahy is being carried on to resist menace of the developing powerful quantum computers, and lattice-based cryptosystems are among the most primising ciphers in the quantum era to defend confidential communication and also to assure information security. Complete integer lattices are the set of all points with integer coefficients in a linear subspace, and have played a significant rôle in cryptanalysis of lattice-based ciphers. This correspondence concentrates on deciding completeness of integer lattices via the local-global principle. Given an integer matrix A consisting of basis vectors of an integer lattice L, two equivalent characterizations of completeness are given, one using ranks of A over residue class fields and the other using decomposition of A over the p-adic ring of integers. From the new characterizations we obtain a new constructive proof of the fact that a complete integer lattice has the same determinant as its orthogonal lattice.

NA40383

15:10-15:25

Title: Secrecy Performance Analysis of UAV-based Relay Communications with SWIPT

Authors: Danyu Diao, Buhong Wang, Kunrui Cao, Runze Dong and Tianhao Cheng
Presenter: Danyu Diao, Air Force Engineering University, China

Abstract: UAV wireless communication has been regarded as a promising technology in the fifth generation (5G) networks. In this paper, we study the secure transmission of unmanned aerial vehicle (UAV) simultaneous wireless information and power transfer (SWIPT) wireless communication. Specifically, a UAV is deployed as an aerial relay to decode and forward confidential information to a distant user in the presence of an eavesdropper. Considering the energy constraints of the UAV, a ground source transmits information and energy simultaneously to the UAV in a power splitting (PS) strategy. To safeguard the UAV communications, we propose a full-duplex cooperative jamming (FCJ) scheme. The ground destination aggravates the malicious eavesdropper by sending noise to the eavesdropper while receiving confidential information. The closed-form expressions of connection outage probability (COP), secrecy outage probability (SOP) and effective secrecy throughput (EST) are derived based on the practical ground-air channel. Numerical simulation results verify the effectiveness of the proposed scheme and the correctness of the derivation.

NA30306

15:25-15:40

Title: Frequency Spectrum Density Prediction Based on Sequence-to-Sequence Deep Learning Model

Authors: Ya-Dong Zhao, Zheng-Wei Chang, Jie Zhang, Ling-Hao Zhang, Li Li
Presenter: Ya-Dong Zhao, Southwest Jiaotong University, China

Abstract: Frequency bandwidth becomes more and more precious owing to the explosion of wireless communications. Hence, frequency spectrum prediction technologies become important for better exploiting the idle frequency resources. However, most of them are subject to single-step prediction. In this paper, we propose a frequency spectrum density prediction method based on a Sequence-to-Sequence (S2S) neural network, which can predict the wireless frequency spectrum density in forthcoming time slots relying on historical records. In the application of monitoring a single frequency band, we focus on leveraging the time-domain correlation between subsequently received signals and accordingly, Long-Short Term Memory (LSTM) is employed as a basic unit of our S2S model. In the more complicate application of monitoring multi-bands, we attempt to jointly leverage both the frequency and time-domain correlations among signals received at different time-slots and different bands. Accordingly, convolution product based LSTM (ConvLSTM) is employed as the new building block of our S2S learning model. Furthermore, We discuss design guidelines for the hyperparameters of our S2S model. The simulation results demonstrate that our S2S learning model outperforms the classical auto-regressive moving average (ARIMA) model. Particularly, in order to verify the generality of our model, both the GSM-900 and WiFi scenarios are engaged in our comparison.

SESSION 33

Topic: Performance Analysis of Wireless Communication System and Network
Time: 13:30-15:40, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/81069396768 Password: 111114

- **Session Chairs:**
  Prof. Xizheng Ke, Xi'an University of Technology, China
  Assoc. Prof. Shiying Han, Nankai University, China

NA55027

Invited Speech

13:30-13:55

Title: Intelligent Reflecting Assisted Wireless Communications

Invited Speaker: Professor Gang Yang, Shenzhen Institute for Advanced Study, University of Electronic Science and Technology of China, China

Abstract: Intelligent reflecting communication (IRC) has recently emerged as a promising technology for spectrum- and energy- efficient as well as cost-efficient communication technology. This presentation will dscuss the recent advances of IRS from the perspects of intelligent backscatter enabled symbiotic communication (IBSC) and reconfigurable intelligent surface assisted communicaton (RISC). On the one hand, IBSC enables wireless-powered backscatter devices to modulate their information symbols over ambient radio-frequency (RF) carriers (e.g., WiFi, TV, or cellular signals) without using any costly and power-hungry RF transmitter. IBSC is especially attractive for Internet-of-Things (IoT) communication, since it does not need dedicated radio spectrum due to the spectrum sharing between the backscatter transmission and the ambient transmission. Since the backscatter transmission depends on the ambient RF signals, there are many challenging problems in both fundamental theory and key techniques waiting to be issued, for example, how to design a high-rate IBSC transceiver and allocate resource optimally? In the first part of this presentation, we will provide efficient technical solutions for the above questions. In particular, we will focus on IBSC over OFDM carriers, MIMO-IBSC, as well as full-duplex IBSC. On the other hand, reconfigurable intelligent surface (RIS) is a rising and revolutionizing communication technology, through which wireless propagation environment can be intelligently reconfigured. In particular, an RIS consists of a large number of passive reflecting elements, which can adjust the phases and/or amplitudes of the incident signals to intentionally establish preferable channels. In the second part of this presentation, we will discuss the optimal designs of an RIS-assisted downlink non-orthogonal-multiple-access (NOMA) system, an RIS-assisted direct device-to-device (D2D) communication system, and an RIS-assisted symbiotic communication system, respectively.

NA11013

13:55-14:10

Title: Beamforming Optimization in MU-MISO URLLC Systems

Authors: Changqing Ye, Hong Jiang, Liping Deng and Honglang Zhu
Presenter: Changqing Ye, Southwest University of Science and Technology, Xichang University, China

Abstract: This paper considers a downlink ultra reliable low latency communication (URLLC) system in which a BS equipped with multi antenna arrays simultaneously serves multi single antenna user equipments (UEs) by transmitting short packet. With the objective of maximizing achievable data rate (ADR) for all UEs, we consider the beamforming optimization design. In the short packet transmitting, the ADR is a complicated function of bandwidth, beamform vectors and decoding error probability, which makes the max-sum ADR optimization problems challenging to solve. This problem is firstly decoupled via Lagrange dual transform and the beamforming at BS is optimized based on fractional programming (FP) method. Then, alternative optimization (AO) algorithm is proposed to solve this problem. Performance of the proposed algorithm is analyzed through extensive simulations under various settings of transmission power budget, transmission time, total bandwidth and the number of antennas. The simulation results clearly demonstrate the merits of the proposed algorithm, and shown that the URLLC ADR obtained by proposed algorithm are quite close to Shannon ADR over a wide range of simulation parameters.

NA21064

14:10-14:25

Title: Research on Time Synchronization System of Wireless Network

Authors: Zhen Liao, Mingze Xu
Presenter: Zhen Liao, China Academy of Information and Communications Technology, China

Abstract: With the rapid development of wireless network, the requirement of time accuracy has become higher for every node in network. Thus, the high precision time synchronization is an important condition to ensure the high-quality service of wireless network. In order to meet the requirement of time synchronization, the research of wireless timing technology has drawn the attention. In the time synchronization system based on wireless network, due to the flexibility and convenience in different scenarios, the timing protocol can be widely used in different scenarios. However, the inherent shortcomings of wireless systems such as multipath interference also limits the further improvement of time synchronization performance. Therefore, this paper proposes an enhanced timestamp algorithm and its implementation scheme to solve the problem of the time synchronization system′ s accuracy in the wireless network. The proposed scheme can estimate the timestamp of physical layer in the time synchronization protocol through the synchronization sequence in the wireless system, and improve the sampling accuracy of the timestamp through the iterative algorithm based on the correlation window. Finally, according to the experimental results, this paper shows the performance of the enhanced algorithm and the traditional method, which can prove the proposed algorithm can solve the inherent problems of wireless channel and improve the accuracy of timestamp effectively.

NA21020

14:25-14:40

Title: Joint Energy and Information Beamforming Design for RIS-assisted Wireless Powered Communication

Authors: Zhen Chen, Jie Tang, Xiaoyu Du, Xiuyin Zhang, Daniel Ka Chun So and Kai-Kit Wong
Presenter: Zhen Chen, South China University of Technology, China

Abstract: In the wireless powered communication network (WPCN), the wireless energy acquisition is weak due to the fading characteristic of the wireless link, which is hard to supply energy to wireless sensor. Reconfifigurable intelligent surface (RIS) is a promising performance enhancing technology for WPCN, which can improve the energy and spectral effifificiency, expand the network coverage, and thus improve the throughput. This paper proposes a new framework for energy harvesting and information transmission of non-orthogonal multiple access (NOMA) based WPCN aided by the RIS. The total transmission capacity is maximized by joint optimization energy beamforming, information beamforming and the RIS phase shift, which turns out to be a non-convex problem. By exploiting the iterative optimization and maximal ratio combining (MRC) algorithm, the energy beamforming and information beamforming are determined for single- and multi-user system, respectively. Numerical results prove that compared with the non-RIS-aided system, the proposed scheme can increase the throughput of the multi-user system.

NA21028

14:40-14:55

Title: Cache Placement with Virtual Matching in Large-scale Cache-enabled Multicasting Wireless Networks

Authors: Wanning Liu, Ducheng Wu, Yitao Xu, Na He, Tianyao Zhong
Presenter: Wanning Liu, Army Engineering University of PLA, China

Abstract: To solve the multi-dimensional resource allocation problem in the large-scale cache-enabled multicasting wireless networks, this paper proposes a multi-stage virtual matching game method. Specifically, the proposed method performs virtual grouping of mobile users (MUs) according to location distribution of MUs, the file request probabilities of MUs, and the coverage area of cache-enabled access points (CAPs). Moreover, by virtual grouping, the huge decision-making space has been significantly reduced. Then, we propose the multi-stage virtual matching game method, which is superior to the better response (BR) algorithm in computation of single iteration, convergence speed, and system utility function.

NA30290

14:55-15:10

Title: Research on End-to-End Wireless Communication System Based on Two Dimensional Convolution

Authors: Qiaoshou Liu, Junjie Liu, Gancheng Yu, Xiong Zhou
Presenter: Junjie Liu, Chongqing University of Posts and Telecommunications, china

Abstract: Aiming at the problem that the existing end-to-end automatic codec wireless communication systems do not perform well in multipath channel, this article proposed an improved auto codec end-to-end wireless communication system. In this article, by changing the size of the convolution kernel, two dimensional(2- D) convolution is used to combat the frequency selective fading caused by the multipath effect, and the traditional OFDM module is combined with the auto-codec, so as to improve the ability of the system to cope with multipath. Simulation results show that the performance of the proposed 2-D convolution based self-codec end-to-end wireless communication system is improved by 17% and 60%, respectively, compared with the one dimensional(1- D) convolution self-codec wireless communication system and the traditional OFDM communication system in 5-path Rayleigh channel and 64QAM modulation.

NA40404

15:10-15:25

Title: Fountain Code based Hop-by-Hop Reliable Data Transmission Scheme in Multi-Hop MANETs

Authors: Changdong Li, Lianghui Ding, Jingan Li, Feng Yang, Liang Qian
Presenter: Changdong Li, Shanghai Jiaotong University, China

Abstract: The characteristics of communication in mobile ad hoc networks (MANETs) such as channel fading, limited bandwidth, and interference, bring challenges to reliable data transmission. In this paper, we propose a reliable transmission scheme for multi-hop MANETs, called Fountain code-based Hopby-Hop Reliable Data Transfer (FHRDT). FHRDT is a hybrid transmission scheme in which the end-to-end transmission mechanism is used for reliability and the hop-by-by mechanism for enhanced efficiency. In addition, the intermediate nodes generate recoded packets without complete decoding of the block which further increases throughput. The simulation results demonstrate that FHRDT performs better than the existing schemes in terms of both end-to-end delay and throughput.

NA21040

15:25-15:40

Title: How to Deploy RIS to Minimize Delay Spread in HST Communications: Railroad Side, or Train Side?

Authors: Ke Wang, Chan-Tong Lam, and Benjamin K. Ng
Presenter: Ke Wang, Macao Polytechnic University, China

Abstract: High-speed train (HST) communications are challenging due to fast time-varying channels and Doppler effects. Recently, reconfigurable intelligent surface (RIS) has been envisioned to be one of the most promising technologies for tackling the difficult problems of HST communications. In this paper, we first propose a transmission model of the HST communication system using RIS on the train side. Then, different strategies for mitigating delay spread (DS) are compared from the perspectives of the phase shift set design and deployment of the RIS. In addition, we derive the spectral efficiency (SE) expression of the proposed system. Numerical evaluations validate the analytical results and reveal that the RIS on the train side not only increases SE but also reduces DS.

SESSION 34

Topic: Next Generation Communication Network Technology and Future Development
Time: 13:30-15:40, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/81673586285 Password: 111114

- **Session Chair: Professor Tiankui Zhang, Beijing University of Posts and Telecommunications, China**

NA40332-A

Invited Speech

13:30-13:55

Title: Continuous Variable Quantum Key Distribution with Shared Partially Characterized Entangled Source

Invited Speaker: Professor Yongmin Li, Shanxi University, China

Abstract: Constructing a high-rate and low-cost secure quantum communication network is an essential task for quantum internet. Locking the sophisticated and expensive entanglement sources at the shared relay node is a promising choice for building a star-type quantum network with efficient use of quantum resources, where the involved parties only need to equip with low-cost and simple homodyne detectors. Here, we demonstrate the first experimental continuous variable quantum key distribution (CVQKD) with entanglement source between the two users. We consider a practical partially characterized entangled source and establish the security analysis model of the protocol under realistic conditions. By applying a biased base technology, the higher key rate than the original protocol is achieved. The experimental results demonstrate that the distance between two users can reach up to 60 km over telecom single mode _ber, implying that the feasibility for high-rate and secure communication with shared entangled source at metropolitan distances. Our results constitute an important step toward the realization of a cost-e_ective, scalable metropolitan quantum communication network.

NA40361

13:55-14:10

Title: An Intent-driven Next-generation Mobile Communication Management System

Authors: Ru Dong, Chungang Yang, Junjie Guo, Jingwen Zhang, Jiaorui Huang
Presenter: Ru Dong, Xidian University, China

Abstract: The next generation of mobile communications will be huge with extensive connections, ultra-dense access points, and full-scenario service across multiple domains, leading to huge complexity and fragility of network and service management. In particular, novel network services and applications require the future huge communications to have capabilities of service intent refinement, network state perception, and autonomous policy generation, which make the network and service management with agility, robustness, and intelligence with human out the full lifecycle of network and service management intents. Intentdriven network (IDN) presents a potential way to guarantee users autonomous and reliable services by expressing what they want without focusing on how to implement the management and configuration details. To explore and exploit these capabilities of IDN, we present an intent-driven next-generation mobile communication management system. Then, the detailed architecture of the presented system is introduced. Finally, we propose a proof-of-concept demonstration of the feasibility and effectiveness of the management system.

NA11074

14:10-14:25

Title: Spectrum Efficient Coexistence Between 5G NR Unlicensed and WiGig in 60 GHz Band

Authors: Fang Liu and Yan Yang
Presenter: Fang Liu, Beijing Jiaotong University, China

Abstract: 60 GHz band (57-71 GHz) offers an exciting opportunity for sharing spectrum between NR-based access to unlicensed spectrum (NR-U) and wireless gigabit (WiGig), also termed as IEEE 802.11ad/ay. However, efficient coexistence is particularly challenging because the operating in the 60 GHz is usually deployed with a dense small-cell setting for indoor application and it is hard to avoid interference. In this study, we propose an efficient spectrum coexistence mechanism for NR-U and WiGig to improve spectrum availability and ensure fair coexistence. We also analyze the effect of duty cycle time fraction on NR-U and

WiGig networks. Furthermore, the proposed algorithm maximizes the overall throughput of the NR-U network by joint spectrum resource and transmission power allocation. Simulation results show that our proposed scheme achieves significant spectrum efficiency improvement compared to existing receiver-assisted Listen-Before-Talk (LBT) mechanism.

NA21042

14:25-14:40

Title: Next Generation Access Network based on Hyperchaotic Spread Spectrum Sequences

Authors: Liwei Yang, Maiyun Zhang, Yuanhao Jiang, Xiangyuan Peng, Xinyu Li, Zhehao Xu
Presenter: Liwei Yang, China Agricultural University, China

Abstract: The research focus of the next-generation optical access networks is spread-spectrum communication. However, finding a high-performing pseudo-random address code is challenging in spread spectrum communication. The conventional address code has shortcomings such as insufficient numbers and being easily cracked. The development of chaos theory has promoted the research of chaotic sequences as a spread spectrum address code. In this paper, an optimal sequence combining Chebyshev mapping and Henon mapping is proposed and constructed. The initial sensitivity and correlation characteristics of the optimal sequence are therefore evaluated. Finally, the BER of the system is simulated and tested, and it is determined that the optimal sequence is suitable for the optical access network system of the next generation.

NA30261

14:40-14:55

Title: Ergodic Achievable Rate for RIS-assisted D2D Communication over Nakagami-m Fading

Authors: Fan Yang, Yiyang Ni, Wenchao Xia, Yaxuan Liu, Hui Zhang, Haitao Zhao
Presenter: Fan Yang, Nanjing University of Posts and Telecommunications, China

Abstract: This letter investigates reconfigurable intelligent surface (RIS) assisted device-to-device (D2D) system over Nakagami-m fading channels. Considering the interference from cellular communications, we derive a closed-form expression for the tight upper bound of ergodic achievable rate. Furthermore, we analyze the performance under high SNR case, as well as the case with a large number of reflecting elements and closed-form approximations for both two cases are also provided in simpler forms. Due to the interference from a cellular user, we observe that an irreducible saturation value exists when SNR grows large, leading to a high SNR slope of order 0. It is also demonstrated that for a large number of reflective elements case, the ergodic achievable rate increases logarithmically with the elements number. Finally, we propose the power allocation to maximize the ergodic achievable sum-rate.

NA30246

14:55-15:10

Title: A Deep Learning-Based Angle Prediction Approach for ISAC-Enabled RIS-Assisted V2I Communications

Authors: Ruixiang Wang, Fanghao Xia, Jingxuan Huang, Xinyi Wang and Zesong Fei
Presenter: Ruixiang Wang, Beijing Institute of Technology, China

Abstract: In the vehicle-to-infrastructure (V2I) scenarios, it is challenging to acquire accurate channel state information (CSI) due to the high mobility of the communication channels, which leads to considerable pilot overhead. To tackle this issue, we employ both integrated sensing and communication (ISAC) technique and reconfigurable intelligent surface (RIS) technique to reduce the pilot overhead significantly while maximizing the achievable rate. In particular, we consider a RIS-assisted ISAC system serving the vehicle and design a transmission protocol based on communication-sensing-computing integration architecture for the proposed system, where the ISAC base station (BS) and the dedicated sensors deployed at the RIS receive the reflected echo signals from the user equipment (UE) via the BS-UEBS link and the BS-UE-sensors link, respectively. Then the CSI of the UE can be acquired from the received signals. Furthermore, to provide both high-quality and low-latency communication services, we propose a covariance-based angle prediction neural network (CAP-Net) to predict the angle parameters facilitating he joint transmit and reflective beamforming design for the next time slot. Simulation results show that the proposed RIS-assisted ISAC system with the CAP-Net achieves better communication performance compared with other baseline schemes and can approach the upper bound in terms of achievable rate.

NA40360

15:10-15:25

Title: IDSM: Intent-driven Slice Management and Maintenance for 6G RANs

Authors: Jingwen Zhang, Chungang Yang, Alagan Anpalagan, Ru Dong and Lulu Zhang
Presenter: Jingwen Zhang, Xidian University, China

Abstract: The next-generation wireless communication networks need to support various vertical industries and emerging use cases, with diverse services making the network architecture increasingly complex. Network slicing enables service-oriented management and maintenance by dividing the infrastructure into multiple logical networks to meet diverse and stringent requirements. However, faced with a large tenant base and personalized slicing requirements, network slice providers should put significant effort to complete the lifecycle management of the slices, which severely hinders the implementation of the large-scale end-to-end sliced network. Intent-driven network (IDN) can be used to reduce the complexity of management and maintenance for 6G Radio Access Networks (RANs) by automating the configuration and operation of managed networks with a high-level abstraction of intent. Therefore, we present the framework of Intent-driven Slice Management and Maintenance for 6G RANs, which is termed as IDSM. Firstly, we describe its architecture, followed by the three key technologies of intent translation, slice generation, and Deep Q Network (DQN) intent maintenance. Finally, OpenAirInterface (OAI) platform and FlexRAN Software-Defined-Network (SDN) controller with DQN are used to demonstrate the presented IDSM.

NA30244

15:25-15:40

Title: A Sensing-Based Cooperative Position Scheme for Perceptive Mobile Network towards 6G

Authors: Yajuan Wang, Jing Jin, Liang Ma, Xiaozhou Zhang, Mengting Lou, Tao Jiang, Qixing Wang, Guangyi Liu, Jiangzhou Wang
Presenter: Yajuan Wang, China Mobile Research Institute, China

Abstract: Integrated Sensing and Communication (ISAC) is a promising technology which will be the core of future 6G network. ISAC will integrate radar sensing capability into current communication-only mobile network, with the sharing and integration of transmit signals, time-frequency resources, major hardware and signal processing modules. The base-station-orientated sensing network, or also known as perceptive mobile network (PMN), will empower the base station to operate beyond communication and provide seamless sensing services. In this paper, we focus on extracting sensing parameters of multiple targets for accurate positioning in the PMN scenario. Specifically, we first implement Multiple Signal Classification (MUSIC) and Root-MUSIC for velocity and distance estimation, and compare their performances with OFDM-Radar method. Furthermore, based upon the sensing parameter estimation, we propose an integrated localization scheme that utilize both active and passive sensing signals. We also investigate the impact of resource allocation on positioning performance. The effectiveness of three sensing algorithms and proposed cooperative positioning method are verified using link-level simulation platform adopted from latest 3GPP standards.

SESSION 35

Topic: Network Attack and Security
Time: 13:30-15:40, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/89549029505 Password: 111114

- **Session Chairs:**
  Prof. Zhang Lijun, Science and Technology on Communication Security Laboratory, China
  Assoc. Prof. Rongfei Zeng, Northeastern University, China

NA55029

Invited Speech

13:30-13:55

Title: Maximizing Service Revenue for Mobile Edge Caching Networks
Invited Speaker: Assoc. Prof. Xiong Wang, University of Electronic Science and Technology of China, China

Abstract: Mobile edge caching networks need to meet the different performance goals of users, content providers and network operators. Existing work focuses on optimizing the total hit rate and latency of requested content from the user's perspective. However, network operators are more concerned with the total service revenue gained by caching content. Existing studies lack different optimization metrics considered from the operator's perspective. Therefore, we design a collaborative caching model for mobile edge caching networks with the goal of maximizing the service revenue, which maximizes operator's service revenue and guarantees the user service quality (cache hit rate) to a certain extent. We first formulate the cache configuration and management problem under this collaborative caching model as a convex optimization problem. To solve this problem efficiently, we adopt a primal-dual decomposition framework to decompose the convex optimization problem into multiple subproblems for iterative solution. To further improve the solution efficiency of the algorithm, we design greedy algorithms that can obtain optimal solutions of the subproblems.

NA11019

13:55-14:10

Title: A Defense Method Against Persistent Fault Attack
Authors: Ning Wu, Fang Zhou, Fen Ge
Presenter: ZhixiangXu, Nanjing University of Aeronautics and Astronautics, China

Abstract: Persistent fault attack is a powerful attack technology to recover key information by using persistent fault and statistical methods. It can be applied to the key recovery realized by block cipher look-up table. Its biggest advantage is that the key information can be recovered only by one failure injection, and persistent fault attack can be applied to the classic block cipher protection implementation such as detection technology and mask technology. Nevertheless, the classic fault attack protection technology still improves the difficulty of persistent fault attack. The detection and infection technologies increase the number of ciphertext required to extract the correct key by a constant multiple, which will hinder the attack in the actual scene. Real time health detection of S-box is an effective means to prevent persistent fault attacks. Once the injected fault of S-box is detected, reset, restart or refuse to continue encryption. However, this defense strategy is not effective against multiple persistent fault attacks without changing the secret key. Persistent fault attack makes full use of the double mapping property of S-box, so health detection based on the double mapping property of S-box is an efficient protection method. Compared with the traditional detection method, the 255 times XOR method proposed in this paper has low cost and high efficiency, and the single byte modification of S-box after inspection can effectively mislead the encrypted data obtained by the attacker, even if this data is extremely useful to attackers. The research results of this paper show that the proposed defense scheme can effectively resist three secret key analysis strategies of persistent fault attack.

NA21057

14:10-14:25

Title: Design and Implementation of DDoS Attack and Defense Simulation Subsystem Based on Mininet
Authors: Yongliang Zhao, Rongheng Lin, Hua Zou, Wei Zeng
Presenter: Yongliang Zhao, Beijing University of Posts and Telecommunications, China

Abstract: As a software-defined network emulation software, Mininet can emulate networks

with limited resources on a single host. When studying the DDoS attack and protection, Mininet can be used to emulate network topology and implement the DDoS attack and defense simulation through Mininet. This work made the design and implementation of the DDoS attack and defense simulation subsystem based on Mininet. The DDoS attack and corresponding defense were deployed in the system, and the system can simulate DDoS attack and defense. The implementation of this system provided a reference for constructing a network attack and defense simulation system based on Mininet.

NA30265

14:25-14:40

Title: An improved information transmission technology based on trust value against SSDF attack

Authors: Chang Xiangbei, Qi Lina, Chen Chengbing
Presenter: Xiangbei Chang, Nanjing University of Posts and Telecommunications, China

Abstract: In the distributed spectrum sensing algorithm, multiple sensing users jointly perform cooperative spectrum sensing, which can effectively solve the hidden terminal problem and reduce the sensing time. However, during the sensing process, the spectrum sensing data falsification (SSDF) by malicious users directly affects the reliability of spectrum sensing. In order to solve this problem, an information transfer algorithm based on trust value to resist SSDF is proposed in this paper. Based on information of the propagation path received by the node, the trust value will be calculated and weighted to restore the tampered true value. The simulation results show that the algorithm improves the detection probability and reduces the false alarm probability.

NA21054

14:40-14:55

Title: GNSS Spoofing Detection Based on Abnormal Receiver Noise and Carrier-to-Noise Ratio Metric

Authors: Min Deng, Honghao Wang, Dexiang Ming, and Yangzhuo Chen
Presenter: Honghao Wang, Xiangtan University, China

Abstract: Spoofing interference is one of the great threats to satellite navigation systems and will pose a great threat to targets using Global Navigation Satellite System (GNSS) technology. At present, most of the methods for detecting spoofing interference of satellite signals based on signal power have the problem of ideal threshold setting and low actual detection probability. Some of them need to build a multi-correlator structure, leading to high receiver cost and difficulty in practical application. This paper proposes a low-cost spoofing signal detection method based on the abnormal changes of noise power and carrier-to-noise ratio in the receiver channel. In order to eliminate the influence of random fluctuation error, the noise uncertainty is considered in the threshold setting. And the outliers are eliminated according to the PauTa criterion. The spoofing detection performance is validated on scenario 2 to scenario 3 from the well-known Texas Spoofing Test Battery (TEXBAT) dataset. The average detection probability of two scenarios is above 90%. Compared with the SQM algorithm and the algorithm based on the autocorrelation function, the proposed method achieves higher detection accuracy with lower device cost.

NA30233

14:55-15:10

Title: Physical Layer Security of Cooperative NOMA Systems with an Untrusted User

Authors: Dan Jiang, Yuanyuan Gao, Nan Sha, Xiaoyu Wang and Na li
Presenter: Dan Jiang, Army Engineering University of PLA, China

Abstract: Non-orthogonal multiple access (NOMA) can be combined with physical layer security technology to greatly improve spectral efficiency while tackling security issues for the Internet of Things (IoT) networks. This paper investigates the security performance in a fifth-generation (5G) downlink NOMA system with an untrusted user in the presence of imperfect successive interference cancellation (SIC). Analytical expressions of secrecy outage probability (SOP) and connection outage probability (COP) are derived as performance metrics to evaluate the secrecy of the proposed system. In order to further improve the secrecy performance, we propose an optimal power allocation scheme based on two users′ different quality of service (QoS) requirements and obtain a closed form solution of the optimal parameter. Through numerical simulations and exhaustive search algorithm, we validate the correctness of the derived analytical results. It is proved that the proposed power allocation scheme can achieve the optimal secrecy performance.

NA40340

15:10-15:25

Title: LogPS: A Robust Log Sequential Anomaly Detection Approach Based on Natural Language Processing

Authors: Dongjiang Li, Jing Zhang, Xianbo Zhang, Feng Lin, Chao Wang and Liang Chang
Presenter: Dongjiang Li, JD Tech, China

Abstract: System logs are widely used by engineers to record runtime status in the information technology (IT) field. The sequential anomaly detection of logs is crucial for building a secure and stable system and is beneficial for the discovery, location, and analysis of system failures. Conventional manual log anomaly detection suffers high costs and unsustainable development. Thus, automatic methods based on Natural Language Processing (NLP) technology are proposed to improve the accuracy and efficiency of log anomaly detection. In this paper, we propose a new log anomaly detection model, named LogPS. LogPS utilizes the Part-of-Speech (PoS) technique to extract semantic information from log messages. By allocating the learned PoS-based weights to different tokens in a log template, LogPS can improve the representation quality of the log template vector. In the final anomaly detection stage, we treat a system log as a natural language sequence and build a Bidirectional Long Short-Term Memory (BiLSTM) neural network as the LogPS detection model. Therefore, LogPS can capture sufficient and contextual information from input log sequences from the forward pass and the backward pass. And LogPS can automatically learn log patterns and detect anomalies. The effectiveness of our model is tested on three datasets and is compared with other state-of-the-art models. The experimental results show that, compared with other log anomaly detection methods, the proposed LogPS performs well.

NA21062

15:25-15:40

Title: A Novel Semi-Supervised Anomaly Detection Method for Network Intrusion Detection

Authors: Xinran Wang, Xiaofeng Qiu
Presenter: Xinran Wang, Beijing University of Posts and Telecommunications, China

Abstract: Deep learning techniques have become an increasingly popular solution for network intrusion detection system (NIDS). Semi-supervised deep anomaly detection methods used in network intrusion detection always need a high proportion of labeled samples and do not have good robustness. To solve these problems, we propose ATSAD: a novel semi-supervised anomaly detection method which is an improvement of the state-of-the-art method Deep SAD (Deep Semi-Supervised Anomaly Detection). Our main idea is to make the model pay more attention to important features of input data. We use an attention network to make the idea come true. We define a new objective function so that the attention network and the mapping network of Deep SAD can be trained together. Our evaluations show ATSAD has the best performance and good robustness compared with other methods on the dataset CSE-CIC-IDS2018.

SESSION 36

Topic: Computer Network Model and Data Transmission
Time: 13:30-15:40, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/86088803609 Password: 111114

- **Session Chair: Assoc. Prof. Congduan Li, Sun Yat-sen University, China**

NA55011

Invited Speech

13:30-13:55

Title: Information Timeliness of Joint Transmission and Processing with Mobile Edge Computing

Invited Speaker: Assoc. Prof. Jie Gong, Sun Yat-sen University, China

Abstract: In status update scenarios, the freshness of information is measured in terms of age-of-information (AoI), which essentially reflects the timeliness for real-time applications to transmit status update messages to a remote controller. For some applications, computational expensive and time-consuming data processing is inevitable for status information of messages to be displayed. Mobile edge servers are equipped with adequate computation resources and they are placed close to users. Thus, mobile edge computing (MEC) can be a promising technology to reduce AoI for computation-intensive messages. In this talk, we will investigate the AoI for computation-intensive messages with MEC, and consider how to jointly schedule data transmission and processing to minimize the average AoI.

NA21059

13:55-14:10

Title: Reinforcement Learning-Based Stream Reservation for Distributed Time Sensitive Networks

Authors: Fengyou Xu, Danfeng Qiu, Bo Lv
Presenter: Fengyou Xu, Nanjing University of Aeronautics and Astronautics, China

Abstract: In order to achieve the pursuit of deterministic delay and unified network transmission in the industrial automation field, the time-sensitive networking group has developed a stream reservation mechanism to reserve the required bandwidth for time-sensitive traffic. In the distributed network configuration model, how to configure per-hop delay guarantee properly has become a key problem to restrict network performance, the reason is that an excessive loose or tight guarantee will reduce the streams that can be added to the network. Therefore, this paper proposes a stream reservation method based on reinforcement learning which can dynamically adjust the per-hop delay guarantee to improve the acceptance of streams. For this, it firstly defines the optimization problem of network configuration in the reservation process and give the per-hop delay model. Then the operation of the algorithm on bridge′ s data plane and control plane is simulated. We evaluate the performance of the algorithm with acceptance rate and bandwidth utilization in different scenarios, and the results demonstrate the effectiveness of the proposed algorithm.

NA30274

14:10-14:25

Title: A Machine Learning Based MPTCP Subflow Control Algorithm for Multi-access Heterogeneous Networks

Authors: Chengbing Chen, Lingyun Jiang, She Jun, Hongbo Zhu, Jia Gu, and Xiangbei Chang
Presenter: Chengbing Chen, Nanjing University of Posts and Telecommunications, China

Abstract: Ever growing number of devices and the demand for applications are generating tremendous network traffic today. In the edge network environment, due to the network instability caused by device movement, the single network cannot meet its throughput requirements. Hence, using multi-access network to transmit data packages has become a way to improve throughput. Multi-path TCP utilizes multiple channels to transmit data packages simultaneously. However, MPTCP is unable to control subflows adaptively, and the disorder of data packages caused by difference between paths leads to its poor performance compared with the single path transmission. Therefore, a new MPTCP subflow control algorithm (MSCA) based on Support Vector Machine (SVM) prediction model is proposed. The SDN controller is utilized to continuously monitor the network status and predicts the impact factor of the network based on the path parameters monitored. Then, according to the impact factor, the subflow configurations is dynamically adjusted by the system for each user to improve the average

throughput. The system is implemented on the network emulator platform Mininet-WiFi. Emulation results shows the proposed MSCA improves the average throughput compared with traditional scheme. MSCA also responses quickly to the network changes.

NA30202

14:25-14:40

Title: Classification, Building and Orchestration Management of Digital Twin Network Models

Authors: anyang Chen, Hongwei Yang, Cheng Zhou, Lu Lu, Tao Sun and Pin Lv
Presenter: Danyang Chen, China Mobile Research Institute, China

Abstract: Digital twin network have gradually become a research hotspot in the field of communication networks. In the digital twin network architecture, the network model is the core component. How to use the network model to meet the network application requirements is the key to the value of digital twin network. This paper introduces the detailed classification of DTN models and the comparative analysis of the model building, and realizes the connection between the basic model and the functional model through the model orchestration, so that the basic model can be automatically orchestrated and run under the demand of the functional model, and finally the digital twin network has the functions of closed-loop simulation verification, logic deduction, and performance optimization.

NA30248

14:40-14:55

Title: IoT-botnet traffic detection based on deep forest

Authors: Yalian Wu, Xieen He, Xingnian Chen
Presenter: Xieen He, Xiangtan University, China

Abstract: In order to further improve the accuracy and efficiency of detecting IoT-Botnet attacks from massive and high-dimensional IoT traffic data with seriously imbalanced class distribution, a botnet traffic detection method based on deep forest is proposed. Firstly, a few dominant features are selected based on the Fisher Score. Then, the multi-grained scanning structure is used to mine more relevant information among low-dimensional features to achieve the purpose of feature enhancement. Finally, the cascade forest performs representation learning and refines the classification layer by layer until the overall performance of the deep forest model converges to the best. The deep forest model is trained and tested on the N_BaIoT dataset, and the results show the deep forest model is not affected by massive and high-dimensional data, its average detection accuracy can reach 99.98% on the imbalanced dataset by using only 6 statistical features.

NA40418

14:55-15:10

Title: Ontology-based Network Intent Refinement Framework

Authors: Ying Ouyang, Fuqiang Li, Chungang Yang, Ruitao Song, Xianglin Liu and Zeyang Ji
Presenter: Ying Ouyang, Xidian University, China

Abstract: Intent-driven network (IDN, also named as intent- based network, IBN) allows users to implement policies in a declarative way, instead of treating complete them in the underlying network. However, how to refine intent in natural language remains to be further researched. Although there exist emerging works on intent refinement, the problem of heterogeneous forms of intents in multiple carrier networks is still unsolved at present. As a formalized term set, ontology makes it possible to unify the various terms at the semantic level. The ontology-based architecture of IDN consists of the application layer, the intent-enabled layer, and the infrastructure layer. Users can input intent in the application layer in various ways, and the input intent can be converted into an intent tuple as <Domain, Attribute, Object, Operation, Result>. The intent-enabled layer constructs an intent ontology, on the basis of intent tuple and network configuration protocol (NETCONF) information from the infrastructure layer. In addition, the refined intent can be verified both in natural language processing (NLP) level and the semantic level. In this paper, we design an intelligent intent refinement system to accomplish intent refinement.

NA40407

15:10-15:25

Title: DACS: A Double-layer Application Classification Scheme for Hybrid Zero-day Traffic

Authors: Yulong Liang, Fei Wang, Shuhui Chen
Presenter: Yulong Liang, National University of Defense Technology, China

Abstract: As a fundamental countermeasure for network management and security, traffic classification has attracted public attention for a long time. All the time, the presence of zero-day traffic, network traffic of unknown applications in a classification system, leads to a significant reduction in the practicability and effectiveness of conventional traffic classification methods. This paper innovatively proposes a traffic classification scheme named DACS, which achieves accurate zero-day traffic detection, application traffic classification and high-performance incremental model updating, fitting for open-world and online traffic classification with plenty of zero-day traffic. DACS uses training samples to cross-simulate zero-day flows and combines the idea of distributed training. With a two-layer structure and a special voting mechanism, DACS is able to perform comprehensive traffic classification tasks in hybrid unknown traffic. In addition, DACS provides great convenience for updating the system knowledge and supports efficient incremental updates. The evaluations with real-world traffic verify the core advantages of the proposed scheme. DACS maintains over 95\% classification accuracy on a public dataset (NUDT_MobileTraffic), which is better than the compared methods, and it only needs 1/K retraining time to achieve model update for new applications, where K is the number of sub-classifiers.

NA30201

15:25-15:40

Title: Multi-source heterogeneous data processing technology for digital twin network

Authors: Hongwei Yang, Pin Lü, Tao Sun, Lu Lu, Cheng Zhou

Presenter: Hongwei Yang, China Mobile Research Institute, China

Abstract: Digital Twin Network (DTN) is a fusion technology of digital twin and information communication, and the processing of multi-source heterogeneous physical network data is the key to building a DTN system. This paper firstly proposes the classification of physical network data and the collection requirements for different types of data; secondly, the physical network data processing process is divided into three steps: ①Data collection and transmission, propose "3 criteria" for selecting data collection protocol, and data transmission method to meet the "3 consistent" requirements of twin traffic and physical traffic; ②Data storage and cleaning, clarify the basis for selecting databases for different physical network data, and propose a data cleaning process; ③Data open service, propose, a set of complete data open service architecture is proposed. Finally, this paper is summarized and the future research directions are prospected.

SESSION 37

Topic: Image Recognition and Segmentation
Time: 13:30-15:40, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us02web.zoom.us/j/86924134522 Password: 111114

- **Session Chair: Prof. Bingcheng Zhu, Southeast Univeristy, China**

NA21012

Invited Speech

13:30-13:55

Title: Recognizing Automotive Ethernet Device by Extracting Fingerprint from Power Spectrum

Invited Speaker: Assoc. Prof. Guyue Li, Southeast University, China

Abstract: With the development of modern cars, the automotive Ethernet has become a backbone network of the invehicle network in recent years. The open interfaces of the automotive Ethernet increase risk of being attacked. Device fingerprints identification can be used for the access authentication by utilizing the hardware characteristics of the devices. The signals are intertwined with random data from the both sides of communication which improves the difficulty of feature extraction in Ethernet devices. We propose a feature extraction method based on power spectrum for the 100BASE-T1, in which the feature can be utilized for the coupled signals and remove the influence of the random data. We built the automotive Ethernet device identification platform based on 100Base-T1 with 10 devices to be identified. According to the test, the recognition rate is above 95% when we take the average of 1000 segments′ power spectrum with 1024 sample points.

NA40359

13:55-14:10

Title: A Two-Branch Network Based on Pixel-Pair and Spatial Patch Model for Hyperspectral Image Classification

Authors: Xichen Zhai, Jun Liu and Siyu Sun
Presenter: Xichen Zhai, University of Science and Technology of China, China

Abstract: Recently, the convolutional neural networks (CNNs) have attracted increasing attention in hyperspectral image classification. The CNN can achieve satisfactory classification performance when the amount of training samples is large enough. However, in the practical situations, only a few training data can be acquired. Besides, the phenomena of inter- and intra-class spectral variability pose a challenge to hyperspectral classification tasks. In this study, we propose a novel two-branch CNN based on the pixel-pair and spatial patch (PPSP) model. On the one hand, the PPSP model is designed to significantly expand the amount of training samples. On the other hand, the PPSP features are extracted via the two-branch CNN from the spectral-spatial domain to overcome the problem of inter- and intra-class spectral variability. In the test procedure, the predicted label of the test pixel is determined via the voting strategy. Experimental results indicate that the proposed method achieves superior classification performance over its counterparts.

NA11057

14:10-14:25

Title: Multi-person Identification and Localization Algorithm Using RGB-D Image Segmentation

Authors: Xu Han, Jun Yan
Presenter: Xu Han, Nanjing University of Posts & Telecommunications, China

Abstract: In recent years, with the development of smart phones and intelligent monitoring systems, visual object detection and localization methods have been widely used. Since RGB-D based person identification and localization technology have achieved better performances, an algorithm based on deep learning and image segmentation is proposed in this paper. First, the raw images are preprocessed. Then, image segmentations are performed according to the results of person detecting by YOLOv3 network. For multi-person identification, the Haar cascade classifier is used to determine regions of face on the segmented color images and the Eigen Face method is used for classification. For person localization, the convolutional neural network is preformed regression learning based on the depth images of a single person. Experiments results show that the proposed algorithm performs better than other existing approaches.

NA40425

14:25-14:40

Title: A Spatial Non-Cooperative Target Image Semantic Segmentation Algorithm with Improved Deeplab V3+

Authors: Zonghua Qu, Chunling Wei
Presenter: Zonghua Qu, Beijing Institute of Control Engineering

Abstract: Faced with a large number of non-cooperative targets in space, more complete image data can be obtained at a closer distance. Image segmentation can be performed to obtain morphological information on the relevant targets, which can provide reliable data support for subsequent tasks such as situational awareness. In this paper, we improve the Deeplab V3+ network by adding Convolutional Block Attention Module（CBAM） , which incorporates the channel attention mechanism and the spatial attention mechanism, and verify that the algorithm has good performance and can be used for practical applications by segmenting the spacecraft attitude estimation dataset from the European Space Agency Space Rendezvous Laboratory.

NA30267

14:40-14:55

Title: OPGW Cable Risk Identification Method based on K-means Clustering

Authors: Peizhe Xin, Jing Zou, Shulin Zhang, Qi Xiao, Jun Lu and Yong Wei
Presenter: Qi Xiao, North China Electric Power University, China

Abstract: In order to solve the problem that it is difficult to accurately evaluate the risk of OPGW cable under the action of multiple factors, an identification method of OPGW cable risk characteristics based on K-means clustering is proposed. Firstly, the risk characteristics of OPGW cable are analyzed, including performance index and operation risk factors. Then, considering the time factor, deformation factor and structural factor of OPGW cable risk, a risk characteristic identification method of OPGW cable based on K-means clustering is proposed. Finally, an example analysis is carried out. The example results show that the proposed method can effectively identify the risk characteristics of OPGW and further improve the risk control strategy of OPGW cable, so as to complete the operation and maintenance of OPGW cable more efficiently.

NA40373

14:55-15:10

Title: Research on Airport Bird Recognition Based on Deep Learning

Authors: Yutong Chen, Yufen Liu, Zihan Wang and Jiayi Lu
Presenter: Yutong Chen, GuangZhou Civil Aviation College, China

Abstract: Bird collision is one of the important factors threatening aviation safety, which seriously affects the safety of human life and property. Therefore, effective measures must be taken to prevent such incidents. According to the problems in the existing ways and methods of bird-repelling, this paper proposes a scheme of building an airport bird-repelling linkage system by using the Internet of Things technology. As the core of the system, object detection is particularly important. In order to prevent birds from adapting to bird driving equipment, we explores a better model for bird recognition and achieve training and test accuracies about 92.53%，which is about 4.32% higher than ResNet50. In order to reach faster and better object detection, this model provides a good choice for the future research of bird target detection.

NA40369

15:10-15:25

Title: Traffic Sign Recognition Based on Multi-branch Residual Mixture Model

Authors: Chaoqi HU, Yaohui LI, Zehao FU
Presenter: Chaoqi HU, Tianjin University of Technology and Education, China

Abstract: In order to improve the accuracy of traffic sign recognition in real environment, a multi-branch residual mixture model based on LeNet-5 is proposed. Firstly, erosion and dilation in morphology are used to preprocess images. Secondly, two relatively independent convolutional branches are constructed to extract the multi-scale feature information of the images. Based on the idea of residual connection, bottleneck blocks are constructed to increase the depth of the network to improve the fitting ability of the model. In addition, Squeeze-and-Excitation block is added to the improved algorithm to reinforce the useful features, and Dropout is added to alleviate the overfitting. Finally, the hyperparameters are selected by using the five-fold cross-validation, and the exponential decay learning rate is used instead of the original fixed learning rate, so that the model can converge better. The accuracy

of the improved algorithm on GTSRB and BelgiumTSC is better than that of the classical LeNet-5 model.

NA00007

15:25-15:40

Title: Research on Intelligent Sorting System

Authors: Yanghong Mao and Chuixin Chen
Presenter: Yanghong Mao, Guangzhou Institute of Science and Technology, China

Abstract: In order to achieve the goal that the manipulator can automatically obtain any position within its working range, and can adjust the end actuator for grasping, a vision sorting system is designed. The system passes through image processing, target recognition and positioning, and finally realizes the sorting effect through end control. The acquired image is enhanced and edge detected. Aiming at the problem that the deep learning algorithm takes a long time, The traditional image processing algorithm and deep learning target detection algorithm are organically combined to reduce the use delay of image processing in the system. Because the training of deep learning model requires a large number of data sets, but the amount of data in manufacturing factories is small, and data labeling is time-consuming and laborious, YOLO v3 algorithm is used to improve the efficiency of training model under a small number of labeled data sets. In the algorithm of position, the centroid is extracted as the positioning reference coordinate, the kinematics model of the manipulator is established. and sent to STM32 through the serial port. Then the STM32 completes the control command to grasp and place the workpiece and complete the sorting task. The experimental results show that the system meets the design requirements.

SESSION 38

Topic: Development of electronic equipment based on AI
Time: 13:30-15:50, Nov. 14, 2022, Beijing Time, GMT+8
Zoom Link: https://us06web.zoom.us/j/89327674351 Password: 111114

- **Session Chair: Assoc. Prof. Yunkai Wei, University of Electronic Science and Technology of China, China**

NA55016

Invited Speech

13:30-13:55

Title: MIG Detectors: Theory and Applications
Invited Speaker: Assistant Professor Xiaoqiang Hua, National University of Defense Technology, China

Abstract: Matrix information geometry is the study of intrinsic properties in the space of Riemannian manifold composed of positive-definite matrices. Matrix information geometry has been successfully applied to radar signal processing, image processing, computer vision, and other inter-disciplinaries. This report gives a brief introduction of the theory of matrix information geometry, and summaries some applications of signal detection in homogeneous and nonhomogeneous clutter. The further work on MIG detectors is also pointed out.

NA55013

Invited Speech

13:55-14:20

Title: Photonic integrated semiconductor laser chip for broadband chaos generation
Invited Speaker: Professor Pu Li, Taiyuan University of Technology, China

Abstract: Laser chaos has been widely used in various fields. However, it should be noticed that in most schemes for laser chaos generation are constructed using the discrete optical components, that are usually bulky, lack of long-term stability and reproducibility. Photonic integrated circuits (PIC) is a promising technology to overcome these issues and few chaotic PIC schemes has been reported. However, most of them are based on the optical-feedback structure, that would inevitably bring about time delay signatures (TDS). In this letter, we propose a novel photonic integrated chaotic semiconductor laser (PICSL). This chip consists of two back to back DFB lasers to form a mutual coupled structure. It can generate laser chaos with the standard bandwidth above 7.0 GHz and the TDS is totally suppressed. Meanwhile, the route into chaos is confirmed through the observation of diverse nonlinear dynamics.

NA11020

14:20-14:35

Title: Efficient Configurable Digit-Serial Multiplier Based on Improved Karatsuba Algorithm Over GF(2m)
Authors: Xinyu Wang, Ning Wu, Fang Zhou, and Fen Ge
Presenter: Xinyu Wang, Nanjing University of Aeronautics and Astronautics, China

Abstract: The core operation of public key cryptosystems such as Elliptic Curve Cryptography (ECC) is modular multiplication. In recent years, designing high-performance multipliers for simplifying circuit structure, reducing hardware area, and improving computational efficiency has become a research hotspot. In this paper, a digit-serial least significant digit (LSD) modular multiplier with pipelined structure is proposed based on the block recombination Karatsuba Algorithm (BRKA). Moreover, by converting the data form of the multiplication operands, we can meet the operational requirements of irreducible polynomials in any field, and achieve the purpose of configurability. From theoretical analysis and synthesis results, compared with the better related work, the proposed multiplier not only meets the operation requirements of various domain-valued ECC algorithms, but also achieves a 20.52% reduction in time, 8.82% savings in area consumption, and provides 27.53% saving of area-delay product (ADP).

NA21072

14:35-14:50

Title: A Block Assembly Tool for Design Automation of FPGA Implementations
Authors: Ke Du, Stéphane Domas and Michel Lanczner
Presenter: Ke Du, China Pharmaceutical University, China

Abstract: Hardware design has been a tough work since it came into being, especially with the emergence of FPGAs that led to a fast rising of project sizes. Thus, it is necessary to investigate how to make hardware programming easier. This paper presents the details of an

EDA tool called BlAsT (Block Assembly Tool) that allows non-expert users to generate VHDL code automatically, compliant with real target architecture and not only for simulations. Moreover, it allows to check whether the result is correct for given input streams and give necessary modification to ensure the correctness. This process involves pattern checking and graph modification algorithms for FPGA design automation. As shown in the example case, BlAsT performs well for design automation for FPGA architectures.

NA30297

14:50-15:05

Title: An Identity Authentication Method Based on Accelerometer and Gyroscope

Authors: Ru Zhao, Junrui Liu, Xiaorong Zhao and Deqiang Wang
Presenter: Ru Zhao, Shandong University, China

Abstract: In this paper, we propose a behavioral biometric authentication method based on accelerometer and gyroscope. The novelty of the proposed lies in feature extraction and similarity calculation. For feature extraction, a newly designed ConvBiGru-FCN network is employed to extract walking features from the multi-dimensional time-series acquired by the accelerometer and gyroscope. For similarity calculation, Tanimoto coefficient is used instead of conventional measures to calculate the distance between feature vectors. A dataset of 50 users has been collected in a realistic test ground for use in model training and testing. Extensive experiments have been carried out to evaluate the performance of the proposed scheme. Numerical results show that the proposed scheme with typical settings achieves an identity authentication accuracy of 93.10%.

NA30299

15:05-15:20

Title: 3D chaos generating by 555 timer

Authors: Jie Cheng, Haiyong Huang, Wenshi Li
Presenter: Jie Cheng, Soochow University, China

Abstract: The most compelling and simplest chaotic circuits have always been technical challenges. Here we report an inductor-less 555 timer chaotic circuit, combined with two resistors and two capacitors, illustrating on three dimensional (3D) strange attractor. After being seen through Lyapunov exponents, the gained 3D chaotic signals passed the complexity measuring tests of spectral entropy complexity, spring test and recurrence plot analysis. The 555 timer chaos generating mechanisms rely on both the nonlinear double threshold of inner Schmidt trigger and the frequency broadening of differential external capacitor. The chaotic start-up characteristic is due to the random resonance induced by the internal random switching noise of comparators in 555 timer chip.

NA11089

15:20-15:35

Title: Path Loss Model for Wearable Robotic Arm System at MHz Band

Authors: Weijia Ren, Fanmiao Sun, Lijia Liu, Yifan Wang, Le Song, Jingjing Shi
Presenter: Weijia Ren, Northeastern University, China

Abstract: Brain-controlled wearable prosthesis system which uses wireless human communication technology provides new ways for the disabled to interact with their surroundings. To realize efficient data transmission between the robot arm and whole body-scattered or implanted sensors, it is necessary to establish reliable human body communication links with the help of human-centered wireless technology. In this paper, the path losses from different locations of the arm surface to the whole body area are calculated and statistically studied based on an anatomical adult male model below 100 MHz. According to the surface wave propagation characteristics, three human body receiving regions, that is, the head, upper-body, and whole-body areas are specified to construct comprehensive and accurate path loss models. The results show that the linear model is more suitable for the head region, the Friis-based logarithmic distance path loss model is appropriate to describe the upper-body area calculated path losses, and the logarithmic distance path loss model with a surface wave-based linear regulation term is more accurate for long-range whole-body area path loss characteristics. The shadow fading is normally distributed around the derived average path loss. The fitted key parameters of the path loss models are also summarized to provide a reliable basis for further research on the brain-controlled robotic arm communication system.

NA11030

15:35-15:50

Title: Reconfigurable Multi-Algorithm Neural Network Accelerator Based on Target Detection

Authors: Wang Han, Ning Wu, Fang Zhou, and Fen Ge
Presenter: Wang Han, Nanjing University of Aeronautics and Astronautics, China

Abstract: With the development of convolutional neural network technology, neural network has made a great breakthrough in target detection. Target detection has become an important research direction of neural network and has played an important role in artificial intelligence and Internet of things technology. In order to make the Internet of things platform with limited computing performance apply more target detection algorithms, a reconfigurable multi-algorithm neural network accelerator for the field of target detection is proposed in this paper. The accelerator configures and combines the parameters of the computing unit through hardware, so as to accelerate a variety of target detection algorithms. This paper designs a SoC verification system with Cortex-M3 as the core, and verifies the performance of the accelerator in FPGA. The accelerator we designed has realized LeNet-5 network and Darknet-19 network, and compares the running time of these two networks with other platforms. Experiments show that this reconfigurable accelerator proposed in this paper outperforms Cortex-A7 and Cortex-A53 in the acceleration effect of CNN at the frequency of 50MHz, and the calculation time of YOLO is significantly reduced compared with the software implementation. This accelerator also consumes significantly less resources than other designs.

Qin Huai River

Qin Huai River, a branch of the great Yangtze, is 110 kilometers in length and pass through the urban area of Nanjing. As the largest river in the area around Nanjing, Qin Huai River is called the "lifeblood" of the city.

The Qin Huai River can be divided into two parts, the inner river and the outer river. As the largest city door in China, Zhonghua Gate can also be found along the inner river. It is also praised as the most intricate and the best-preserved city door in the world.

Sun Yat-sen Mausoleum

Sun Yat-sen Mausoleum, designed in the shape of an alarm bell, is the mausoleum for Dr. Sun Yat-sen, the “Father of Modern China”. With a great and inspiring design, this mausoleum was started in 1926 and completed in 1929 with an area of 80, 000 sq. m. (about 20 acres), located at the south slope of the Purple Mountain facing with fertile plain and leaning against a green mountain, close to Xiaoling Mausoleum to the west and Linggu Temple to the east. It is also Sun Yat-sen's wish to be buried near Purple Mountain. Sun Yat-sen Mausoleum was listed as “National AAAAA Tourist Attraction” in 2006 and “Architectural Heritage in the 20th Century in China” in 2016.

Nanjing City Wall

Covering a length of 25.1 km, Nanjing City Wall is the largest and longest city wall preserved in the world. It was firstly built in 1366 by Zhu Yuanzhang - the first emperor in Ming Dynasty to consolidate his sovereignty and keep out invaders. 27 years later, this consummate city wall was finished. Nanjing City Wall is the best place to appreciate Nanjing's antique flavor. Standing on the wall, you can imagine how flourishing Nanjing could be in one thousand years ago. In daytime, you can also have great views of the Xuanwu Lake, Purple Mountain and the tower of Jiming Temple. When the night falls, the wall is nicely lit-up.

Purple Mountain

Known as one of the Four Famed Mountains in South China, Purple Mountain perches in the east side of Nanjing City like a tortuous dragon. Its peaks are often found enveloped in mysterious purple and golden clouds at dawn and dusk, hence it gets name. The main peak of this mountain reaches to about 450 meters high. No matter when you visit Purple Mountain, you can enjoy a great natural view. In spring, you can see many beautiful flowers in blossom, like orchids, sakuras, begonias, etc. In autumn, the whole mountain will be dyed into various colors from yellow to scarlate. When it snows in winter, the Purple Mountain is one of the best places of Nanjing to see snow view. Great scenic areas to enjoy natural beauty include Zixia Cave, Zixia Lake and Plum Blossom Hill.

一、研究院简介

电子科技大学长三角研究院（湖州）是由湖州市人民政府与电子科技大学共同举办的事业单位性质的校地合作科研办学机构，2020年9月4日正式揭牌成立，现有科研办公面积1万多平米，在建院区510亩。研究院以汇集全球“电子信息+”创新资源、培养创新人才、建设科创平台、发展高新技术、助力产业升级为目标，将努力打造长三角地区一流“电子信息+”人才与技术高地。

二、研究领域

研究院围绕湖州市以及长三角地区重点科技和产业发展方向，聚焦“电子信息+”领域发展所需，目前已成立6个研究中心和2个实验室，入驻50余支科研队伍。

研究中心（实验室）名称	主要研究方向
太赫兹技术及无线通信研究中心	太赫兹集成电路芯片、器件与系统，先进天线与电磁波调控，绿色通信与信能一体技术，智能感知/通信及未来网络等
集成电路与系统研究中心	新一代半导体开发、封装与检测，集成电路与微系统，柔性电子技术，芯片智能化技术等
工业智联网及智能制造研究中心	智能制造与高端装备，工业智联网，数字化/网络化智慧工厂，电力电子控制技术等
新材料与能源科学研究中心	新能源材料与智慧能源、光电催化与环境材料、传感/智能材料与器件、表面工程与电子封装等
人工智能及公共安全研究中心	数字经济与区块链，数字安防与网络安全，量子互联网技术，无线传感与智能计算等
卫星导航及遥感研究中心	卫星导航与遥感，深空深地深海智能探测，环境监测与大数据分析等
生物医学与信息技术实验室	智慧医疗与大健康，数字康养，纳米技术与生物医学，医疗器械与智能可穿戴设备等
文管实验室	数字乡村、企业智慧运营、数字化转型、社会共同富裕、城乡融合等

三、共享实验平台

研究院与湖州市政府共同推进六大共享实验平台建设，平台旨在打造从研发、检测、服务到应用验证的创新“闭环”，根据实际需求进行功能集成，交叉复用，推动核心技术攻关和源头创新。平台对外开放共享，重点服务成长型科技型企业，助推湖州市以及长三角地区科技创新与产业发展。

平台名称	平台功能简介
微波暗室	由远场测试系统、平面近场测试系统、球面近场测试系统、拱形架测试系统和波导法测试系统共5个测试系统组成，可以对天线及材料性能进行测试，有效测试频率高达110GHz。
超净间实验平台	可承担毫米波、太赫兹芯、集成电路芯片和各种电子器件的封装、测试等工作，最高测试频率高达110GHz。
电路实验平台	满足微波毫米波电路与系统、太赫兹技术、新一代无线通信技术等多个领域的全面测试要求，最高能够进行4THz的信号分析。
强电实验平台	主要承担动力系统与功率变化以及电力电子和电机电器科学研发与测试，拥有200KW内直流电机大功率输入输出测试系统，以及820A、165KVA的大功率交直流供电系统。
材料实验室	配备完善的新能源材料、光电催化材料等高端材料的合成设备，以及化学物理传感器等重要器件的组装设备，并搭载高精尖表征技术，助力新材料与能源器件的应用研究。
智算中心	满足大数据计算、人工智能、量子化学等各类数据计算和模拟仿真运算要求。包含GPU服务器、高密度计算服务器和交换机，最大浮点运算能力高达571TFLOPs.

四、发展现状

➢ 人才招引

建有浙江省博士后科研工作站、湖州市院士专家工作站；面向海内外招引吸纳一批顶尖人才、领航人才、卓越人才、高级人才、青年人才等各层次优秀人才；为人才量身定制电子科大“南太湖学者”及“青年领军人才成长计划”等，助力青年人才快速发展。

➢ 科技创新

承担国家级、省部级等重大或重点科研项目；加快与企事业单位的技术联合攻关，开展横向课题合作；连续在相关领域国际顶级期刊上发表论文；持续推进发明专利申报工作，推动系列优质项目落地。

➢ 平台建设

院级研究中心 6 个
院级共享实验平台 6 个
国家级平台分支机构 2 个
市重点实验室 1 个
区重点实验室 6 个
院企科创平台 13 个

➢ 产学研合作

西塞山“电子信息+”产学研联盟理事长单位
浙江省医疗器械知识产权联盟理事单位
科技特派团队与科技特派员派遣
企业孵化及引进 12 家
西塞山英才计划创业项目 3 项

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紫金山实验室是省市重点打造的服务国家战略的重大科研平台，自2018年启动建设以来，聚焦国家网络通信与安全领域重大需求，开展基础性、前沿性研究和“卡脖子”技术攻关，取得一系列重大科研成果，已正式进入国家战略科技力量序列。

实验室拥有国家重大科技基础设施CENI、移动通信国家重点实验室、毫米波国家重点实验室、网络内生安全试验场等一批国际一流的科研条件设施，设有国家级博士后科研工作站、江苏省院士工作站等一批高水平人才载体，具备独立招收博士后研究人员资格，拥有职称自主评审权，已组建一批年龄结构合理、学历层次高、科研创新能力强、跨学科的高端人才团队。

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