2026 Asia-Pacific Conference on Communications

Xi'an, China | November 10-12, 2026

Conference Program



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OPPO, China
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Shanghai Jiao Tong University, China
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Southern University of Science and Technology, China

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Yayu Gao
Huazhong University of Science and Technology, China

Track 3: Networking

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Mingchun Tang
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Track 4: Emerging Technologies, Applications, and Services

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Queen's University Belfast, United Kingdom
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Tsinghua University, China
Xianfu Lei
Southwest Jiaotong University, China

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Special Session 1: Space and Satellite Communications

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Mingchuan Yang
Harbin Institute of Technology, China
Lixia Xiao
Huazhong University of Science and Technology, China

Special Session 2: Movable Antenna and IRS

Qingqing Wu
Shanghai Jiao Tong University, China
Lipeng Zhu
Beijing Institute of Technology, China
Guojie Hu
Rocket Force University of Engineering, China

Special Session 3: AI-Empowered Communications for Unmanned Systems

Lili Chen
Northwestern Polytechnical University, China
Min Jia
Harbin Institute of Technology, China
Chuan Zhang
Southeast University, Purple Mountain Laboratories, China

Special Session 4: AI-Native 6G Networks: Toward Intelligent, Ubiquitous, and Trustworthy Connectivity

Bin Cao
Beijing University of Posts and Telecommunications, China
Xu Xia
China Telecom Research Institute, China
Hao Xu
Tongji University, China
Yijing Liu
University of Electronic Science and Technology of China, China

Special Session 5: Integrated Sensing, Communication, Computing and Intelligence for Future Communication Networks

Cunhua Pan
Southeast University, China
Zhaohui Yang
Zhejiang University, China
Changsheng You
Southern University of Science and Technology, China
Zhiyong Chen
Shanghai Jiao Tong University, China
Daquan Feng
Shenzhen University, China

Special Session 6: Semantic Communication and Semantic-Aware Agentic AI Networking

Yong Xiao
Huazhong University of Science and Technology, China
Rongpeng Li
Zhejiang University, China
Yingyu Li
China University of Geosciences (Wuhan), China

Special Session 7: Semantic-Aware Immersive Communication: Theory, Systems, and Applications

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North China Electric Power University, China
Yao Sun
University of Electronic Science and Technology of China, China
Runze Cheng
University of Glasgow, United Kingdom

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Yoon-Ho Choi
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Young-Chai Ko
Korea University, South Korea
Yuanxin Cai
Beijing Information Science and Technology University, China
Yuezhi Zhou
Tsinghua University, China
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Yuichi Ohsita
The University of Osaka, Japan
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Sookmyung Women's University, South Korea
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CONFERENCE GUIDELINES

Oral Presentation

- Each oral presentation is allocated 15 minutes (12 minutes for presentation + 3 minutes for Q&A).
- Please get your presentation PPT or PDF files prepared and backed up and arrive at your assigned session room at least 15 minutes before the session begins to prepare for your talk.
- Laptops, projector & screen, and laser pointers will be provided by the conference organizer.

Poster Presentation

- The poster sessions will be held at the following times:
  Poster Session 1: November 11, 15:30–16:30
  Poster Session 2: November 12, 10:00–11:00

- Poster presenters are required to be present at their assigned poster boards during the following designated times:

- Presenters in Poster Session 1 must remain at their posters from 15:30 to 15:45 on November 11.
- Presenters in Poster Session 2 must remain at their posters from 10:00 to 10:15 on November 12 to present their work and answer questions.

- Each poster has been assigned a specific poster board number, as indicated in the Poster Session sections of the conference program.

Badges Required for Admission

Badges are required for admission to all APCC events and activities. Those who have registered for the conference can collect their badges at the registration desk. Please keep your badge safe, as lost badges will not be replaced.

No-show Policy

Papers whose presenters fail to attend and present at the conference will be excluded from the conference proceedings and will not be published. Registration fees are non-refundable.

Catering for the conference			
Nov. 10, 2026	Welcome Reception	2F	Changle Ballroom 3
Nov. 11, 2026	Lunch	38F	JW Kitchen Restaurant
	Banquet	2F	Changle Ballroom 1+2
Nov. 12, 2026	Lunch	38F	JW Kitchen Restaurant

CONFERENCE VENUE

JW Marriott Hotel Xi'an

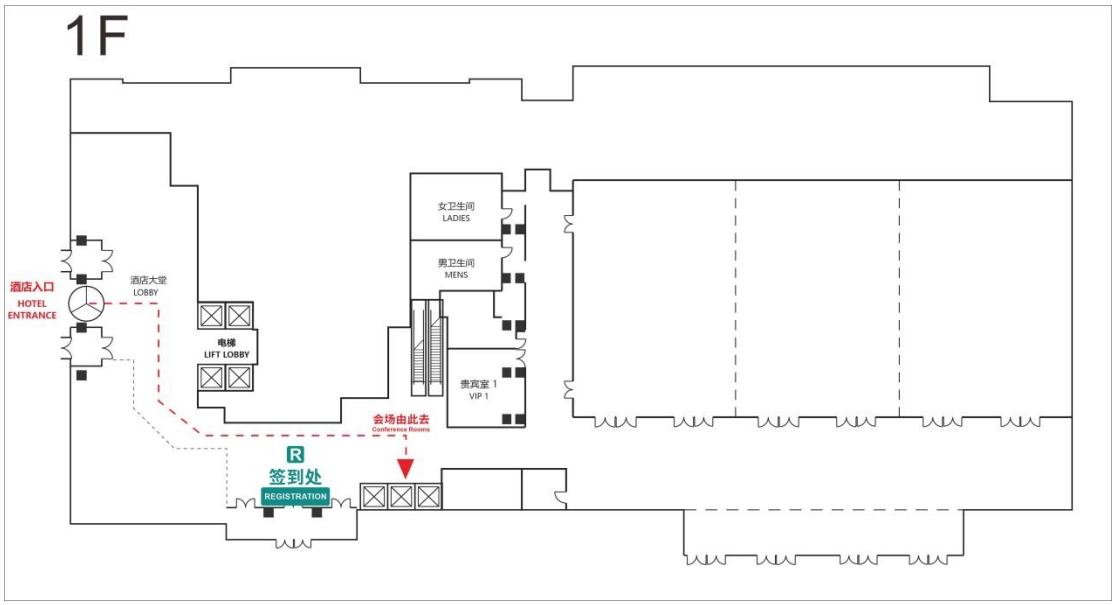
No. 168 Fengcheng 8th Road, Economic and Technological Development Zone, Xi'an, Shaanxi, China

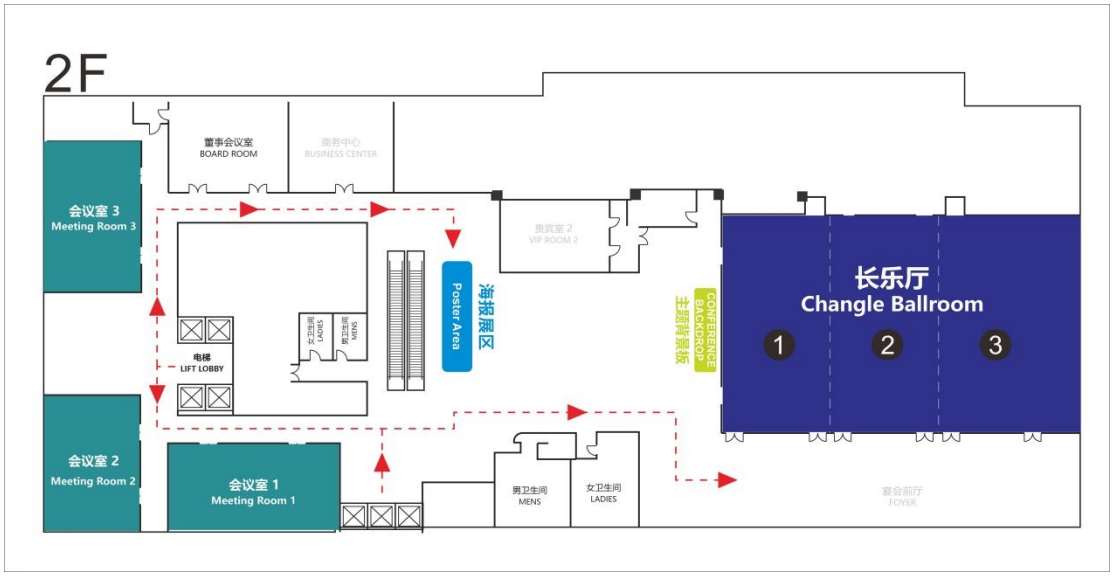
TRANSPORTATION

From Xi'an Xianyang International Airport
27 km, 25 mins by vehicle

From Xi'an North Railway Station
5 km, 10 mins by vehicle

Metro & Taxi
Nearest metro station: Wenjing Road Station (Line 4, Exit C Southeast, ~400 m walk) · Taxi stand at the hotel main entrance





AGENDA OVERVIEW

Registration & Conference Materials Collection

JW Marriott Hotel Xi'an • Lobby 1F

- **10:00-18:00, Nov. 10, 2026**
- **08:00-18:00, Nov. 11, 2026**
- **08:00-15:00, Nov. 12, 2026**

- Nov. 10, 2026 · Tuesday-

Time	Event	Venue
10:00-18:00	**Registration**	Lobby 1F
18:00-20:00	**Welcome Reception**	2F Changle Ballroom 3

- Nov. 11, 2026 · Wednesday-

Time	Event	Venue
	Opening Ceremony ***Host: Yunsong Li, Xidian University, China***	
09:00-09:10	***OPENING REMARKS*** **Tong Song,** China Institute of Communications, China **Zan Li,** Xidian University, China	2F Changle Ballroom 1+2
	Keynote Speeches ***Host: Yunsong Li, Xidian University, China***	
09:10-09:40	**Ping Zhang,** Beijing University of Posts and Telecommunications, China **Speech Title:** Toward the Convergence of Communication and Artificial Intelligence (ComAI)	2F Changle Ballroom 1+2
09:40-10:00	***Coffee Break***	2F Foyer
10:00-10:25	**Takaya Yamazato,** Nagoya University, Japan **Speech Title:** Optical Wireless Communications from the Edge to the Backbone: From Image Sensors to Space-Based Optical Networks	2F Changle Ballroom 1+2
10:25-10:50	**Yan Jia,** National University of Defense Technology, China **Speech Title:** Security of Network Communication Systems and Cyber Ranges	2F Changle Ballroom 1+2
10:50-11:15	**Byonghyo Shim,** Seoul National University, South Korea **Speech Title:** Task-oriented Token Communications for Humanoid Era	2F Changle Ballroom 1+2

- Nov. 11, 2026 · Wednesday-

Time	Event	Venue
	Keynote Speeches ***Host: Yunsong Li, Xidian University, China***	
11:15-11:40	**Celimuge Wu,** The University of Electro-Communications, Japan **Speech Title:** Semantic Communications for Remote Driving: From Bits to Meaning	2F Changle Ballroom 1+2
11:40-13:30	***Lunch***	JW Kitchen Restaurant, 38F
13:30-15:30	**Special Session 1: Space and Satellite Communications-I**	2F Meeting Room 1
	Special Session 4: AI-Native 6G Networks: Toward Intelligent, Ubiquitous, and Trustworthy Connectivity-I	2F Meeting Room 2
	Special Session 5: Integrated Sensing, Communication, Computing and Intelligence for Future Communication Networks-I	2F Meeting Room 3
14:00-16:00	**ASC Meeting**	"2F Board Room"
	The Huashan Scholars Forum of APCC	2F Changle Ballroom 3
15:30-15:45	***Coffee Break***	2F Foyer
15:30-16:30	**Poster Session 1**	2F Foyer
15:45-17:45	**Special Session 1: Space and Satellite Communications-II**	2F Meeting Room 1
	Special Session 4: AI-Native 6G Networks: Toward Intelligent, Ubiquitous, and Trustworthy Connectivity-II	2F Meeting Room 2
	Special Session 5: Integrated Sensing, Communication, Computing and Intelligence for Future Communication Networks-II	2F Meeting Room 3
18:30-20:30	***Banquet***	2F Changle Ballroom 1+2

- Nov. 12, 2026 · Thursday-

Time	Event	Venue
08:30-10:00	**Special Session 2: Movable Antenna and IRS**	2F Meeting Room 1
	Special Session 3: AI-Empowered Communications for Unmanned Systems	2F Meeting Room 2
	Special Session 6: Semantic Communication and Semantic-Aware Agentic AI Networking	2F Meeting Room 3
10:00-10:15	***Coffee Break***	2F Foyer
10:00-11:00	**Poster Session 2**	2F Foyer
10:15-12:00	**Technical Session 1: Signal Processing for Communications-I**	2F Meeting Room 1
	Technical Session 2: Wireless Communications-I	2F Meeting Room 2
	Technical Session 3: Networking	2F Meeting Room 3
12:00-13:30	***Lunch***	JW Kitchen Restaurant, 38F
13:30-15:30	**Technical Session 4: Signal Processing for Communications-II**	2F Meeting Room 1
	Technical Session 5: Wireless Communications-II	2F Meeting Room 2
	Technical Session 6: Emerging Technologies, Applications, and Services	2F Meeting Room 3

KEYNOTE SPEAKERS



09:10-09:40 Nov. 11, 2026 | 2F Changle Ballroom 1+2

Prof. Ping Zhang

Academician of the Chinese Academy of Engineering (CAE)

Beijing University of Posts and Telecommunications, China

Bio.: Ping Zhang is Counsellor of the State Council, Member of the Chinese Academy of Engineering (CAE), Professor of Beijing University of Posts and Telecommunications (BUPT), Director of the State Key Laboratory of Networking and Switching Technology. He is the Editor-in-Chief of Journal on Communications, and IEEE Fellow. He has long been committed to theoretical research and technological innovation in mobile communications. He has received many awards and honors including the Grand Prize for the National Science and Technology Progress Award. He is one of the most well-known key contributors to the development of China-pioneered mobile communication technologies, which have been widely adopted on a global scale. His research interests include next-generation mobile networks, semantic communications, and ComAI system.

Speech Title: Toward the Convergence of Communication and Artificial Intelligence (ComAI)

Abstract: In recent years, wireless communication systems have pursued performance gains by exploiting physical resources such as time, spectrum, power, and antenna dimensions, increasing channel capacity limits but raising concerns about long-term sustainability. Motivated by the integration of AI into wireless communications, a new ComAI paradigm converged communications and intrinsic native AI has emerged as a promising alternative, centered on semantic communications. However, unlike classical information theory, which provides foundation and guidance for traditional wireless communication systems, semantic information theory has long lacked a coherent framework due to diverse perspective of semantic information, limiting its ability to guide system design and optimization for semantic communications. Recently, a synonymity-based advances have offers a potential way to address this gap, enabling semantic information theory to offer principled theoretical support and potentially evolve into a unified framework for semantic communication systems.

This report presents a survey of semantic information theory and methods beyond Shannon. We will first introduce ComAI, a new communication paradigm that converges communication and native AI. The system architecture of ComAI, inspired by human intelligence, and its key technologies will be subsequently provided, and then its essences will also be discussed, elaborating the relationships among communication, intelligence, and semantic information.

KEYNOTE SPEAKERS



10:00-10:25 Nov. 11, 2026 | 2F Changle Ballroom 1+2

Prof. Takaya Yamazato

Nagoya University, Japan

Bio.: Dr. Takaya Yamazato is a professor and Deputy Director at the Institute of Liberal Arts and Sciences at Nagoya University in Japan. He earned his Ph.D. in Electrical Engineering from Keio University in Yokohama, Japan, in 1993. From 1993 to 1998, he served as an Assistant Professor in the Department of Information Electronics at Nagoya University. Additionally, he was a visiting researcher at the Research Group for RF Communications at the University of Kaiserslautern from 1997 to 1998. In 2006, Dr. Yamazato received the IEEE Communication Society's Best Tutorial Paper Award. He co-chaired the Wireless Communication Symposia at IEEE ICC 2009 and the Selected Areas in Communication Symposia at IEEE ICC 2011. Additionally, he served as the chair of the Satellite and Space Communication Technical Committee of the IEEE Communication Society from 2008 to 2010. In 2011, he conducted a half-day tutorial titled "Visible Light Communication" at IEEE ICC 2011 in Kyoto, Japan. He also served as the editor-in-chief of the Japanese Section of the IEICE Transactions on Communications from 2009 to 2011, and chaired the IEICE Communication Society editorial board from 2020 to 2021. Furthermore, he received the IEICE Best Paper Award in 2020. Since 2024, he has been serving as the Director of Journals and Transactions for the IEICE.

In addition to his research in wireless communications, Dr. Yamazato has been actively engaged in open education initiatives. He launched the Nagoya University OpenCourseWare in 2005 and has been involved in its management and operation ever since. He has served as a board member of JOCW since its inception in 2005 and is currently a member of the board of Open Education Japan (OEJ). As of 2024, he is also a member of the Board of Directors at Open Education Global (OEG).Dr. Yamazato's research interests include visible light communication (VLC), intelligent transport systems (ITS), stochastic resonance (SR), and open educational resources (OER).

Speech Title: Optical Wireless Communications from the Edge to the Backbone: From Image Sensors to Space-Based Optical Networks

Abstract: Optical wireless communication encompasses a diverse family of technologies, ranging from visible light signals received by cameras to narrow laser beams connecting underwater vehicles, high-altitude platforms, satellites, and ground stations. These systems should not be evaluated by data rate alone. Their roles depend on communication range, spatial selectivity, mobility, propagation environment, and their ability to integrate communication with sensing and positioning.

This keynote examines the expanding role of optical wireless communication from the intelligent network edge to future backbone infrastructure. It first introduces image-sensor communication for intelligent transportation systems. Although its data rate is generally lower than that of radio-based systems, an imaging receiver can spatially separate transmitters, associate information with visible objects, and combine communication with perception, localization, and ranging. In this sense, image-sensor communication is inherently an integrated sensing and communication technology: the camera senses

the surrounding environment while simultaneously receiving data encoded in light. Vehicular experiments using rolling-shutter and event cameras illustrate these distinctive capabilities and their practical limitations.

The discussion then extends to high-capacity, beam-directed optical links. Underwater and high-altitude-platform communications offer substantial capacity where conventional radio or acoustic technologies face constraints. Still, absorption, scattering, atmospheric effects, platform motion, and beam misalignment make acquisition and tracking essential. Finally, optical inter-satellite links and large LEO constellations are considered a possible new layer of global backbone infrastructure. Recent demonstrations and emerging multi-orbit optical-network projects suggest that space-based optical networks could complement terrestrial and submarine fiber by providing flexible routes, lower latency on selected long-distance paths, and greater network resilience.

The talk concludes with a unified research roadmap for identifying, acquiring, tracking, adapting, recovering, and routing spatially selective optical links from the edge to the backbone.

KEYNOTE SPEAKERS



10:25-10:50 Nov. 11, 2026 | 2F Changle Ballroom 1+2

Prof. Yan Jia

National University of Defense Technology, China

Bio.: Yan Jia is a Research Professor at the National University of Defense Technology (NUDT). She currently serves as the principal investigator of a national major research program and as Vice President of the Chinese Information Processing Society of China, among other positions. Her primary research interests include the application of artificial intelligence and big data analytics to cyberspace security. As a principal investigator and project leader, she has led or participated in more than 20 major and key national-level research projects and has received five Second Prizes of the National Science and Technology Progress Award. She has published more than 300 SCI/EI-indexed papers, authored eight monographs, been granted 130 invention patents, and led the development of 35 national and industry standards. She is a recipient of the Ho Leung Ho Lee Foundation Prize for Scientific and Technological Progress and has been honored as a National Women's Achievement Pacesetter.

Speech Title: Security of Network Communication Systems and Cyber Ranges

Abstract: The report begins with the cybersecurity challenges facing network communication systems and provides a comprehensive introduction to the Cyber Range, a Large-Scale Scientific Facility for Cyberspace, from the perspectives of application requirements, theory, technology, and system architecture. It focuses in particular on the methods and technologies through which cyber ranges can enhance the cybersecurity protection capabilities of network communication systems, advancing them from baseline security to real-world operational security and full-lifecycle security.

KEYNOTE SPEAKERS



10:50-11:15 Nov. 11, 2026 | 2F Changle Ballroom 1+2

Prof. Byonghyo Shim

Seoul National University, South Korea

Bio.: Byonghyo Shim is a professor in the Department of Electrical and Computer Engineering at Seoul National University (SNU), and a Vice Dean of the College of Engineering. He received B.S. and M.S. degrees in control and instrumentation engineering from SNU in 1995 and 1997, respectively, and an M.S. degree in mathematics and a Ph.D. degree in electrical and computer engineering from the University of Illinois at Urbana-Champaign (UIUC) in 2004 and 2005, respectively. He worked for Texas Instruments in 2004, and from 2005 to 2007, he was with Qualcomm Incorporated. From 2007 to 2014 he was with Korea University as an associate professor. He is an IEEE Fellow and also a member of the Korean Academy of Science and Technology. He was a recipient of the M. E. Van Valkenburg Research Award from UIUC, the Irwin Jacobs Award from Qualcomm and KICS, the Shinyang Research Award from the College of Engineering in SNU, the Okawa Foundation Research Award, the IEEE AP Outstanding Paper Award, the JCN Best Paper Award, and SNU Academic Research Award. His current research focuses on wireless communications, deep learning, information theory, and statistical signal processing. He has been served as an Associate Editor for the IEEE Transactions on Wireless Communications (TWC), IEEE Transactions on Communications (TCOM), IEEE Transactions on Vehicular Technology (TVT), IEEE Transactions on Signal Processing (TSP), IEEE Wireless Communications Letters (WCL), and a division editor for Journal of Communications and Networks (JCN) and also a Guest Editor for IEEE Journal on Selected Areas in Communications (JSAC).

Speech Title: Task-oriented Token Communications for Humanoid Era

Abstract: The rapid advancement of AI technologies is profoundly reshaping the way we live, work, and interact with the world. In this talk, we explore how AI will empower emerging autonomous systems, providing a compelling vision and motivation for future 6G systems. Particular attention is given to the convergence of physical AI and wireless communications, highlighting how autonomous tasks are related to AI-RAN systems. Real-world demonstrations will be presented to illustrate the opportunities and challenges of AI-native wireless systems.

KEYNOTE SPEAKERS



11:15-11:40 Nov. 11, 2026 | 2F Changle Ballroom 1+2

Prof. Celimuge Wu

The University of Electro-Communications, Japan

Bio.: Celimuge Wu received his PhD degree from The University of Electro-Communications, Japan. He is currently a professor and the director of Meta-Networking Research Center, The University of Electro-Communications. His research interests include Semantic Communications, Vehicular Networks, Edge Computing, IoT, and AI for Wireless Networking and Computing. He serves as an associate editor of IEEE Transactions on Networking, IEEE Transactions on Cognitive Communications and Networking, IEEE Transactions on Network Science and Engineering, and IEEE Transactions on Green Communications and Networking. He is a recipient of 2021 IEEE Communications Society Outstanding Paper Award, 2021 IEEE Internet of Things Journal Best Paper Award, IEEE Computer Society 2020 Best Paper Award and IEEE Computer Society 2019 Best Paper Award Runner-Up. He is an IEEE Vehicular Technology Society Distinguished Lecturer. He is a Foreign Fellow of The Engineering Academy of Japan (EAJ), and a Fellow of Asia-Pacific Artificial Intelligence Association (AAIA).

Speech Title: Semantic Communications for Remote Driving: From Bits to Meaning

Abstract: The explosive growth of multimedia data, connected devices, and real-time intelligent applications is creating unprecedented challenges for existing communication infrastructures. Traditional systems that transmit raw or compressed data often suffer from high latency and inefficient use of bandwidth, particularly in delay-sensitive applications such as remote driving. Semantic communications offer a promising paradigm shift by focusing on conveying meaningful information rather than transmitting data itself.

This talk introduces a novel low-latency video semantic communication framework for remote driving, based on an asymmetric encoder – decoder architecture. The framework extracts and transmits only essential semantic features, while generative AI at the receiver reconstructs high-quality, semantically consistent video. We also present a prototype implementation that integrates semantic feature extraction, efficient transmission, and AI-based video reconstruction, demonstrating the practical feasibility of the proposed approach. The talk further discusses the broader vision of integrating semantic communications, generative AI, and intelligent networking toward task-oriented, meaning-aware, and resource-efficient 6G systems, highlighting key challenges and future research opportunities.

SPECIAL SESSIONS

Special Session 1: Space and Satellite Communications-I

13:30-15:30 Nov. 11, 2026 | 2F Meeting Room 1

Session Chair: Fangyang Gong, University of Electronic Science and Technology of China, China

Time: 13:30-13:45

1571350525: A Tilted-Beam Interference-Aware Beam Hopping Design for LEO Satellite Systems

Author(s): Zhuang Yao and Lixia Xiao (Huazhong University of Science and Technology, China); Zhe Ji (Beijing University of Posts and Telecommunications, China); Yue Cao (Wuhan University, China); De Mi (Birmingham City University, United Kingdom); Jintao Zhang (MARINESAT & Marinesat Network Technology, China)

Abstract: In this paper, a tilted-beam-interference-aware resource scheduling scheme with frequency reuse (FR) is proposed for low earth orbit (LEO) satellite beam hopping (BH) systems. Concretely, an FR-based BH downlink transmission model is formulated, where the tilted projection of satellite beams is explicitly characterized by a three-dimensional off-axis-angle-based channel model. Next, a low-complexity resource scheduling framework is proposed to improve the traffic satisfaction rate (TSR). Specifically, the cells are first allocated into different frequency sub-bands by jointly considering traffic load balancing and tilted-beam interference risk. Then, a weighted-interference-graph-based BH scheduling algorithm is developed, where dynamic node weights and interference edge weights are jointly considered to select the illuminated cells in each time slot. Furthermore, a successive convex approximation (SCA)-based power allocation method is adopted to further alleviate co-frequency interference. Simulation results show that the proposed scheme achieves a higher average TSR and better service fairness than benchmark BH schemes that do not account for tilted-beam effects.

Time: 13:45-14:00

1571356663: FAP-LEO: Failure-Adaptive Physarum Routing for Fast Local Recovery in LEO Satellite Networks

Author(s): Kowiyou Okpeyerou Akambi Adekambi, Jiayi Jiang and Xiaoning Zhang (University of Electronic Science and Technology of China, Chengdu, China); Nelson Josias Gbètoho Saho and Eugène C. Ezin (Université d'Abomey-Calavi, Abomey-Calavi, Benin); Aly Boro (University of Electronic Science and Technology of China, Chengdu, China)

Abstract: Low Earth Orbit (LEO) mega-constellations promise global broadband through meshes of thousands of inter-satellite links (ISLs). However, those links fail without warning under debris, radiation and short satellite lifetimes, and recovery must run onboard within tight deadlines. Existing approaches face a dilemma between latency and cost: global reconvergence returns the best detour but needs 486 to 525 ms, ten times a 50 ms onboard budget, while a precomputed loop-free alternate reacts instantly but goes stale, delivering only 5% of flows. To address this, we propose FAP-LEO, a failure-adaptive routing scheme that produces a detour rather than reading one, confining recovery to a bounded k-hop neighbourhood of the break. FAP-LEO first assembles a k-hop ball of live ISLs at the satellite that detects the failure. It then runs a training-free, controller-free Physarum reinforcement on that ball and picks a near-shortest in-ball detour that favours durable tubes, before reverting to the shortest path.

Extensive simulations show that FAP-LEO installs each detour in about 19 ms at a recovery cost flat in constellation size, 194 to 40,377 times below a global Physarum solve across 66 to 1,584 satellites. On loop-free delivery it matches a bounded local shortest path and trails only full global recomputation, which misses the deadline. Its advantage is durability: on Iridium its chosen bypass keeps 21% more remaining lifetime than a bounded local shortest path and survives thirty minutes of orbital motion in 92.5% of cases, against 75.8% for that baseline.

Time: 14:00-14:15

1571356405: GATEL: Graph-Attentive Topology Encoding for Inter-Satellite Link Load Forecasting in LEO Networks

Author(s): Fengliang Mi, Chunlin He, Qi Zhou and Weidan Liu (Huazhong University of Science and Technology, China); Ping Du (Shanghai Key Laboratory of Satellite Network, China); Jiaxi Zhou (Huazhong University of Science and Technology, China)

Abstract: This paper proposes GATEL, a graph-attentive topology encoding method for network-wide inter-satellite link (ISL) load forecasting in low Earth orbit (LEO) satellite networks. First, GATEL transforms the original satellite topology into a link-centric graph, treating ISLs as graph nodes and constructing local neighborhoods according to shared satellite endpoints to align topology modeling directly with link-level forecasting targets. Second, masked graph attention adaptively captures local cross-link dependencies within shared-endpoint neighborhoods, and the resulting topology representation is fused into the complete historical sequence to form the history-based main forecast. Third, future orbital states that are available in advance at prediction time are introduced as auxiliary conditions through a horizon-wise gated residual mechanism, providing conditional corrections to the main forecast without replacing history-based prediction. GATEL outperforms the best-performing external baseline, ST-GAGCN-LEO, reducing the average MAE, RMSE, WAPE, and WMAE across five forecast horizons by 2.2%, 10.0%, 2.2%, and 8.9%, respectively.

Time: 14:15-14:30

1571356628: Modulation Index Estimation of Composite Modulation Signal for Satellite Communication via Cyclic Spectrum

Author(s): Fangyang Gong and Lidong Zhu (University of Electronic Science and Technology of China, China); Yanjun Huang (Shanghai Xiaoyuan Innovation Center, China)

Abstract: Satellite communications and space links use composite modulation (CM) signals to carry information in the telemetry, track, and command (TT&C) systems. For the TT&C systems, CM modulation index need to be estimated because it controls the carrier/subcarrier power split and therefore affects carrier tracking and demodulation for receivers. This paper proposes a new modulation index estimation method for the CM TT&C signals. In our proposed approach, the cyclic spectrum of the received CM signal is first extracted. Based on the closed-form derivation, a phase-independent ratio of Bessel-function coefficients is established to relate the spectral characteristics of the signal to modulation index. A physical fitting procedure is then used to estimate modulation index within the prescribed range, with a bounded residual correction further improving the estimate without prior knowledge of the modulation format. Across the eight modulation formats, the aggregate NRMSE remains low and decreases further at high SNR, indicating a small modulation index estimation error. In the paired receiver test, the bit error ratio (BER) obtained with the estimated index is close to that obtained with the true index, demonstrating the effectiveness of the proposed method.

Time: 14:30-14:45

1571356686: Rate-Flexible Image Transmission in Satellite Communications via Residual Progressive Binary JSCC

Author(s): Zhang Chen, Bowen Feng and Qinyu Zhang (Harbin Institute of Technology (Shenzhen), China)

Abstract: Satellite image transmission involves time-varying link conditions, which makes rate-flexible transmission important across different link scenarios. In this paper, we investigate rate-flexible image transmission in satellite communications and propose a residual progressive binary joint source-channel coding (JSCC) scheme that combines residual-guided block generation with block-wise additive logit-domain reconstruction. The first stage encodes the source image into a binary base block, while each subsequent stage encodes the residual derived from the transmitter-side reconstruction using previously generated uncorrupted blocks. At the receiver, each received refinement block is independently decoded into a bounded correction and progressively accumulated in the logit domain. This design retains previously generated blocks as more bits are transmitted and appends new refinement blocks without requiring channel-output feedback. Experimental results show that reconstruction quality progressively improves as the number of transmitted bits increases from 128 to 1280 bits, with consistent performance gains over the considered reference schemes at the refinement stages.

Time: 14:45-15:00

1571356726: Quantization-Aware Power Allocation for AFDM in LEO Satellite Channels

Author(s): Zhixuan Du and Zhuo Zhang (University of Electronic Science and Technology of China, China); Yanjun Huang (Shanghai Xiaoyuan Innovation Center, China)

Abstract: Affine frequency division multiplexing (AFDM) can effectively combat doubly selective fading in low Earth orbit (LEO) satellite-unmanned aerial vehicle (UAV) communications over complex terrain. UAVs are subject to stringent power constraints, making low-resolution analog-to-digital converters (ADCs) a viable solution for long-term deployment; however, the resulting non-negligible quantization distortion makes accurate modeling of this nonlinear system and efficient resource allocation essential. This paper investigates quantization-aware power allocation for symbols in the discrete affine Fourier transform (DAFT) domain over doubly selective Rician channels when only statistical channel state information (CSI) is available at the satellite. We construct a power-dependent Bussgang model and derive an ergodic achievable-rate lower bound. To handle the channel expectation and coupled quantization statistics, we adopt sample average approximation (SAA), derive the full power gradient, and develop an SAA-based projected-gradient (SAA-PG) algorithm with projected Armijo backtracking under the total-power constraint. Simulations show that the proposed scheme consistently outperforms equal power allocation and average-subchannel-gain water-filling while approaching instantaneous-CSI optimization, with the clearest gains at low ADC resolutions and low-to-medium signal-to-noise ratios (SNRs).

Time: 15:00-15:15

1571355459: Collaborative Intelligent NTN-TN Spectrum Sharing in FR3 Band

Author(s): Yuan Liang and Zhuang Ling (Jilin University, China); Hui Zhou (Coventry University, United Kingdom); Xiaolan Liu (University of Bristol, United Kingdom); Fengye Hu (Jilin University, China)

Abstract: Frequency Range 3 (FR3) is a promising spectrum candidate for future Sixth Generation (6G) systems, but its partial overlap with incumbent satellite services makes efficient Non-Terrestrial Network

(NTN)-Terrestrial Network (TN) spectrum sharing a key challenge. This paper studies a downlink NTN-TN dynamic spectrum sharing model in FR3 band, where terrestrial base stations (BSs) dynamically access the NTN spectrum to improve long-term TN throughput while guaranteeing the quality of service (QoS) of the NTN user equipment (UE). Taking into account FR3 channel characteristics, multi-source interference, and time-varying low-earth orbit (LEO) satellite links, we formulate a long-term joint optimization problem of BS-level sharing decisions and per-UE power allocation while guaranteeing NTN UE QoS. To solve this long-term non-convex problem, we propose a Multi-Agent Deep Deterministic Policy Gradient (MADDPG)-based collaborative intelligent spectrum sharing (CISS) scheme. Simulation results show that the proposed CISS scheme achieves better reward convergence than single-agent DDPG and improves the average TN long-term throughput by about 16.7 %, 27.8 %, and 99.2 % compared with single-agent DDPG, fixed sharing, and the no-sharing baseline, respectively, while satisfying the NTN UE QoS requirements.

Time: 15:15-15:30

1571356589: Multi-Agent Reinforcement Learning-based Handover Strategy in Low Earth Orbit Mega-Constellation Networks

Author(s): You Hailong and Xirui Xian (Harbin Institute of Technology, China); Rui Ding (China Academy of Space Technology, China); Ming-Chuan Yang (Harbin Institute of Technology, China)

Abstract: In low Earth orbit (LEO) mega-constellation networks, frequent topology-driven handovers and massive user access make it difficult for conventional single-metric handover strategies to jointly guarantee link quality and satellite load balancing, easily causing hotspot congestion. This paper proposes a multi-agent reinforcement learning-based satellite handover strategy that maximizes the joint utility of link quality and load balancing. Ground users are modeled as agents, and a coupled reward integrating elevation angle, residual service duration, received signal strength and load-aware capacity provides three-level load guidance through a co-channel interference constraint, a load incentive and an overload soft penalty. The multi-agent deep deterministic policy gradient framework adopts centralized training and distributed execution, with a centralized critic capturing multi-user coupling and the Gumbel-Softmax straight-through estimator enabling differentiable discrete selection. Simulations with realistic satellite orbital data and five greedy baselines show that the proposed algorithm converges within about 100 episodes; as the number of users scales from 10 to 30, it maintains the highest average reward, achieves up to 1.85 times the throughput of the best baseline, keeps the peak satellite load below 28% of the channel threshold, and attains the highest normalized Jain index.

Special Session 1: Space and Satellite Communications-II

15:45-17:45 Nov. 11, 2026 | 2F Meeting Room 1

Session Chair: Fengliang Mi, Huazhong University of Science and Technology, China

Time: 15:45-16:00

1571349290: Covert Satellite Communications via OTFS-Enabled Public Signal Overlay

Author(s): Lei Zhang, Zhao Chen and Liuguo Yin (Tsinghua University, China)

Abstract: For low-Earth-orbit (LEO) satellite broadband data services in urban environments, satellite mobility and multipath propagation induce time- and frequency-selective channels, challenging reliable

covert transmission.

Therefore, we propose an orthogonal time frequency space (OTFS)-enabled public-signal-overlay scheme, where public pilots enable reliable covert reception without dedicated pilots for the covert signal, while channel-estimation and public-signal cancellation errors are further exploited to enhance covertness.

Specifically, we develop a successive interference cancellation (SIC) model in which Willie estimates the delay-Doppler channel and cancels the recovered public signal before covert detection. Then, accounting for both channel-estimation and public-signal decision errors, we derive approximate detection error probabilities using the covariance and low-rank structure of the SIC residual. Finally, characterizing Bob's effective covert capacity, the energies of the pilot, public-signal, and covert-signal are jointly optimized to maximize covert capacity subject to reliability and covertness constraints. Numerical results validate the detection analysis and demonstrate the effectiveness of the proposed energy allocation.

Time: 16:00-16:15

1571355768: Orbit-Prior-Aided Joint Compensation and Sequential PMF-FFT Acquisition for Inter-Satellite DSSS Links

Author(s): Yuxuan Sun, Xiaoxu Guo, Lianyu Li and Zhizhong Zhang (Nanjing University of Information Science and Technology, China)

Abstract: To address carrier and code phase mismatch and the acquisition overhead in high-dynamic DSSS inter-satellite links, this paper proposes an orbit-prior-aided joint compensation and sequential PMF-FFT acquisition method. Satellite orbit prior information is used to correct the carrier phase and the position offset of the local spreading code, a staged search strategy is introduced to accelerate acquisition, and two detection thresholds are set in a unified manner to control the overall false alarm probability. Simulation results show that, compared with the conventional method, the proposed method raises the correct acquisition probability by 11.0 percentage points, reduces the core computational cost by up to 79.45%, and shortens the average acquisition time by more than 45.83%, thereby improving the acquisition capability and search efficiency under dynamic conditions.

Time: 16:15-16:30

1571356588: A multi-agent reinforcement learning beam hopping scheduling algorithm in LEO networks

Author(s): Zhai Yifan, Ting Li (Harbin Institute of Technology, China); Jingchao Wang (National Key Laboratory of Multi-domain Data Collaborative Processing and Control); Ming-Chuan Yang (Harbin Institute of Technology, China)

Abstract: With the rapid growth of LEO megaconstellations, beam scheduling faces fast-varying topologies and uneven traffic, while per-satellite decisions offer limited coordination against inter-satellite interference coupling and network-wide load imbalance. To address this issue, this paper proposes a multi-agent proximal policy optimization algorithm for coordinated multisatellite beam hopping under the centralized-training and distributed-execution (CTDE) paradigm. It decomposes the beam decision space into cell association, bandwidth allocation, and power control, and employs a Lyapunov-based multi-objective reward jointly accounting for queue stability, handover frequency, energy efficiency, and fairness. Simulation results show that, compared with the heuristic and learning baselines, the proposed algorithm attains the best joint throughput-fairness utility, substantially reduces queue backlog and energy consumption relative to the greedy and round-robin schedulers, and

remains competitive in throughput with the full-frequency-reuse benchmark without incurring its severe fairness loss.

Time: 16:30-16:45

1571349642: Channel-Aware Deep JSCC Receiver for Satellite-Ground Semantic Communications

Author(s): Xinyue Xi (Harbin Institute of Technology, China); Hanzhi Li (South China University of Technology, China); Zhang Chen, Lirong An, Bowen Feng and Qinyu Zhang (Harbin Institute of Technology (Shenzhen), China)

Abstract: Satellite-to-ground image downlinks suffer from time-varying channel quality and limited visibility windows caused by satellite motion, which complicates the reliable delivery of visually meaningful content. Deep joint source-channel coding (JSCC) provides a natural fit by learning a direct mapping from images to channel symbols. However, conventional JSCC receivers are designed with a fixed structure, leaving residual distortions in the equalized latent space-distortions that cannot be adequately handled under realistic fading and Doppler phase rotations. To address this issue, we propose a channel-aware deep JSCC receiver (CAR) that incorporates an observation-driven soft selector and multiple residual-recovery branches. Using the equalized complex-valued latent observations, CAR adaptively computes branch-level soft weights and refines the latent representation prior to image decoding. Numerical evaluations show that, in the high-SNR regime, CAR consistently outperforms fixed-receiver neural baselines in reconstruction quality. Inference-time ablations further confirm that the observation-dependent soft fusion mechanism is more effective than either a fixed single branch or uniform averaging of all branches.

Time: 16:45-17:00

1571356725: Livelock-Free Dynamic Reconfiguration for OFDMA-Based LEO Satellite Resource Management: A Two-Stage DRDES Framework

Author(s): Jiafeng Zhang, Xuan Xue and Zhixiang Li (Xidian University, China); Zhong Zheng (China Academy of Space Technology, China)

Abstract: Resource allocation poses a fundamental challenge for satellite-communication systems owing to scarce spectral and temporal resources, especially when multiple tasks compete for shared channels. Poor allocation strategies may cause channel conflicts, degraded service quality or communication interruptions. Besides, unexpected channel impairments can invalidate preassigned schemes and require timely system reconfiguration. To tackle these coupled challenges, this paper proposes a two-stage framework. In the first stage, a genetic-algorithm-based static resource allocator is built to maximize scheduled tasks and balance system-wide channel utilization. In the second stage, a dynamic reconfiguration mechanism handles sudden channel outages. The resource-management system is modeled as a dynamically reconfigurable discrete event system, where reconfiguration is realized via task insertion, deletion and migration over current task sets. A heuristic-guided search is developed to obtain feasible reconfiguration sequences that optimize the average fitness of intermediate system states. Moreover, a livelock-prevention strategy is adopted: it uses directed graphs to detect risky migration transitions and eliminates circular dependencies through graph decomposition. Extensive experiments under both small- and large-scale scenarios verify the effectiveness of the proposed method.

Time: 17:00-17:15

1571315631: MVDR-Based Adaptive Beamforming and Interference Cancellation for LEO Multi-Beam Satellite Communications

Author(s): Haohua Ai (Innovation Academy for Microsatellites of Chinese Academy of Sciences; Shanghai Ocean University); Siyue Sun, HaiHua Xie, Zhenglong Zhang and Haiying Hu (Innovation Academy for Microsatellites of Chinese Academy of Sciences; University of Chinese Academy of Sciences)

Abstract: Full Frequency Reuse (FFR) architectures in Low Earth Orbit (LEO) multi-beam satellite systems significantly enhance spectral efficiency but introduce severe Co-Channel Interference (CCI) and critical capacity-demand mismatches under non-uniform geographical traffic distributions. To dynamically balance network load and mitigate multi-beam coupling interference, this paper proposes a cross-layer joint interference management and adaptive resource allocation framework. A Quality of Service (QoS)-aware weighted K-Means clustering algorithm is developed to dynamically reconstruct the beam topology based on multi-level terminal traffic requirements, effectively shifting beam centers toward localized hotspots. At the physical layer, a Minimum Variance Distortionless Response (MVDR) adaptive beamforming model leverages spatial degrees of freedom to steer precise nulls toward active interference clusters, thereby suppressing inter-cluster and intra-cluster CCI. Building upon these topology adjustments, a demand-driven bandwidth optimization strategy adaptively allocates baseband spectrum based on real-time queue states to maximize system capacity. Simulation results demonstrate that the proposed joint optimization framework effectively mitigates congestion bottlenecks induced by non-uniform traffic and significantly improves global network throughput compared to conventional multi-color reuse benchmarks.

Time: 17:15-17:30

1571320778: CAET: Cyclic Asynchronous Evolution Topology Scheduling for LEO Satellite Optical Networks

Author(s): Kai Han (Anhui University, China & Innovation Academy for Microsatellites of Chinese Academy of Sciences, China); Marie Siew (Singapore University of Technology and Design, Singapore); Wenbin Gong (Shanghai MicroSatellite Engineering Center, China); Symeon Chatzinotas (University of Luxembourg, Luxembourg); Qianyi Ren (University of Chinese Academy of Sciences & Innovation Academy for Microsatellites, Chinese Academy of Sciences, China)

Abstract: Topology scheduling is a critical factor determining communication performance in Low Earth Orbit (LEO) megaconstellations. Although Laser Inter-Satellite Links (LISLs) improve network routing efficiency, existing scheduling schemes based on synchronous time slots introduce excessive switching operations, posing challenges for laser Acquisition, Pointing, and Tracking (APT). This paper proposes the Cyclic Asynchronous Evolution Topology (CAET) scheduling paradigm, which exploits orbital periodicity to enable asynchronous LISL evolution based on individual visibility cycles while reducing laser switching overhead. By folding the temporal dimension into a few orbital periods, CAET transforms strip-level (visibility window) scheduling into pair-level topology optimization, reducing the decision space from millions of link opportunities to thousands of satellite pairs. A prior-knowledge-guided NSGA-II algorithm with permanent visible topology initialization and constraint-aware repair is developed to obtain feasible low-switching solutions. Simulation results over 86400 seconds on the Starlink mega-constellation demonstrate that CAET reduces maximum latency by 17.54% and maximum hop count by 70.21% compared with the Grid-Mesh + topology, while requiring only 660 laser switches per day, demonstrating the effectiveness of CAET for megaLEO optical network topology scheduling.

Time: 17:30-17:45

1571333082: Intelligent MCS Selection for LEO Satellite Communications Based on DQN with Dynamic Penalty

Author(s): Hehui Du (Xi'an Jiaotong University, China); Zhihua Tang and Fang Zhang (Shanghai Satellite Network Research Institute Co., Ltd., China); Zhenzhen Gao (Xi'an Jiaotong University, China); Lingxiao Jiao (Shanghai Satellite Network Research Institute Co., Ltd., China); Xuewen Liao (Xi'an Jiaotong University, China)

Abstract: In Low Earth Orbit (LEO) satellite communications, the high-speed mobility of satellites and long transmission distances induce significant Doppler shifts and high propagation delays, resulting in severe lagging of the Channel Quality Indicator (CQI) reported by ground terminals. This outdated channel information renders traditional link adaptation algorithms ineffective, thereby causing an increase in the Block Error Rate (BLER) or a degradation in spectral efficiency. To address this issue, this paper proposes an intelligent Modulation and Coding Scheme (MCS) selection strategy for the satellite base station, which combines a dynamic penalty mechanism with Deep Reinforcement Learning (DRL). Specifically, the MCS selection process is modeled as a Markov Decision Process (MDP). The state space is constructed using historical CQI sequences and Acknowledgment/Negative Acknowledgment (ACK/NACK) feedback information reported by ground terminals. Under this framework, a Deep Q-Network (DQN) incorporating a dynamic penalty mechanism is designed to strictly guarantee reliability requirements while maximizing system throughput. Simulation results demonstrate that under various reporting period and Round-Trip Time (RTT) scenarios, the proposed scheme can effectively track and adapt to the rapidly changing and high-delay satellite channels. Compared with the Outer Loop Link Adaptation (OLLA) strategy, the proposed scheme achieves a system throughput improvement of up to 12% while strictly satisfying the 10% final BLER target specified by the 3rd Generation Partnership Project (3GPP).

SPECIAL SESSIONS

Special Session 2: Movable Antenna and IRS

08:30-10:00 Nov. 12, 2026 | 2F Meeting Room 1

Session Chair: Jiale Bai, Xidian University, China

Time: 08:30-08:45

1571359030: Secrecy-Preserving Path Planning for Movable Antenna Repositioning

Author(s): Jiale Bai, Jiangbo Si and Hui Li (Xidian University, China)

Abstract: Movable antennas (MAs) provide additional spatial degrees of freedom for physical-layer security by exploiting position-dependent channel variations. Existing studies mainly optimize secrecy performance at selected MA positions, while the secrecy performance during mechanical repositioning has received less attention. In this paper, we investigate secrecy-preserving MA repositioning between two given positions that individually satisfy a prescribed secrecy-rate requirement. We first show that endpoint secrecy feasibility does not necessarily guarantee transition feasibility. In particular, a two-path field-response channel is used to demonstrate that the secrecy-feasible region can be non-convex, so that two secrecy-feasible positions may have a direct transition containing secrecy-infeasible intermediate positions. Then, we formulate the shortest secrecy-preserving repositioning problem, where the secrecy-rate requirement must be satisfied throughout the complete movement. To obtain a tractable solution, the continuous movement region is discretized into a secrecy-feasible spatial graph by checking both node and edge feasibility, and the resulting weighted shortest-path problem is solved using A* search. Numerical results show that the proposed method avoids secrecy-infeasible regions while satisfying the prescribed secrecy-rate requirement along the evaluated repositioning path, and quantify the additional movement distance required under increasingly stringent secrecy-rate requirements.

Time: 08:45-09:00

1571356432: Communication-Preserving Asynchronous Reconfiguration for Linear Movable Antenna Arrays

Author(s): Qiyu Yan, Heng He and Yiyao Hou (Rocket Force University of Engineering, China)

Abstract: Movable antennas (MAs) provide position-domain degrees of freedom, but practical reconfiguration takes non-negligible time. This paper studies a multiuser uplink with a one-dimensional MA array in which antenna movement and communication proceed concurrently. We propose a communication-preserving time-division movement (CP-TDM) protocol: only moving MAs are temporarily muted, while stationary MAs continue reception and completed MAs immediately rejoin the active array. Final antenna positions are first optimized by multi-start projected gradient ascent (PGA) under movement-region and spacing constraints, and are then assigned to physical MAs by order-preserving matching. For asynchronous movement, an event-driven model captures the time-varying zero-forcing (ZF) rate, while an exact continuous-time test guarantees collision safety. The launch order is optimized by a communication-aware beam search, with reduced exhaustive search used as a benchmark for moderate array sizes. Numerical results show that CP-TDM substantially reduces reconfiguration loss compared with move-then-transmit and batched movement, especially when mechanical movement overhead is significant.

Time: 09:00-09:15

1571356655: Secrecy Energy Efficiency Maximization for Group-Connected BD-RIS-Assisted MIMO Systems

Author(s): Zhijian Zeng and Gongchao Su (Shenzhen University, China)

Abstract: Reconfigurable intelligent surfaces (RISs) have emerged as a promising technology for enhancing wireless security and energy efficiency. This paper investigates the secrecy energy efficiency (SEE) maximization problem for a group-connected beyond-diagonal RIS (BD-RIS)-assisted MIMO wiretap system. Specifically, the transmit covariance matrix and the BD-RIS scattering matrix are jointly optimized under the symmetric-unitary constraints of the group-connected BD-RIS. To solve the formulated non-convex problem, an alternating optimization framework is developed, where successive convex approximation is employed for transmit covariance optimization and Riemannian conjugate gradient is adopted to optimize the BD-RIS scattering matrix on the corresponding manifold. Simulation results demonstrate that the proposed SEE-oriented design achieves superior energy efficiency compared with secrecy-rate maximization schemes, especially in high transmit power regimes. Furthermore, group-connected BD-RIS provides a favorable trade-off between security performance and implementation complexity.

Time: 09:15-09:30

1571355966: Causal Attention-Assisted RIS-Enabled Integrated Sensing and Communication

Author(s): Yuxuan Wang, Yimeng Ge and Jing Jiang (Xi'an University of Posts and Telecommunications, China)

Abstract: For RIS assisted ISAC systems under high mobility, conventional beamforming based on instantaneous CSI suffers from channel aging and optimization delays. This paper proposes a causal attention based RIS assisted ISAC framework that employs multi-head self-attention with strict causal masking to predict next slot direct, cascaded, and sensing channels without future information leakage. Based on the predicted states, a weighted sum-rate maximization problem is formulated under transmit power, RIS unit modulus, and sensing constraints. WMMSE and successive convex approximation are employed for active beamforming, while a feasible projected gradient method is developed for RIS phase optimization. The proposed framework integrates causal prediction with model-driven optimization, enabling future state prediction and physically feasible transmission design.

Time: 09:30-09:45

1571356385: Energy-Efficiency Optimization for a Movable-Antenna-Enabled UAV Two-Way Relay System

Author(s): Zhiyuan Wang, Tong Xiao Bing and Haichao Wang (Army Engineering University of PLA, China)

Abstract: This paper investigates a movable-antenna (MA)-enabled unmanned aerial vehicle (UAV) two-way relay system serving multiple ground-user pairs. Fairness-oriented energy efficiency (EE) is defined as the minimum downlink throughput divided by the total UAV energy consumption. We jointly optimize the multiple-access (MAC)/broadcast (BC) schedule, UAV trajectory, and slot-wise MA positions through block coordinate descent. The MA-position, trajectory, and scheduling subproblems are solved by discrete-grid coordinate search, successive convex approximation with the Dinkelbach method, and linear programming, respectively. Numerical results demonstrate that complementary macroscopic UAV mobility and microscopic MA reconfiguration improve EE over benchmark schemes.

Time: 09:45-10:00

1571349433: SER and Outage Analysis of RIS-Assisted Systems over Correlated Nakagami-m Fading: with Quantized Phase Shifts and Imperfect CSI

Author(s): Madhav Ramesh Gawande, Vishal Yadav, Sandhya Chakali and Venkata Mani Vakamulla (National Institute of Technology Warangal, India)

Abstract: Reconfigurable Intelligent Surfaces (RIS) are a promising technology for enhancing wireless communication performance. This paper analyzes the symbol error rate (SER), outage probability (OP), and ergodic capacity (EC) of an RIS-assisted single-input single-output (SISO) system over spatially correlated Nakagami-m fading channels. Practical impairments, including finite B-bit RIS phase quantization and imperfect channel state information (CSI), are also considered. Closed-form channel moments are derived, and a moment-matched Gamma model is used to obtain tractable expressions for SER, OP, EC, and energy efficiency (EE). Monte Carlo (MC) simulations validate the analysis and show close agreement with the theoretical results. The results indicate that spatial correlation and CSI errors degrade system performance, while increasing the number of RIS elements improves reliability and capacity. Moreover, under the considered power-consumption model, 2 – 3 bits of RIS phase resolution provide near-optimal energy efficiency.

SPECIAL SESSIONS

Special Session 3: AI-Empowered Communications for Unmanned Systems

08:30-09:45 Nov. 12, 2026 | 2F Meeting Room 2

Session Chair: Lechuan Lv, Northwestern Polytechnical University, China

Time: 08:30-08:45

1571353918: Joint-Spectrum Localization of GNSS Interference Sources Using Mobile Observations

Author(s): Qingfeng Wang, Fusang Zhang and Qi Wang (Beihang University, China); Zhi Wang, Junqi Ma and Yuqi Su (Institute of Software, Chinese Academy of Sciences, China & University of Chinese Academy of Sciences, China); Shan Zhang, Zhiyuan Wang, Mingsheng Tang and Hongbin Luo (Beihang University, China)

Abstract: Global Navigation Satellite System (GNSS) signals reach the Earth's surface at extremely low power and are therefore vulnerable to radio-frequency (RF) interference. Because GNSS supports aviation, intelligent transportation, and critical infrastructure, interference can degrade positioning services and threaten operational safety, making rapid and accurate source localization essential. Field investigations commonly use a mobile platform to acquire observations at multiple locations and combine them to estimate the source position. Yet two practical problems remain. First, the short dwell time and small array aperture at each location provide limited spatial information, making localization sensitive to environmental effects. Second, observation quality varies across locations, so low-quality observations can destabilize fusion across observation locations. We therefore propose a joint-spectrum localization method for mobile observations. For each observation, complementary spatial responses are combined to retain directional discrimination and power information, strengthening the representation of the source location under limited observations. An observation-reliability-aware mechanism then adjusts each location's contribution before noncoherent position-domain fusion. Outdoor measurements show consistent localization performance for three representative RF signal forms: single-tone continuous-wave, swept-frequency chirp, and digitally modulated BPSK. With seven observation locations, the median localization error is approximately 0.4 m for each signal form. In an outdoor test containing a low-quality observation, CEP90 is approximately 0.7 m, about 60% lower than that of MUSIC-AOA two-step localization, indicating improved stability under the tested condition.

Time: 08:45-09:00

1571356677: LP-FedWITT: A Lightweight-Personalized Federated WITT Framework for Efficient Image Semantic Communication

Author(s): Huawei Xin, Zhisong Bie and Lin Xue Hong (Beijing University of Posts and Telecommunications, China); Yichen Zhi (Xi'an Microelectronic Technology Institute, China)

Abstract: To address the high model transmission overhead, frequent model exchanges, and limited adaptability of unified aggregation to heterogeneous channels in federated WITT training, this paper proposes a lightweight personalized federated WITT method, LP-FedWITT. Without altering the original JSCC encoding, decoding, and channel transmission mechanisms, LP-FedWITT reduces the cost of each model transmission through model lightweighting, reduces communication overhead in federated

training through multiple local epochs and client sampling, and retains the SNR modulation branch locally based on the different sharing properties of WITT modules while performing global aggregation only on the shared backbone. This design enables cross-client knowledge sharing while preserving local channel adaptation. Experimental results show that, in the multi-SNR setting, LP-FedWITT reduces the total communication volume of federated training to only 2.96 GB, substantially lower than the comparison methods, while achieving an average PSNR, MS-SSIM, and LPIPS of 33.75 dB, 0.9881, and 0.0009, respectively, demonstrating competitive image reconstruction performance. LP-FedWITT substantially reduces federated training communication overhead while maintaining high reconstruction quality and enhancing the model's adaptability to heterogeneous channel conditions.

Time: 09:00-09:15

1571356659: Efficient Traffic Scheduling in Data Center Networks

Author(s): Lechuan Lv, Zhaolin Zhang and Wenjie Guo (Northwestern Polytechnical University, China)

Abstract: Effective traffic engineering in data center networks hinges on reconciling dynamic traffic adaptation with configuration stability across consecutive control periods. We propose Budgeted Sequential Source – Destination Optimization (B-SSDO), which explicitly constrains the number of source – destination (SD) pairs that can be reconfigured in each period. Starting from the previously deployed configuration, B-SSDO identifies SD pairs that contribute substantially to current bottlenecks and allocates the limited update opportunities through a three-stage procedure. Specifically, it employs bottleneck load contribution for candidate pre-screening, evaluates the marginal congestion-reduction gain and configuration-change cost of each retained candidate, and accounts for bottleneck-effect complementarity during batch selection to avoid redundant updates. Experiments over consecutive traffic snapshots show that B-SSDO achieves a normalized maximum link utilization of 1.0089 with only a small number of SD-pair updates and provides a 12.78x speedup over advanced baseline, thereby closely approaching the congestion performance of full re-optimization with substantially fewer configuration changes and lower online computational overhead.

Time: 09:15-09:30

1571349903: Semantic-CSI Coupled Power Allocation for Fixed-CBR MIMO DeepJSCC Image Transmission

Author(s): Jiapeng Mai, Zhisong Bie and Ping Gong (Beijing University of Posts and Telecommunications, China)

Abstract: Deep joint source-channel coding (DeepJSCC) enables bandwidth-efficient visual sensing for unmanned systems, yet reliable image transmission over MIMO fading channels is challenging under a fixed channel bandwidth ratio (CBR), where channel uses are fixed and SVD spatial eigenmodes exhibit heterogeneous reliability. Existing MIMO DeepJSCC works focus on feature/rate adaptation and channel-aware representation learning, with little explicit optimization of power redistribution across latent visual regions and eigenmodes under a fixed symbol budget. This paper proposes an AI-enabled semantic-CSI coupled window-eigenmode power allocation strategy for fixed-CBR MIMO DeepJSCC visual transmission. We extract reconstruction-aware latent window features and fuse them with singular-value-based CSI reliability to build a normalized power matrix with G rows and K columns, corresponding to G latent windows and K active eigenmodes. The scheme merely rescales payload symbols and applies per-image power normalization, preserving the original CBR, channel usage count and average transmit power; allocation metadata is transmitted over a control link. Evaluations on DIV2K and Kodak datasets under various CBR and SNR settings show consistent gains against BPG-Capacity and DeepJSCC-MIMO. Ablations verify that performance improvements stem from jointly

exploiting reconstruction-aware window importance and MIMO eigenmode reliability, with clear advantages for low-CBR visual sensing under tight wireless resource constraints.

Time: 09:30-09:45

1571355003: Implementation and Optimization of Transformer OFDM Channel Estimation on MaPU for Unmanned Systems

Author(s): Daoshuai Lin, Yumei Wang and Zhisong Bie (Beijing University of Posts and Telecommunications, China)

Abstract: Neural receiver processing for unmanned systems requires efficient computation, memory use, and software flexibility. We investigate Transformer inference for orthogonal frequency division multiplexing (OFDM) channel estimation on MaPU, a programmable architecture supporting software updates. Onboard reception is the target application. An initial AdaFortiTran implementation executes six encoder layers and subsequent reconstruction and refinement using MaPU's scalar processing unit (SPU) and microcode processing unit (MPU). Independently evaluated SPU kernels fuse final linear projection with nonoverlapping grid reconstruction through direct grid writes while preserving single precision projection arithmetic. Against matching baselines retaining the patch tensor in local memory, software timer counts on MaPU decrease by 1.18% for projection and reconstruction and 1.83% for a separate residual extension. The primary fusion removes an intermediate tensor of 6,720 bytes. Source code accounting shows 13,440 fewer bytes of logical local memory accesses per invocation. Offline validation inserts actual primary kernel outputs into an independent reference model for 160 samples across 20 channel conditions covering signal-to-noise ratio, delay spread, and Doppler. Baseline and fused grids are bitwise identical on these samples. Relative to unmodified reference inference, the maximum absolute difference in normalized mean square error (NMSE) per sample is approximately $1.98*10^{-6}$ dB. These results quantify execution and access savings while preserving the tested baseline estimates.

SPECIAL SESSIONS

Special Session 4: AI-Native 6G Networks: Toward Intelligent, Ubiquitous, and Trustworthy Connectivity-I

13:30-15:30 Nov. 11, 2026 | 2F Meeting Room 2

Session Chair: Yongbiao Su, Beijing University of Posts and Telecommunications, China

Time: 13:30-13:45

1571356201: EDEN: An Endogenous Distributed Edge Network for LLM Collaborative Inference in 5G-A

Author(s): Yitao Chen, Haoyang Li, Yongbiao Su and Mingrui Cao (Beijing University of Posts and Telecommunications, China)

Abstract: Large Language Models (LLMs) are ushering in a new paradigm for the large-scale application of artificial intelligence. However, traditional cloud-based deployment suffers from long response latencies and privacy leakage risks during massive data uploads, while on-device inference is constrained by hardware memory and computing power, resulting in slow speeds and an inability to support models with large parameters. To overcome these challenges, the evolution of 6G network architecture has made it an inevitable path to shift computing resources from the cloud to the Radio Access Network (RAN) to build network-endogenous intelligence.

This paper proposes a collaborative inference system architecture based on 5G-Advanced endogenous intelligence, which partitions the LLM by layers and deploys it across base stations (gNBs) and User Plane Function (UPF) network elements integrated with inference engines. In the proposed design, the AI Inference Function (AIF) integrated into the UPF executes the front model layers, and the gNB completes the remaining layers and token generation. Experimental results on the OpenAirInterface platform demonstrate that the proposed scheme leverages cross-network-element pipeline parallelism to significantly reduce first-token latency; for the 7B model, the latency is reduced by up to 78.68% compared to cloud-based solutions.

Time: 13:45-14:00

1571356455: Efficient Subcarrier-Level Channel Estimation: A CSI-RS-Assisted Scheme

Author(s): Mingyuan Hu, Mingchen Ma, Ji Yan, Junhao Zhao and Zhongyuan Zhao (Beijing University of Posts and Telecommunications, China)

Abstract: High-accuracy downlink channel estimation is essential for massive multiple-input multiple-output (MIMO) systems. However, it is limited by the frequency overhead of the demodulation reference signal (DMRS), which grows rapidly with the number of spatial layers. The channel state information reference signal (CSI-RS) is transmitted periodically and observes the physical channel over all transmit antennas and the entire bandwidth, so it provides the wideband information that the frequency-sparse DMRS lacks. First, a CSI-RS-assisted channel estimation framework is proposed which combines RB-level physical channel information with subcarrier-level DMRS observations. Second, a cross-granularity dual-branch network (CDNet) is proposed to implement this framework by processing the two inputs separately. Finally, simulations based on the 3GPP channel model show that CDNet achieves a lower NMSE than the conventional estimator and the learning-based benchmarks at every considered SNR and DMRS density.

Time: 14:00-14:15

1571352246: Focused Interference Performance of Topologically Reconfigurable and Movable Antenna Arrays

Author(s): Gangcai Ma, Yebo Gu and Tao Shen (Kunming University of Science and Technology, China)

Abstract: To improve the focusing interference capability of topology reconfigurable movable antenna (TRMA) assisted multiple-input multiple-output (MIMO) systems against cooperative eavesdropping links, this paper proposes a dual-source focusing artificial noise (FAN) framework. In this framework, the base station (BS) and TRMA cooperate to generate directional interference pointing towards the target link. The FAN covariance matrix, the active antenna topology, and the active antenna position are jointly optimized to maximize the channel capacity reduction of the eavesdropping link. Due to the binary nature of the topology variables, the coupling of covariance and position variables, and the non-convex constraints, this problem is a hybrid discrete-continuous non-convex optimization problem. To solve this problem, this paper develops an adaptive variable neighborhood search-assisted alternating optimization-continuous convex approximation (AVNS-AO-SCA) algorithm. Specifically, AVNS searches for a fixed-cardinality active topology, while AO decomposes the continuous variables into FAN covariance optimization and MA position optimization subproblems, which are then solved by SCA. Simulation results show that, compared with the baseline scheme, the proposed method achieves stronger interference focusing and greater capacity reduction.

Time: 14:15-14:30

1571356465: DAG Task Scheduling in Cloud-Edge Computing Networks: A Transformer-Enhanced DRL Approach

Author(s): Chenzhao Miao and Fengxian Guo (Beijing University of Posts and Telecommunications, China)

Abstract: Cloud-edge collaborative computing provides distributed resources for computation-intensive applications with task dependencies in Internet of Things (IoT) systems. Such applications are commonly represented as directed acyclic graphs (DAGs), and the placement of DAG tasks across heterogeneous cloud-edge resources directly affects application completion time and resource use. Existing learning-based schedulers often model either local dependency structure or long-range task interactions, but not both explicitly. This paper presents a GAT-Transformer-enhanced deep reinforcement learning (DRL) scheduling framework and formulates the scheduling process as a sequential decision problem subject to resource, precedence, and communication constraints. A GAT-Transformer encoder represents local dependency structure and relations among reachable tasks, while a Double DQN scheduler jointly selects a ready task, an execution node, and a computing-unit allocation. Simulations across different task scales, workflow parallelism levels, and network topologies show lower makespan and higher resource utilization than the evaluated baselines.

Time: 14:30-14:45

1571350048: SecBGP: A Scalable Trust Plane for Secure Inter-Domain Routing toward 6G Networks

Author(s): Yongcai Xiao and Baoming Yao (State Grid Jiangxi Electric Power Company Research Institute, China); Yongbiao Su, Wentao Liu, Mingrui Cao (Beijing University of Posts and Telecommunications, China)

Abstract: Future 6G networks will increasingly interconnect networks operated by different administrative entities, making trustworthy inter-domain connectivity essential. However, the Border

Gateway Protocol (BGP) lacks a scalable trust infrastructure for validating inter-domain routes, leaving networks vulnerable to prefix hijacking, path manipulation, and route leaks. This paper presents SecBGP, a scalable trust plane for secure BGP routing based on partitioned hierarchical consensus. SecBGP maintains globally consistent network identity, authorization, and routing-security state, including prefix ownership, active prefix announcements, and typed AS relationships, while enabling local validation without an additional consensus operation. For scalability, Autonomous system representatives are organized into lower-layer partitions for Byzantine fault-tolerant validation, while partition leaders participate in upper-layer global block ordering, validation and confirmation. We implement SecBGP on a blockchain substrate and integrate it with an FRR-based BGP system. Evaluation demonstrates broad protection against typical routing attacks, stable committed throughput as membership grows, and millisecond-level route validation latency.

Time: 14:45-15:00

1571352241: Movable Antenna-Assisted Focused Artificial Noise Jamming for Secure Wireless Communications

Author(s): Zeyao Zhang, Yebo Gu and Tao Shen (Kunming University of Science and Technology, China)

Abstract: The movable antenna-assisted focused artificial noise jamming scheme is different from traditional artificial noise, which has a uniform distribution of interference energy in its propagation area and a low probability of alignment with the target eavesdropping communication link, thus causing limited interference to the eavesdropping communication link. Focused artificial noise interference scheme based on movable antenna assistance is jointly designed by focusing artificial noise beamforming matrix and movable antenna position, and the focused artificial noise is mapped to the eavesdropping communication link under the constraints of the maximum total output power and minimum movable antenna spacing to reduce the eavesdropping channel capacity. In this paper, the minimization-maximization algorithm is used to linearize the non-convex part of the optimization problem, and the block coordinate descent algorithm is used to alternately iteratively solve the focused artificial noise covariance matrix and movable antenna position. The simulation results show that the capacity of the eavesdropping channel is significantly reduced. The proposed scheme provides a new solution to enhance the physical layer security of wireless communication systems based on artificial noise.

Time: 15:00-15:15

1571356415: How to Reconstruct RB-Level CSI With Subband-Level CSI-RS: An SRS-Assisted Scheme

Author(s): Mingchen Ma, Ji Yan, Mingyuan Hu, Junhao Zhao and Zhongyuan Zhao (Beijing University of Posts and Telecommunications, China)

Abstract: Accurate full-bandwidth channel state information (CSI) is essential for beamforming and precoding in massive multiple-input multiple-output (MIMO) systems, while acquiring high-resolution CSI incurs substantial measurement and feedback overhead. A cross-granularity CSI reconstruction paradigm is proposed, which exploits full-bandwidth RB-level CSI obtained from SRS to complement subband-level CSI-RS measurements, enabling accurate RB-level CSI reconstruction with reduced CSI-RS measurement overhead. Based on this paradigm, a Transformer-based reconstruction network is designed to compress the CSI-RS measurements for feedback and jointly exploit the CSI-RS and SRS features for RB-level CSI reconstruction. Extensive simulations demonstrate that the proposed scheme consistently outperforms CSI-RS-only and existing CSI-RS/SRS fusion baselines under different feedback overheads, measurement sparsity levels, and channel estimation qualities. Notably, improved

reconstruction accuracy is achieved with reduced CSI-RS measurement resources.

Time: 15:15-15:30

1571350517: A Novel Channel Map Enabled Multi-User Interference Prediction Algorithm for 6G MIMO Communications

Author(s): Fei Wang (Southeast University, China); Cheng-Xiang Wang and Chen Huang (Southeast University, China & Purple Mountain Laboratories, China); Junling Li and Yinglan Bu (Southeast University, China)

Abstract: Channel measurement data are used to investigate wideband multi-user multiple-input multiple-output (MIMO) interference prediction for sixth-generation (6G) communications. The task is challenging because the interference components across receive beams, transmit antennas, and frequencies exhibit different temporal variations, while only limited real-time channel state information (CSI) is available. In this paper, we propose a channel map enabled U-Net (CM-U-Net) to predict future interference channel matrices and their dominant transmit directions for spatial interference suppression. The channel map provides prior information about the temporal variation, average power, and phase evolution of each component. This information is combined with two previous real-time channel estimates through feature modulation in the U-Net decoder, which captures spatial, frequency, and temporal correlations. Measurement results from four data sets show that the proposed algorithm achieves the highest interference prediction accuracy compared with Transformer, long short-term memory (LSTM), Hold, and beam-delay autoregression (BDAR).

Special Session 4: AI-Native 6G Networks: Toward Intelligent, Ubiquitous, and Trustworthy Connectivity-II

15:45-18:00 Nov. 11, 2026 | 2F Meeting Room 2

Session Chair: Bin Wang, Xi'an University of Science and Technology, China

Time: 15:45-16:00

1571349361: A Transformer-GRU-Based 6G Predictive Channel Model for Indoor Scenario Communications

Author(s): Zhao Zhao (Southeast University, China); Cheng-Xiang Wang and Chen Huang (Southeast University, China & Purple Mountain Laboratories, China); Junling Li (Southeast University, China)

Abstract: Predicting channel characteristics at future times or locations can support proactive network planning and optimization in sixth-generation (6G) wireless systems, making predictive channel modeling increasingly important. However, obtaining sufficiently representative channel measurement data for data-driven predictive channel modeling remains difficult in practice. To address this limitation, this paper proposes a Transformer-GRU based 6G predictive channel model for indoor scenario communications. Delay-domain features are extracted from historical channel data and fused across measurement routes using distance-dependent spatial weights. A reference-based Transformer branch predicts future channel variations relative to the latest available channel information, whereas a gated recurrent unit (GRU) branch provides a complementary direct prediction from historical channel data. The proposed predictive channel model is validated by using 28-GHz indoor channel measurement data. The results show that the influence of training-data availability becomes more pronounced as the prediction distance increases. At short and intermediate prediction distances, the proposed predictive

channel model achieves better prediction accuracy than the considered benchmark methods under limited training data.

Time: 16:00-16:15

1571356208: ICF: KV-Cache-Aware Model Placement for Heterogeneous LLM Serving

Author(s): Huiying Zhang, Yongbiao Su and Renzhi Yuan (Beijing University of Posts and Telecommunications, China)

Abstract: Model placement for large language model (LLM) serving must balance GPU processing capacity with memory for concurrent requests. Distributing layers across more devices can free memory for the key – value (KV) cache. Longer pipeline round trips, however, require more concurrent requests to sustain the same generation rate. We present inventory-constrained flow (ICF), a placement method that accounts for this trade-off between pipeline latency and KV capacity. ICF estimates the request occupancy of each pipeline and constrains the total occupancy of pipelines sharing a device by its KV budget. The resulting linear program guides a local search over layer partitions and device assignments, followed by candidate selection under service constraints. We derive tight bounds between ICF and its capacity-only relaxation and give an exact condition for their optimal values to coincide. Trace-driven simulations of LLaMA-2 70B on three heterogeneous clusters show that ICF improves decode throughput over Helix by 21.8% in the geo-distributed setting and 9.6% in the single-datacenter setting, while meeting the prescribed latency and request-count bounds.

Time: 16:15-16:30

1571355171: 5G-A Integrated communication and sensing technology for nearshore and offshore cross-domain scenarios

Author(s): Zhe Qiao (Beijing Institute of Technology, China); Dongchen He (China Mobile Communications Group Hainan Co., Ltd., China); Desheng Chen (Beijing Institute of Technology, China); Zihui Jin (China Mobile, China)

Abstract: As one of the key technologies of 5G-A and a building block of future 6G, the integrated sensing and communication (ISAC) technology has important applications in low-altitude targets, water targets, meteorology, micro-deformation monitoring and other fields. 6G is envisioned as a ubiquitous intelligent connectivity infrastructure that integrates terrestrial, aerial and space networks and unifies communication, computing, sensing and intelligence, in which AI-native networking makes intelligence a fundamental network capability; ISAC is therefore evolving toward the convergence of communication, computing, sensing and intelligence in AI-native 6G. This paper describes the principle and development trend of ISAC, analyzes its application requirements and advantages in offshore cross-domain communication and sensing scenarios, and proposes a scheme to monitor offshore targets based on ISAC. Experiments were carried out in typical sea areas, and the results show that the scheme has good cross-domain communication and sensing capability. This study provides a practical case for the application of ISAC in the field of cross- domain communication and sensing, which has scientific and application value for promoting the development of 5G-A, AI-native 6G and cross-domain communication technology.

Time: 16:30-16:45

1571347508: Time-Domain Channel Extrapolation for Massive MIMO Using CNN-LSTM Networks

Author(s): Ruonan Jin, Yiwen Wang, Xinyi Zhang, Yingchun Chen and Xiaojun Huang (Xi'an University of Science and Technology, China)

Abstract: Massive MIMO improves spectral efficiency and supports multi-user transmission in high-mobility scenarios, but Doppler-induced channel variations cause pilot-estimated channel state information (CSI) to become outdated. Existing parametric and data-driven extrapolation methods have limited ability to capture dynamic spatiotemporal channel correlations, resulting in suboptimal accuracy. This paper proposes a phase-aware CNN-LSTM temporal channel extrapolation method that combines antenna-domain feature extraction with temporal modeling. Compared with conventional LSTM, the proposed method reduces amplitude and phase RMSE from 0.7117 and 0.7578 to 0.5572 and 0.3884, respectively, while increasing the corresponding correlation coefficients to 0.9864 and 0.9924. Increasing the LSTM prediction horizon from 1 ms to 5 ms raises amplitude and phase RMSE by 44% and 79%, respectively. The results show that the proposed method improves CSI extrapolation accuracy within the channel coherence time by exploiting spatiotemporal correlations, thereby mitigating CSI mismatch, reducing pilot overhead, and improving precoding and detection performance.

Time: 16:45-17:00

1571356861: Risk-Aware Federated Reinforcement Learning for Multi-Interface Association in Integrated sub6/mmWave Mobile IoT Networks

Author(s): Thi Ha Ly Dinh and Manh Do Duc (Hanoi University of Science and Technology, Vietnam)

Abstract: Future mobile IoT networks are expected to support increasingly diverse traffic demands while maintaining reliable and energy-efficient wireless connectivity under mobility and dynamic channel conditions. Although deep reinforcement learning (DRL) has shown potential for adaptive association, relying only on instantaneous channel information can lead to unstable associations and frequent handovers. In this work, we investigate the multi-interface association problem in heterogeneous Sub-6GHz/mmWave IoT networks. We develop a risk-aware federated reinforcement learning framework in which each IoT device selects its AP-interface association based on local observations. Unlike approaches using only current link conditions, the proposed state incorporates historical throughput and mmWave outage information, together with a throughput-variance-based risk index to capture link volatility. A personalized federated structure further enables agents to share common feature representations while retaining local decision layers. The reward jointly considers throughput, QoS satisfaction, outage, communication energy, and handover cost. Numerical results show that the proposed methods achieve an outage rate 7.6x lower than the benchmark, while reducing handover rates by up to 88.5%. The proposed methods also achieve higher throughput while maintaining competitive energy consumption, demonstrating a favorable balance among throughput, reliability, and energy usage.

Time: 17:00-17:15

1571332592: CTDE-QMIX for Joint Resource Allocation in Multi-cell Uplink NOMA Networks

Author(s): Kento Hirata and Xiaoyan Wang (Ibaraki University, Japan); Biao Han (National University of Defense Technology, China); Hao Zhou (University of Science and Technology of China, China)

Abstract: Joint resource allocation plays a critical role in improving the performance of uplink non-orthogonal multiple access (NOMA) networks. Conventional methods often optimize only a subset of these resources and struggle to adapt to dynamic wireless environments. This paper proposes a centralized training with decentralized execution (CTDE) framework based on QMIX for joint BS association, channel selection, and transmit power control in multi-cell uplink NOMA networks. Each user equipment is modeled as an autonomous agent that learns cooperative resource allocation policies through multi-agent deep reinforcement learning (MADRL). A team reward combining energy efficiency, communication success rate, and Jain's fairness index is designed to guide cooperative

learning. Simulation results in both static and dynamic environments demonstrate that the proposed method significantly outperforms conventional orthogonal multiple access (OMA) and random NOMA in terms of energy efficiency, communication success rate, and fairness, while exhibiting strong robustness to user mobility.

Time: 17:15-17:30

1571356634: Intent-Driven and Safety-Gated Resource Control in Dynamic Elastic Optical Networks: A Value, Cost and Optimality-Gap Study

Author(s): Liang Liao, Hongguang Sun and Peng Zhang (China Information Communication Technologies Group, China); Zhicong Peng and Suwen Zou (Huazhong University of Science and Technology, China); Li Shu (Fiberhome, China); Yingyu Li (China University of Geosciences (Wuhan), China)

Abstract: Large language model (LLM) agents have been demonstrated as optical-network controllers, but the field lacks measurements of what such a layer adds over the classical optimisation that operators already trust, what it costs, and how far the deterministic part of the loop is from an exact bound. We report a reproducible study in two parts. First, a dynamic event-driven simulation grid of 4800 runs in 60 cells compares four deterministic controllers-KSP with first-fit, a fragmentation-aware heuristic, a constraint-checked intent-aware controller, and an always-defer variant-across three topologies, five calibrated load levels per topology, four intent mixes and twenty seeds, with paired statistics over 1200 matched pairs. Second, an exact integer-programming reference solves 360 small static instances twice: once subject to the intent constraints and once without them, so that each metric is compared with the bound of the problem it actually solves. The dynamic results show a reversal that depends entirely on the metric: the intent-aware controller carries less raw bandwidth but delivers more compliant service, and it eliminates constraint violations exactly. The static bounds show the same tension and quantify the headroom of the deterministic controller. All 360 static instances were solved to proven optimality. No language model was called; the model-based arms are defined but not evaluated.

Time: 17:30-17:45

1571326445: Research on 6G Network Traffic Prediction Model Based on Multi-Scale Statistical Anchoring

Author(s): Haoying Mo, Jing Wang and Rongfei Ye (Aerospace Jinmei (Chongqing) Communication Co., Ltd., China); Xiaotao Xu (Information Support Force Engineering University, Wuhan, China)

Abstract: For resource scheduling of 6G cellular base stations, the bursty and nonlinear characteristics of network traffic easily lead to bandwidth allocation jitter. Existing deep learning prediction models lack global statistical priors and, under abrupt traffic changes, suffer from prediction fluctuation and scale drift caused by random weight initialization. To this end, this paper proposes a Multi-Scale Statistical Anchoring (MSA) model. First, multi-scale statistical features with short, medium, and long windows are constructed to explicitly characterize multi-granularity traffic baselines and temporal trends. Second, a recent-mean residual anchoring module is designed to constrain predictions to converge toward the real traffic baseline. Five rounds of controlled simulation experiments demonstrate that, with MAE as the criterion and MUL_Attn as the best baseline model, MSA achieves a 38.2% reduction in MAE, with a five-round MAE standard deviation of 92.96. In the Milan real-world data test, MSA attains an RMSE of 32229.65, a MAPE of 6.01%, and an R^2 of 0.9902, all ranking best among the five models. The results indicate that the proposed method has good comprehensive prediction capability and generalization in both controlled simulation and real-world scenarios, and can serve as a reference for real-time bandwidth allocation of target cells.

Time: 17:45-18:00

1571356502: RESQ: Region-Quality Enhancement for Unmanned-System Ultra-Compressed Image Transmission by DNNs

Author(s): Jiayi Hu, Hongxia Bie and Zhisong Bie (Beijing University of Posts and Telecommunications, China)

Abstract: Ultra-compressed image transmission from unmanned systems must operate over severely constrained links, where deep neural networks (DNNs) have made such transmission feasible; however, since existing learned image compression (LIC) models optimize full-image average distortion, salient regions are reconstructed markedly worse than background regions at ultra-low bitrates. Addressing this region quality imbalance, we propose RESQ (Region-Equalized Saliency-Quality reallocation), a bit-guided mechanism that allocates the limited bits across regions according to semantic perception. RESQ distills vision-language knowledge into a lightweight saliency model to locate, without annotation, the regions of joint interest to humans and downstream algorithms; defines an area-decoupled bit density that converts the bit biasing toward salient regions into an observable, tunable constraint; and enforces it with a complementary-slackness-inspired hinge penalty that intervenes only while the constraint is violated, precluding over-allocation by construction. Plug-and-play compatible with mainstream LIC models, RESQ relatively reduces the region quality gap by 44.6% while preserving rate-distortion efficiency on par with the baseline.

SPECIAL SESSIONS

Special Session 5: Integrated Sensing, Communication, Computing and Intelligence for Future Communication Networks-I

13:30-15:30 Nov. 11, 2026 | 2F Meeting Room 3

Session Chair: Yimeng Ge, Xi'an University of Posts and Telecommunications, China

Time: 13:30-13:45

1571356446: Reliability-Aware Semantic Token Selection for Integrated Sensing and Communication Systems

Author(s): Yichen Wu and Jianxin Dai (Nanjing University of Posts and Telecommunications, China); Zhaohui Yang (Zhejiang University, China)

Abstract: Integrated sensing and communication (ISAC) systems provide a framework for supporting sensing and communication services in future wireless networks. However, conventional sensing metrics, such as the estimation error and Cram´er – Rao bound (CRB), mainly describe target-level sensing performance and cannot directly characterize the reliability of individual semantic events. This limitation makes it difficult to select task-relevant semantic information under communication resource constraints. In this paper, we propose a sensing-driven semantic token selection framework for ISAC systems. Each semantic token is associated with a physical event region, and a token-level reliability metric is derived from the sensing posterior distribution to quantify the probability of observing the corresponding event. Based on the obtained reliability, a joint beamforming and token selection problem is formulated by considering task importance, semantic redundancy, and communication latency constraints. A cosine-similarity based correlation penalty is introduced to reduce the selection of semantically overlapping tokens. To solve the resulting mixed discrete-continuous optimization problem, an alternating optimization algorithm is developed by combining sample average approximation and successive convex approximation. Simulation results show that the proposed framework improves the semantic utility compared with baseline schemes and reduces the redundancy among selected semantic tokens.

Time: 13:45-14:00

1571356720: Efficient Power Allocation and Precoding Design for Multi-User MIMO Semantic Image Transmission

Author(s): Pinrui Yan, Jinyuan Shang and Liang Wang (Northwestern Polytechnical University, China)

Abstract: The transmission design of semantic image in Multi-User Multiple-Input Multiple-Output (MU-MIMO) system is challenging, which requires to operate the joint optimization of image-context complexity, power allocation, precoding design under the circumstances of image-content heterogeneity and poor channel quality. This paper develops an efficient Power Allocation and Precoding design of semantic Image Transmission in MU-MIMO system (PAPIT-M2) algorithm, in which the power allocation and precoding matrix are jointly optimized using a fixed SwinJSCC codec, Regularized Zero-Forcing (RZF) precoding, and Linear Minimum Mean-Square Error (LMMSE) receive combining. From the experimental results, it has obvious performance gains over traditional baselines in terms of mean minimum Peak Signal-to-Noise Ratio (PSNR) and lower Learned Perceptual Image Patch Similarity (LPIPS).

Time: 14:00-14:15

1571357574: Energy-Efficient Cooperative Localization Based on Alternating GA and Stackelberg Game

Author(s): Zhilin Zhu and Geng Chen (Shandong University of Science and Technology, China)

Abstract: To address the tradeoff between localization accuracy and energy consumption in resource-constrained warehouse automated guided vehicle (AGV) networks, this paper proposes an inter-generational alternating optimization method combining a genetic algorithm (GA) and a Stackelberg game. A joint cooperative link-selection and transmit-power allocation model is formulated using the squared position error bound (SPEB), subject to node power, energy budget, network power, and cooperation-degree constraints. The proposed inter-generational GA-Stackelberg (IGS) method optimizes the cooperation topology in odd generations and allocates power in even generations. Leaders and followers are assigned according to residual energy and localization reliability, and leader power updates account for follower responses. A unified reciprocal fitness evaluates the joint solutions. Simulation results show that IGS reduces network-average SPEB by 25.6 percent and 20.8 percent compared with topology-only and power-only optimization, respectively, achieving a favorable accuracy – power tradeoff in the tested scenarios.

Time: 14:15-14:30

1571353357: Hardware-Impaired RIS-Aided Covert ISAC Against an Intelligent Mobile Target: A Stackelberg Multi-Agent Game

Author(s): Wang Yueyue, Xiaojian Li, Ziqi Song, Yu Yao and Feng Shu (Hainan University, China)

Abstract: This paper studies a double reconfigurable intelligent surface (RIS)-aided covert integrated sensing and communication (ISAC) network subject to hardware impairments (HWIs) and an intelligent mobile aerial target (iMAT). The interaction between the hardware-impaired legitimate network and the iMAT is formulated as a stochastic Stackelberg game (SSG), where the legitimate network acts as the leader to maximize covert energy efficiency (EE), while the iMAT follows by adjusting its trajectory to enhance signal detection capability. To solve this problem, we propose a multi-agent reinforcement learning (MARL) scheme based on a unified soft actor-critic (SAC) framework supporting hybrid action spaces. Specifically, the leader utilizes SAC with discrete action outputs (SAC-D) for adaptive trajectory planning, while the follower adopts continuous SAC for joint transmit beamforming and RIS phase-shift optimization. This unified framework achieves stable convergence under the stochastic policies of both agents. Simulation results demonstrate its robustness against HWIs, achieving a 37.5% gain in covert EE over existing learning-based benchmarks without compromising sensing performance.

Time: 14:30-14:45

1571356111: Covert RIS-ISAC System: Joint Active and Passive Beamforming Design

Author(s): Ruotong Zhu, Zheng Chu, David Chieng and Chiew Foong Kwong (University of Nottingham Ningbo China, China); Zheng Li and Zhengyu Zhu (Zhengzhou University, China)

Abstract: This paper studies a covert integrated sensing and communication (ISAC) system assisted by a reconfigurable intelligentsurface (RIS). We investigate a joint active-passive beamforming problem to maximize the sensing performance subject to the covertness constraint, the legitimate users' quality-of-service requirements, the RIS hardware limitations, and the prescribed power budget. To deal with the resulting non-convex problem, we develop a sequential optimization framework, where the active beamforming and RIS phase shifts are updated iteratively via semidefinite relaxation. Our simulations confirm that the integrated RIS design achieves a robust compromise across different performance requirements, and covertness, and delivers better performance than others.

Time: 14:45-15:00

1571357576: Hierarchical Resource Allocation for UAV-Assisted Vehicular Networks with Emergency-Service Prioritization and Energy Constraints

Author(s): Tianyu Pang and Geng Chen (Shandong University of Science and Technology, China)

Abstract: To address the issues of reduced ground access capacity and limited endurance of unmanned aerial vehicles (UAVs) during urban road emergencies, this paper investigates the joint resource allocation of Emergency Service Slices (ES) and Flexible Service Slices (FS) in a multi-UAV-assisted Vehicle-to-Everything (V2X) network. The joint design involves UAV mobility, vehicle association, radio-resource allocation, and dynamic ES reservation, resulting in a nonconvex optimization problem with coupled discrete and continuous variables. To this end, a hierarchical framework comprising Multi-Agent Soft Actor-Critic (MASAC) and a priority-aware two-stage auction is proposed: the outer layer learns UAV mobility and resource reservation strategies, while the inner layer determines association and bandwidth-power allocation subject to ES service requirements, followed by an actual SINR check and bounded repair to remove residual infeasibility. Compared with the MASAC-based benchmarks, MASAC-P2A provides higher ES service satisfaction and fewer actual SINR violations while retaining FS throughput and UAV residual energy.

Time: 15:00-15:15

1571355437: Physics-Constrained Deep Learning for Covert Beamforming in LEO Satellite ISAC Systems

Author(s): Zebin Ouyang and Zhengyu Zhu (Zhengzhou University, China); Yabo Guo (Henan University of Technology, China)

Abstract: Integrated sensing and communication (ISAC) over low Earth orbit (LEO) satellites can provide wide area coverage, but the open broadcast nature of satellite links exposes transmissions to detection by unintended listeners. This paper proposes a deep learning scheme for covert beamforming in LEO satellite ISAC systems that uses artificial noise generated by the radar to interfere with a passive warden while preserving a prescribed sensing performance. We jointly design the satellite beamformer, radar beamformer, and radar receive filter under power, sensing, and covertness constraints. To solve this design problem, we develop a physics-constrained unsupervised beamforming network that takes channel information and system parameters as inputs and directly generates the two beamformers. Training samples are generated online, and the network is optimized through a differentiable physical model with an augmented Lagrangian objective. Numerical results show that, compared with the baseline scheme, the proposed scheme has almost no difference in Bob's signal to interference plus noise ratio, but Willie's Kullback-Leibler divergence decreases by up to 29%, indicating that the proposed scheme improves the communication covertness of the system. These results demonstrate that incorporating radar into beamforming can enhance communication covertness while maintaining sensing and communication capability in LEO satellite ISAC systems.

Time: 15:15-15:30

1571358054: GACR-RANSAC: Bias Node Culling for Cooperative Target Localization

Author(s): Ziqi Zhao, Huici Wu and Xiaofeng Tao (Beijing University of Posts and Telecommunications, China)

Abstract: Ranging biases and unfavorable node geometry can degrade target localization in cooperative sensing. This paper proposes geometry-aware and confidence region random sample consensus (GACR-RANSAC) for bias node culling. A first-order error analysis relates localization

accuracy to ranging noise, bias statistics, and observation geometry. The method accounts for both ranging and candidate-position uncertainties in residual thresholds, scores inlier sets using normalized geometric dilution of precision, and estimates the target position through confidence region localization. Simulations examine the effects of the number of bias nodes under four node layouts and the effects of bias statistics under five layouts. With prior knowledge of normal nodes used to assist sampling, GACR-RANSAC achieves root mean square error (RMSE) close to that of the confidence region reference using normal nodes only. In the bias node-count experiment, GACR-RANSAC reduces the RMSE averaged over the tested bias-node counts by 3.20% to 95.48% relative to the least-squares reference using normal nodes only, with the largest reductions observed for the one-sided clustered and nearly collinear layouts.

Special Session 5: Integrated Sensing, Communication, Computing and Intelligence for Future Communication Networks-II

15:45-17:45 Nov. 11, 2026 | 2F Meeting Room 3

Session Chair: Jingqing Wang, Xidian University, China

Time: 15:45-16:00

1571356671: Cluster-Level Characterization of Monostatic and Bistatic Sensing Channels for ISAC Systems at Urban Intersections: Impact of Traffic Density

Author(s): Fan Yang, Zhichao Xin, Yu Liu, Yuxuan Han and Lingqiang Kong (Shandong University, China); Jie Huang (Southeast University, China)

Abstract: Integrated sensing and communication (ISAC) is a key enabling technology for sixth-generation (6G) vehicular networks, whereby roadside infrastructure integrates environment perception and communication capabilities to deliver high-reliability services for connected road users. However, accurate ISAC channel characterization for urban intersection scenarios, which serves as a critical foundation for 6G vehicular network deployment, remains insufficiently studied. This paper presents a cluster-level channel analysis for ISAC systems at urban intersections under diverse traffic conditions. A realistic urban intersection model with four roadside units (RSUs) is constructed, and sparse and dense traffic flows are generated using a Poisson arrival process. Sensing channels are divided into monostatic and bistatic configurations. Based on the sensing and communication channel data acquired using Sionna RT, the density based spatial clustering of applications with noise (DBSCAN) is adopted for multipath clustering, and a cross-snapshot tracking algorithm is utilized to extract cluster evolution. Results show that the monostatic clusters are more stable over time and dominated by short-delay paths, whereas bistatic clusters exhibit more dynamic birth-death behavior and wider delay spread. Furthermore, the angular power spectrum is governed primarily by the sensing configuration rather than traffic density for moderate traffic volumes. These findings can provide useful insights for mode selection and beam management in intersection ISAC systems.

Time: 16:00-16:15

1571356742: Physics-Guided Recursive Self-Improvement for LLM-Based Resource Allocation in UAV-Assisted ISAC

Author(s): Yuan Gao (Henan Polytechnic University, China); Liutong Du (The China Academy of Information and Communication Technology, China); Xingwang Li (Henan Polytechnic University, China)

Abstract: We propose physics-guided recursive self-improvement (RSI) for unmanned aerial vehicle (UAV)-assisted integrated sensing and communication (ISAC). A single 1.5-billion-parameter language model generates communication-power allocations, sensing-energy allocations, beamwidth selections, and improvement plans. Paired multi-slot rollouts assess resource interventions and guide training-scenario selection, while bounded trial updates measure the resulting learning gains. Communication utility and trial-learning gains train the control and improvement roles, respectively, through shared low-rank adapters. The updated model then proposes plans for subsequent adaptation, forming a parameter-level RSI loop under a common computational budget and independent deployment validation.

Time: 16:15-16:30

1571356599: Coarray Tensor ESPRIT for Sparse OFDM Sensing: An RFSoC-GPU Implementation

Author(s): Jinkuan Jia, Haojian Wang, Haisu Wu, Hong Ren and Cunhua Pan (Southeast University, China); Jiangzhou Wang (National Mobile Communications Research Lab.; Southeast University, China)

Abstract: Sparse resource-element (RE) allocation reduces the pilot overhead of OFDM sensing but requires estimators that exploit irregular time-frequency observations. This paper presents an hourglass sensing pattern organized in 12x14 design units and a coarray tensor ESPRIT implementation on an RFSoC-Orin platform. Repeated sensing units provide covariance snapshots, and same-lag aggregation reconstructs a contiguous virtual grid from the sparse observations. A fourth-order Hankel representation supports continuous delay-Doppler estimation without a two-dimensional spectral search or alternating factor-recovery iterations. The implementation exploits the fixed pattern geometry through precomputed index maps, fused preprocessing, direct Hankel unfolding, and reusable device buffers. The GPU performs preprocessing through subspace recovery, while the CPU completes the compact parameter-estimation stage. The configured sensing pattern occupies 22.6% of the REs. The evaluation examines estimation errors at different target separations and reports a mean core processing latency of 27.8 ms, corresponding to 13.9% of the 200 ms sensing-update interval.

Time: 16:30-16:45

1571356647: Factor Graph-Based Near-Field Localization for XL-MIMO with Graph Attention Network Extrapolation

Author(s): Hongyun Chu and Ruiqi Yin (Xi'an University of Posts and Telecommunications, China)

Abstract: In near-field non-line-of-sight (NLOS) extremely large-scale multiple-input multiple-output (XL-MIMO) systems, localization via natural scatterer reflections inherently couples user and scatterer positions, while spatially non-stationary propagation yields uneven visibility and observation quality across the array. This paper proposes a visible-region extrapolation factor graph message passing (VRE-FGMP) localization method. The array is partitioned into subarrays with local far-field plane-wave approximations to reduce complexity. Subarray visibility is determined from received energy, and a graph attention network (GAT) learns spatial angle-of-arrival (AOA) correlations between neighboring subarrays to extrapolate messages from visible to non-visible subarrays, thereby mitigating error propagation from unreliable AOA observations and resolution loss caused by using only visible

subarrays. A factor graph integrates AOA direction constraints, time-of-arrival (TOA) propagation-distance constraints, and user state-transition priors to iteratively update scatterer and user positions. Simulations demonstrate improved scatterer localization accuracy and enhanced user positioning and tracking performance in spatially non-stationary NLOS environments.

Time: 16:45-17:00

1571356349: Optimal Placement of AAV-Mounted EIH for the Internet of Embodied AI Agents with SC3 Closed Loops

Author(s): Shijie Wei and Wei Feng (Tsinghua University, China); Yunfei Chen (University of Durham, United Kingdom); Chao Dong (Nanjing University of Aeronautics and Astronautics, China); Baoquan Ren (Institute of China Electronic System Engineering, China); Ning Ge (Tsinghua University, China)

Abstract: The Internet of Embodied Artificial Intelligence (AI) Agents integrates heterogeneous agent capabilities, and provides an information foundation for complex task execution under extreme conditions. When terrestrial infrastructure is unavailable, maneuver-deployed autonomous aerial vehicles (AAVs) can support these operations. In this context, an AAV-mounted edge information hub (EIH) with integrated communication and computing capabilities connects a sensing agent and an actuation agent, typically forming a sensing-communication-computing-control (SC3) closed loop. In each loop cycle, the sensing agent uploads sensing data over the uplink, while the EIH computes and transmits control commands over the downlink. Accounting for the task-level coupling between the two links, we propose a task-oriented EIH placement scheme, which jointly optimizes the EIH location and the communication/computing resources to maximize the closed-loop negentropy (CNE). We first derive the closed-form intra-loop resource allocation and confine the location search to a bounded planar region. We then transform the resulting problem into an equivalent transmission-time minimization problem and develop an iterative algorithm based on successive convex approximation. Simulation results show that the proposed scheme outperforms communication-oriented benchmarks, especially when communication becomes the bottleneck of the SC3 loop.

Time: 17:00-17:15

1571301180: Experimental Study on Respiration Detection Using 5G Downlink Reference Signals

Author(s): Yuzhou Ning, Na Li and Qimei Cui (Beijing University of Posts and Telecommunications, China)

Abstract: Integrated Sensing and Communication (ISAC) is one of the key technologies for next-generation mobile networks. Previous studies have evaluated the performance of 5G signals in macro-motion sensing, such as range, velocity, location and presence detection of targets, theoretically or experimentally. However, micro-motion sensing scenarios, such as human respiration detection, which is another representative use case of ISAC, still lack studies and experimental evaluations. To fill this gap, we study respiration detection using 5G downlink reference signals in this paper. Specifically, we propose a respiration detection framework in a bistatic configuration by reusing the native measurement features of standard 5G reference signals, including the Synchronization Signal Block (SSB), Demodulation Reference Signal (DMRS), Channel State Information Reference Signal (CSI-RS), Positioning Reference Signal (PRS), and Phase Tracking Reference Signal (PT-RS). The proposed framework does not modify the 5G physical-layer signal structure, but extracts respiration-related amplitude, phase, and delay variations from the measurement features originally provided by these signals. Moreover, we developed a Software Defined Radio (SDR) based experimental platform using Universal Software Radio Peripheral (USRP) and 5G waveform generating software. We evaluated and compared the respiration detection performance of these reference signals in an indoor environment. The results demonstrate that all these signals can be used as candidate signals for respiration detection,

and when phase-based features are available, better detection performance can be achieved.

Time: 17:15-17:30

1571307443: Robust Secure and Covert Communication for Multi-UAV-Assisted ISAC Networks via RSMA Under Imperfect SIC

Author(s): Minghui Cui, Ying Su and Jing Zhang (Shanghai Normal University, China)

Abstract: This paper investigates a cooperative multi-UAV RSMA-ISAC network for secure and covert low-altitude services under imperfect SIC. In the considered network, ULA-equipped UAVs serve ground users and sense targets through RSMA common and private streams, while a mobile EUAV acts as both an eavesdropper and a warden. Different from ideal-SIC-based designs, residual common-stream interference is explicitly included in private-stream decoding, so that the impact of imperfect SIC on secrecy performance can be captured. A finite-horizon joint optimization problem is formulated to maximize the long-term secure communication and sensing utility by controlling UAV trajectories, common-stream and private-stream power allocation, and common-rate allocation, subject to covertness, sensing completion, collision avoidance, energy, and terminal-return constraints. To solve the resulting non-convex and long-horizon problem, a parameter-sharing multi-agent soft actor – critic framework is developed. The framework applies one shared actor and shared twin critics to all homogeneous UAVs, so that different UAVs generate different actions from their own local observations while updating common network parameters to improve training efficiency and robustness. Simulation results show that although the imperfect-SIC-aware strategy slightly reduces the secrecy rate, it provides more stable secrecy and sensing performance under varying SIC residuals.

Time: 17:30-17:45

1571356662: Joint DAG Task Scheduling and Resource Allocation in Satellite Edge Computing via Hierarchical Deep Reinforcement Learning

Author(s): Haoyue Duan, Zhe Ji and Sheng Wu (Beijing University of Posts and Telecommunications, China); Xiaomin Chen and Ye Li (Nantong University, China); Lixia Xiao (Huazhong University of Science and Technology, China)

Abstract: With the development of sixth-generation (6G) networks, satellite edge computing (SEC) has emerged as a promising paradigm for providing ubiquitous computing services. However, the limited, highly dynamic, and unevenly distributed computing resources in satellite networks pose significant challenges to efficient task scheduling. Moreover, practical applications often involve complex precedence and data dependency constraints among sub-tasks, further complicating the scheduling process. To address these challenges, this paper investigates directed acyclic graph (DAG) task scheduling in SEC and proposes a novel hierarchical scheduling framework. Specifically, we formulate a joint optimization problem for DAG sub-task scheduling and computing resource allocation, while accounting for service deployment constraints and dynamic satellite network topologies. To efficiently solve this problem, we develop a global-local coordinated hierarchical deep reinforcement learning (GLOC-HDRL) framework, which consists of a centralized upper layer for global discrete sub-task scheduling and a distributed lower layer for continuous resource allocation at individual satellites. Furthermore, a shared feedback mechanism is introduced to enable coordinated training between the two layers. Simulation results demonstrate that the proposed GLOC-HDRL framework effectively reduces DAG task completion latency and improves overall task completion performance.

SPECIAL SESSIONS

Special Session 6: Semantic Communication and Semantic-Aware Agentic AI Networking

08:30-10:00 Nov. 12, 2026 | 2F Meeting Room 3

Session Chair: Zixin Wang, The Hong Kong University of Science and Technology, Hong Kong, China

Time: 08:30-08:45

1571356747: Foundation Model Services over Edge Networks: SLA-Aware Predictive Microservice Routing

Author(s): Zixin Wang, Khaled B. Letaief, Juan Zhu and Jiachen Sun (The Hong Kong University of Science and Technology, Hong Kong, China); Mehdi Bennis (Centre of Wireless Communications, University of Oulu, Finland)

Abstract: Modular foundation model (FM) inference enables collaborative execution across heterogeneous edge resources, but routing its dependent microservices must reconcile end-to-end delay requirements specified by service-level agreements (SLAs) with resource budgets. Time-varying network state and delayed state reports make deadline-aware node selection challenging. To address this challenge, we propose an SLA-aware predictive routing framework that integrates network state prediction with Lyapunov-guided online control. Specifically, a neural predictor supplies age-aligned network state predictions, which are combined with execution backlog to estimate stage completion times. We construct an SLA-aware score by applying a sigmoid to the predicted deadline slack after accounting for nominal remaining critical-path time, and subtracting a normalized stage-delay penalty.

A virtual queue tracks resource cost relative to the budget and supplies a virtual resource price, allowing node selection to balance this score against resource cost. Simulation results demonstrate a higher SLA satisfaction rate and lower resource cost than greedy routing across the tested synthetic Driving loads, achieving an SLA satisfaction rate of 97.20% and resource cost savings of 19.59% at the default setting.

On Azure trace-driven workloads, the framework reduces cost by 20.91% with a lower SLA satisfaction rate.

Time: 08:45-09:00

1571356159: Safety-Aware LLM Agents for Automated Fault-Discovery and Recovery in Optical Transport Networks

Author(s): Peng Zhang, Hanbing Li and Liang Liao (China Information Communication Technologies Group, China); Peng Zhicong and Suwen Zou (Huazhong University of Science and Technology, China); Li Shu (Fiberhome, China)

Abstract: Autonomous fault recovery in optical transport networks requires more than diagnosis: the operator must decide which physical actions are safe, apply them under control, and confirm that recovery actually took effect. We present a safety aware agentic recovery framework in which an LLM-based agent proposes diagnoses and recovery plans while deterministic components gate the loop. Every proposed action is validated for target, type, parameter, and cross-action conflicts before execution; post-action verification checks that telemetry moved toward the intended state; rejected plans are regenerated from structured safety feedback; and snapshot-based rollback restores the pre-action state when verification fails. On a simulated three-node optical network with a locally served

7B multimodal LLM, the framework diagnosed representative faults and stayed accurate at the highest telemetry noise level (5/5) where a robust rule-based variant failed (0/5). All 30 controlled unsafe proposals-invalid targets, conflicting actions, and out-of-range parameters-were rejected, and all 30 feedback-driven replans passed safety, executed, verified, and restored the network; a component ablation shows that only the full loop recovers rejected faults (1.0 versus 0.25 overall). Under an injected ineffective action, verification detected the failure and rollback restored the pre-action safe state in 10/10 paired trials. A deterministic repair policy matched LLM replanning (30/30 versus 30/30) with zero LLM calls, so LLM replanning necessity is not established on the tested violation set. The results decompose the contribution of each loop stage and delimit where LLM planning helps and where deterministic safety mechanisms must remain in control.

Time: 09:00-09:15

1571359193: DuoVLC: Semantic Image Transmission over Bandwidth-Limited LEDs via Cross-Branch Interaction

Author(s): Bin Yuan, Ziyang Meng and Ting Wang (University of Chinese Academy of Sciences, China); Lu Lu (Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences & University of Chinese Academy of Sciences, China); Yongsheng Gong (Technology and Engineering Center for Space Utilization, China)

Abstract: The limited modulation bandwidth and low-pass frequency response of light-emitting diodes (LEDs) constrain high-quality image transmission over visible light communication (VLC) links. Unlike conventional approaches that rely on additional physical-layer processing, we retain the modeled LED response and improve how semantic features are represented and protected during transmission. To this end, we propose DuoVLC, an end-to-end semantic image transmission framework for VLC. DuoVLC incorporates a cross-branch interaction (CBI) module with parallel CNN and Swin Transformer V2 branches, in which a convolutional branch extracts local structural details and a Transformer branch captures broader contextual dependencies, followed by feature fusion. An importance- and SNR-aware power allocation module further redistributes a fixed transmit-power budget across two frequency groups and their individual feature channels according to learned semantic importance- and channel conditions. We evaluate DuoVLC on the Kodak dataset using a line-of-sight VLC channel with a first-order LED low-pass response. Across the tested SNR range from 0 to 27 dB, DuoVLC outperforms DeepJSCC-V, LICRNet, and DSIE-JSCC in PSNR, MS-SSIM, and LPIPS, with average PSNR gains of 1.756 dB and 4.668 dB over DeepJSCC-V and DSIE-JSCC, respectively. At 0 dB, it achieves an average PSNR of 30.57 dB, compared with 28.83 dB for DeepJSCC-V and 26.00 dB for DSIE-JSCC. Ablation results show that CBI improves the convolutional backbone by 0.84 dB without power allocation, while adding power allocation yields a further 0.48 dB. These results demonstrate improved image reconstruction over the modeled bandwidth-limited VLC link.

Time: 09:15-09:30

1571356640: Semantic Communication Based on an Auto-Training Approach with Automated Hyperparameter Scheduling

Author(s): Zhengkai Yin, Hangzhou Ma, Shaobo Ma and Wei Liang (Northwestern Polytechnical University, China); Jiankang Zhang (Bournemouth University, United Kingdom)

Abstract: Semantic communication, an approach employing artificial intelligence (AI), aims to extract, transmit, and reconstruct the meaning of information. Existing semantic communication systems often rely on task-specific optimizers and manually designed learning-rate schedules during training. To address this limitation, we develop an automated learning-rate scheduling framework for semantic

communication codec training. The proposed Auto Training Semantic Communication Network (ATSC-Net) uses a recurrent meta-learning module to model the evolving training state and generate the learning rate used for codec optimization. In addition, a channel-adaptive training mechanism considers different signal-to-noise ratio (SNR) conditions during task training and meta-learning, while retained scheduling policies are transferred to evaluated heterogeneous semantic communication tasks. Simulation results across image classification, image reconstruction, and text reconstruction indicate the effectiveness of the proposed scheduling framework in the evaluated settings.

Time: 09:30-09:45

1571356718: Adaptive Quantized Short-Packet Semantic Communication Systems via Deep Reinforcement Learning

Author(s): Xin Wang, Yuchen Zhou, Mofan Luo, Min Hui, Bingtao He and Jian Chen (Xidian University, China)

Abstract: Finite-blocklength semantic communication couples reconstruction fidelity with short-packet reliability: retaining more features increases payload, coding rate, and decoding-error risk. We model this tradeoff in a multiuser downlink and develop adaptive semantic bit quantization (SBQ) to control feature selection and quantization resolution according to channel, queue, and task states. To assess both delivery and fidelity, we define effective short-packet semantic communication quality of service (Effective SSC-QoS) from effective goodput and semantic loss. Joint semantic and radio-resource allocation yields a mixed-integer nonconvex problem, addressed by a constraint-aware soft actor-critic (SAC) policy with feasibility projection. Simulations show superior Effective SSC-QoS and goodput-fidelity tradeoffs over learning- and optimization-based baselines.

Time: 09:45-10:00

1571356401: Sampling-Free Diffusion-Aligned Generative Semantic Communication for Wireless Image Transmission

Author(s): Zhixiong Chen (Queen Mary University of London, United Kingdom); Yingyu Li (China University of Geosciences (Wuhan), China); Hyundong Shin (Kyung Hee University, South Korea); Ranjan K. Mallik (Indian Institute of Technology Delhi, India); A Nallanathan (Queen Mary University of London, United Kingdom)

Abstract: Diffusion-based generative semantic communication offers a promising solution by exploiting learned priors to recover information omitted under bandwidth constraints. However, generative reconstruction faces two fundamentally different sources of uncertainty, i.e., semantic information intentionally discarded by the encoder and transmitted information corrupted by the wireless channel. When these two effects are handled jointly, channel errors may be interpreted as valid semantic cues, resulting in visually plausible yet source-inconsistent reconstruction. In addition, iterative reverse diffusion introduces substantial decoding latency. To address these challenges, we propose a sampling-free diffusion-aligned generative semantic communication framework that explicitly separates channel denoising from generative reconstruction. At the transmitter, a dual-branch encoder combines diffusion-compatible features with reconstruction-oriented source information and compresses them into bandwidth-constrained channel symbols. At the receiver, least-squares (LS) equalization converts the wireless observation into an additive Gaussian latent whose conditional distribution matches a variance-exploding (VE) diffusion state. This correspondence enables a lightweight noise-conditioned diffusion transformer (DiT) to remove channel-induced perturbations in a single forward pass. The denoised semantics are then passed to a one-step diffusion generator to recover information omitted by semantic compression.
Numerical results show that, compared with state-of-the-art diffusion-based generative semantic communication methods, the proposed approach reduces FID by up to 46.9% and achieves a 116.9x speedup in end-to-end computation.

TECHNICAL SESSIONS

Technical Session 1: Signal Processing for Communications-I

10:15-12:00 Nov. 12, 2026 | 2F Meeting Room 1

Session Chair: Neng Ye, Beijing Institute of Technology, China

Time: 10:15-10:30

1571347756: Peak-Pattern Fingerprint Spoofing Detection for BOC Signals in LEO-Aided GNSS

Author(s): Peiqi Lin, Shuxun Li, JinQiu Li, Yuxin You, Huiling Hou and Huijie Liu (Innovation Academy for Microsatellites, Chinese Academy of Sciences)

Abstract: Binary Offset Carrier (BOC) modulation is widely used in Global Navigation Satellite Systems (GNSS) for its spectral separation and multipath resilience, yet its multi-peak autocorrelation function (ACF) makes meaconing a threat. Existing detectors rely on heuristic features with empirical thresholds. This paper presents a peak-pattern fingerprint detector that samples the BOC ACF structure and performs shift-matched generalized likelihood ratio test (GLRT) over a delay dictionary, subtracting the template's structural projection to remove bias, while also providing a spoofing delay estimate. A low Earth orbit (LEO) dynamic model covers residual carrier Doppler, spoofing Doppler mismatch, and code Doppler drift. Monte Carlo results show area under the curve (AUC) ≥ 0.9996 on BOC(1,1) and BeiDou B1C QMBOC(6,1,4/33), outperforming side-lobe cancellation (SLC), signal quality monitoring (SQM), symmetry, and peak-counting baselines, with significant gains at low carrier-to-noise density ratio (C/N0) and low spoofing-to-signal power ratio (SDR). The method is robust to 500 Hz Doppler mismatch, tolerates 500 Hz residual carrier Doppler at 1 ms integration, and requires only 13-19 taps for spaceborne real-time deployment.

Time: 10:30-10:45

1571349830: Entropy-Weighted EM-CFAR Detector for Improved False-Alarm Control at Clutter Edges

Author(s): Hyoung-Nam Kim, Dowon Ko and Soon-Young Kwon (Pusan National University, South Korea)

Abstract: Maintaining a prescribed false-alarm probability is essential for reliable radar target detection. However, abrupt variations in clutter-plus-noise power at clutter edges can cause substantial false-alarm inflation. This paper proposes an entropy-based expectation-maximization constant false-alarm rate (EM-CFAR) detector for nonhomogeneous clutter environments. The proposed detector quantifies classification uncertainty using posterior entropy and incorporates this uncertainty into threshold determination through an entropy-weighted harmonic mean. Monte Carlo simulations were performed using a complex Gaussian clutter-plus-noise model under clutter-edge conditions with a prescribed false-alarm probability. When the cell under test(CUT) was located in a higher-power clutter-plus-noise region than a subset of the reference cells, the proposed detector reduces the excess false-alarm probability by approximately 23.9% relative to conventional EM-CFAR; equivalently, its false-alarm excess was approximately 76.1% of that of conventional EM-CFAR. The proposed detector also achieved detection performance comparable to that of conventional EM-CFAR over the considered SNR range. These results demonstrate that the proposed detector can mitigate false-alarm inflation at clutter edges without significantly degrading detection performance.

Time: 10:45-11:00

1571358614: What Repairs a Heliox Voice Link: Physical Severity, Insertion, and Label-Free Calibration

Author(s): Long Ji (Shanghai Institute of Commerce & Foreign Languages, China); Shibing Zhang (Nantong University, China)

Abstract: Voice links between saturation divers and the surface are safety-critical, yet the breathing gas distorts the signal: in a helium-oxygen (heliox) atmosphere the speed of sound rises, formants shift upward by αgas, and air-trained recognisers break down. On 2,584 operational utterances from 12 Mandarin speaking divers at 83-120 m, four public backbones fail zero-shot (character error rate, CER, 0.87-2.04): substitutions dominate for three, while the weakest inserts more characters than the reference contains (insertion rate 1.27, an edit-distance quantity rather than a semantic judgement). Severity is a physical ratio, αgas = cmix/cair, computable from the dive profile; published corpora span 1.82-2.59, so their CERs do not compare. We then give two procedures that need no target transcripts at inference. A training-free magnitude-axis warp at a corpus-tuned operating point cuts CER by 77% (0.9311 → 0.2165) and improves all 36 speaker × backbone cells at 0.0022× real time on the timed subset; the same parameter is recoverable without labels: cross-model agreement matched the labelled optimum, or came within 0.0004 CER of it, in all three settings tested, one of them held out (R2 = 0.987 against CER over the grid). A duration-anchored decoding budget removes 64% of inserted characters at the same group-averaged deletion rate, whereas a fixed budget tuned for CER deletes 24.0% of reference characters.

Time: 11:00-11:15

1571355547: Few-Shot UAV Individual Identification Method Based on RF Fingerprinting via Meta-Learning with Spectrum-Energy Adaptive Weighting

Author(s): Zijian Wang, Chunlai Ma, Hongjun Wang, Xinhao Li, Ruhao Jiang and Yewei Gu (National University of Defense Technology, China)

Abstract: The widespread application of unmanned aerial vehicles (UAVs) brings threats to low-altitude security management, and individual identification of UAVs is an urgent issue that needs to be addressed. Radio frequency fingerprint identification (RFFI) based on meta-learning approaches has great potential to address this problem. However, most existing approaches still suffer from limited identification accuracy. In this paper, we propose a meta-learning based framework for few-shot UAV individual identification. Specifically, we employ the Model-Agnostic Meta-Learning (MAML) algorithm with a ResNet-18 backbone to enable rapid adaptation to new UAV individuals with only a few labeled samples. Furthermore, we introduce a Spectrum-Energy Adaptive Weighting (SEAW) strategy to preprocess time-frequency spectrograms, which dynamically suppresses noise-dominated regions and enhances discriminative signal components, thereby improving identification robustness in complex electromagnetic environments. Extensive experiments on the DroneRFb-DIR dataset demonstrate that our method achieves 91.56% accuracy on the 5-way 5-shot task, outperforming MAML and prototypical network baselines by 5.64 and 4.93 percentage points respectively. The results validate that SEAW offers an effective and data-efficient solution for UAV individual identification.

Time: 11:15-11:30

1571316791: Delayed Dual-Threshold V2C Message Post-Processing for QAM LDPC Decoding

Author(s): Eunhae Lee and Byungin Moon (Kyungpook National University, South Korea)

Abstract: This paper proposes delayed dual-threshold-based variable-to-check (V2C) message

post-processing to improve the decoding performance and convergence of low-density parity check (LDPC) decoders in 4096-QAM systems. Conventional self-corrected min-sum (SCMS) erases sign-flipped messages, while dual-threshold SCMS (DT-SCMS) selectively applies erasure using two thresholds. However, both may suppress sign flips during normal early-iteration convergence, causing the loss of useful reliability information. The proposed method maintains normalized min-sum (NMS) decoding during initial iterations and, starting from a predefined activation iteration, classifies sign-flipped V2C messages into three regions using two thresholds for selective damping or erasure. The method was evaluated using an IEEE 802.11 LDPC code (1,944 bits, rate 1/2) with 4096-QAM over an additional white Gaussian noise (AWGN) channel, using 5,000 frames (9,720,000 bits) per Eb/N0 point and 7-bit Q5.2 fixed-point quantization. At 15.5 dB, BER and FER decreased by 43.31% and 50% in floating-point simulations, and by 33.91% and 37.5% in fixed-point simulations, respectively, compared with DT-SCMS. Furthermore, the selected fixed-point parameters enable shift-and-add post-processing without dedicated DSP multipliers.

Time: 11:30-11:45

1571355591: An FSQ-Based Low-Bitrate Neural Vocoder for Chinese Speech

Author(s): Zonghe Yu (Beijing University of Aeronautics and Astronautics, China)

Abstract: Recent advances in generative neural networks have made it possible to reconstruct high-fidelity speech at very low bitrates. However, most existing neural speech coding methods are developed and evaluated primarily for English speech, and many of them rely on high-complexity architectures or offline inference with substantial latency, which limits their applicability to real-time communication. To address these limitations, this paper proposes a low-bitrate neural vocoder for Chinese speech based on a causal streaming architecture. ConvNeXt blocks are adopted in place of conventional ResNet modules to reduce model complexity and computational overhead. Although multi-layer residual vector quantization (RVQ) can provide high perceptual quality for Chinese speech transmission at 2 kbps, reconstruction in the low-to-mid frequency bands (2 kHz) remains degraded under restricted codebook capacity. We therefore introduce a joint feature quantization strategy that combines finite scalar quantization (FSQ) with RVQ. Experimental results show that, under the same bitrate conditions, the proposed architecture improves the reconstruction of low-to-mid frequency information and achieves better perceptual speech quality.

Time: 11:45-12:00

1571350038: Performance Analysis of U-Net-Based Drone Detection With Varying Numbers of Input Range-Doppler Maps in Passive Radar

Author(s): Hyoung-Nam Kim, Hui Jae Jo and Min-Wook Jeon (Pusan National University, South Korea)

Abstract: Digital television (DTV)-based passive radar enables drone detection without a dedicated transmitter. However, residual clutter and propeller micro-Doppler signatures can make reliable drone detection challenging. This paper investigates the effect of the number of consecutive input range-Doppler (RD) maps on U-Net-based drone detection. Multiple consecutive RD maps are concatenated along the channel dimension, and each RD cell is classified as background, drone body, or propeller. The number of input RD maps is varied from one to five while maintaining identical training and evaluation conditions. Simulations using synthetic drone sequences generated by injecting simulated drone echoes into measured target-free DTV passive-radar data show that using multiple consecutive RD maps improves the detection probability and F1 score while reducing false-alarm probability compared with using a single RD map. The largest performance gains are obtained when the number of input maps increases from one to two or three, whereas the additional improvement becomes limited beyond three maps. These results demonstrate that incorporating short-term inter-frame is effective for U-Net-based drone detection in DTV-based passive radar.

TECHNICAL SESSIONS

Technical Session 2: Wireless Communications-I

10:15-12:00 Nov. 12, 2026 | 2F Meeting Room 2

Session Chair: Hairong Jia, Taiyuan University of Technology, China

Time: 10:15-10:30

1571332089: Task-Aware Semantic UEP over RSMA for Multi-User Generative Semantic Communication

Author(s): Hyun-Woong Choo and Dong In Kim (Sungkyunkwan University, South Korea)

Abstract: Generative semantic communication reduces transmission overhead by conveying compact semantic representations for receiver-side reconstruction. In multi-user systems, however, users may perform different tasks, such that only a subset of the scene information is relevant to each user. Existing rate-splitting multiple access (RSMA)-based semantic transmission separates common and user-specific messages but does not differentiate the protection levels of semantic sub-packets within each private payload. To address this limitation, this paper proposes a task-aware semantic unequal error protection (UEP) framework for multi-user generative semantic communication over an RSMA downlink. Shared scene information is transmitted through the common stream, while user-specific information is divided into critical and auxiliary sub-packets and delivered through private streams using different repetition factors. Simulation results show that the proposed design achieves equivalent task-delivery performance while using between 0.43% and 4.32% fewer coded bits than split-uniform protection and between 9.81% and 20.16% fewer coded bits than plain RSMA. The results further show that residual successive interference cancellation degrades task-delivery reliability, and that interleaving the repeated private symbols recovers 14.4 to 21.6 percentage points of this loss.

Time: 10:30-10:45

1571346570: Target-Measurement-Free Cross-Frequency Path-Loss Prediction Using Uncalibrated Ray-Tracing Priors in Mine Tunnels

Author(s): Yifan Zheng, Shengqiang Shen and Shiyin Li (China University of Mining and Technology, China)

Abstract: Accurate multi-band path-loss prediction is essential for underground wireless-network planning, yet repeated measurement campaigns at every candidate band are costly and disruptive. Empirical and measurement-only neural models generally transfer poorly across frequency, whereas high-fidelity ray tracing (RT) shifts the burden to detailed scene construction and material calibration. This paper uses uncalibrated RT as a structured spatial-frequency prior rather than synthetic ground truth. A two-stage deep network first pretrains on multi-band RT data at 650, 1450, and 2350 MHz, then aligns the real-world power scale using 1450 MHz measurements as the sole source band. Target-measurement-free prediction means that no measured target-band samples are used during training, although uncalibrated RT priors at the target frequencies are included in pretraining. On measurements from a production mine tunnel, the RT-prior model achieves RMSE of 3.88 and 5.20 dB at 650 and 2350 MHz, outperforming classical free-space, no-prior, and weak-prior neural baselines without measurement-based material calibration.

Time: 10:45-11:00

1571331416: A Receiver-Agnostic RFFI Scheme Based on Model-Agnostic Meta-Learning

Author(s): Kening Zhang (Xi'an Jiaotong University, China); Lingxiao Jiao and Yueyue Zhang (Shanghai Satellite Network Research Institute Co., Ltd., China); Zhenzhen Gao (Xi'an Jiaotong University, China); Zhihua Tang and Fang Zhang (Shanghai Satellite Network Research Institute Co., Ltd., China)

Abstract: Deep learning-based Radio Frequency Fingerprint Identification (RFFI) suffers from performance degradation when deployed on unseen receivers due to hardware variations, a challenge that is particularly acute in satellite communication scenarios, where receiver labels are limited or unavailable, and heterogeneous satellite receivers exacerbate cross-receiver generalization issues. For this cross-receiver challenge, a receiver-agnostic scheme based on meta-learning is proposed. By constructing independent sub-tasks for different receivers, the proposed model learns domain-agnostic parameters that are invariant to receiver hardware variations. Group Normalization is used to remove source-domain dependency. A gradient mask is proposed to explicitly capture transmitter-specific traits while suppressing receiver-induced interference. Experiments on the WiSig dataset and a simulation dataset for satellite communications show that the average accuracy achieves an improvement of 5.21% and 2.96%, respectively, compared to recent studies. The proposed scheme maintains robust performance even without source receiver labels, and its low complexity makes it well-suited for resource-constrained edge devices and satellites.

Time: 11:00-11:15

1571348844: DQN-based directional MAC protocol for predicting mobile obstacles in THz environments

Author(s): Junyoung Park and Woongsoo Na (Kongju National University, South Korea)

Abstract: The rapid growth of the Internet of Things (IoT) has enabled intelligent services such as smart homes, smart factories, and smart buildings. Emerging applications, including real-time video processing, Extended Reality (XR), and digital twins, require high data rates and low communication latency. Terahertz (THz) communications are considered a promising solution due to their extremely wide available bandwidth. However, THz signals suffer from severe path loss and are highly vulnerable to blockage. In dynamic indoor environments, moving people or objects can obstruct propagation paths, causing line-of-sight (LoS) links to transition to non-line-of-sight (NLoS) conditions. Such blockage can result in packet loss, retransmissions, increased delay, and communication disruptions.

Various techniques, including directional beam management, relay selection, multi-hop communication, resource allocation, and reinforcement learning (RL), have been investigated to improve THz communication reliability. Relay-based communication can provide alternative paths when direct links are blocked, while RL can adapt communication decisions according to observed network conditions. However, most existing approaches primarily rely on current network states and react only after link degradation or blockage occurs. Therefore, they cannot effectively anticipate future blockage caused by obstacle movement.

In this study, we propose a prediction-based RL MAC framework for proactive blockage mitigation in indoor THz IoT environments. The framework models obstacle movement using a Markov chain, where transitions between neighboring locations are represented by state transition probabilities. Based on the current obstacle location and transition probabilities, the likely obstacle location at the next time step is estimated, enabling potential link blockage to be identified in advance.

The predicted obstacle information is incorporated into the RL state space together with the LoS/NLoS conditions of candidate links. The RL agent then selects an appropriate relay by considering both

current link quality and predicted environmental changes. Even when a candidate link currently maintains LoS connectivity, the agent can avoid that relay if an obstacle is likely to intersect the propagation path. Similarly, links that are currently NLoS or have a high predicted blockage probability can be excluded in favor of more reliable alternatives.

Unlike conventional reactive approaches, the proposed framework integrates Markov chain-based obstacle movement prediction with RL-based relay selection to establish alternative paths before actual blockage occurs. This proactive mechanism aims to maintain reliable THz connectivity while reducing packet loss, retransmissions, transmission delay, and communication disruptions in dynamic indoor IoT environments.

Time: 11:15-11:30

1571356740: Codebook-Based CSI Acquisition for Precoded CSI-RS in 6G

Author(s): Xiang Li, Fan Wang, Xiaolin Hou and Lan Chen (DOCOMO Beijing Communications Laboratories Co., Ltd., China)

Abstract: This paper investigates codebook-based channel state information (CSI) acquisition for precoded CSI-reference signals (CSI-RS) to address the coverage gap in higher frequency bands, e.g., 7 GHz. Although precoded CSI-RS enhances reference signal coverage, conventional deployments are hindered by mandatory reliance on complex port selection (PS) codebooks. To overcome these challenges, we propose explicitly signaling 2D-DFT-based CSI-RS precoder information derived from long-term spatial covariance matrices directly to the UE. This explicit indication enables the UE to perform low-complexity channel recovery and utilize widely deployed Type-I-like codebooks for channel reporting, effectively decoupling channel measurement from codebook reporting. Both link-level and system-level evaluations demonstrate that the proposed scheme maintains robust channel estimation accuracy while drastically reducing terminal complexity. Under reduced-port configurations, the proposed framework achieves throughput gains of up to 11% and 20% for cell-edge users using low-resolution (Type-I) and high-resolution (eType-II) codebooks, respectively, confirming its viability for 6G network deployments.

Time: 11:30-11:45

1571332857: Structured Context-Action Learning for Online Waveform Adaptation in Automotive Radar

Author(s): Yuchen Wang and Xiaoyan Wang (Ibaraki University, Japan); Biao Han (National University of Defense Technology, China); Hao Zhou (University of Science and Technology of China, China)

Abstract: Mutual interference in the shared 76-81 GHz band degrades automotive frequency-modulated continuous-wave (FMCW) radar in different ways. Non-coherent interference raises the noise floor in the frequency domain and can be mitigated by adapting the center frequency when an interference-free sub-band is available, whereas coherent interference produces ghost targets that can be suppressed through slow-time phase coding. Since the interference environment changes dynamically due to vehicle mobility and uncoordinated radar transmissions, the radar must adapt its waveform online. To address this challenge, we propose a Joint-Interaction Linear Upper Confidence Bound (JI-LinUCB) algorithm for online radar waveform adaptation. The proposed method jointly exploits the relationships between frequency-domain observations and carrier-frequency selection, as well as between phase-coherence observations and phase-code selection, enabling information sharing among related waveform candidates while preserving context-dependent decision making. Extensive simulation results demonstrate that the proposed JI-LinUCB significantly outperforms state-of-the-art methods by achieving lower cumulative regret, a lower interference-induced noise floor, and a higher peak-to-ghost ratio.

Time: 11:45-12:00

1571356476: A Neural Network Optimization Algorithm with Encoder-Decoder Framework for Array Pattern Synthesis

Author(s): Mengfei Zhang, Zihong Wan, Wentao Li and Yongqiang Hei (Xidian University, China)

Abstract: To address the issue that the optimization speed of antenna arrays drops sharply with the increase in the number of array elements, this paper proposes an array optimization algorithm based on an encoder-decoder structure, inspired by the powerful search capability of neural networks. In this algorithm, the encoder optimizes the excitation, while the decoder calculates the radiation pattern from the excitation. When the output results satisfy the target pattern, the encoder stops optimizing the excitation. To enable the same decoder to handle arrays with different number of elements, virtual array elements are introduced into the decoder's dataset and randomly set to zero. Simulation results demonstrate that the algorithm can obtain an appropriate decoder structure, and when using the same decoder to optimize arrays with different number of elements and spacings, it maintains good optimization results with extremely fast convergence speed.

TECHNICAL SESSIONS

Technical Session 3: Networking

10:15-12:00 Nov. 12, 2026 | 2F Meeting Room 3

Session Chair: Ying Zhang, Xi'an University of Technology

Time: 10:15-10:30

1571332687: Region-Aware UAV Trajectory and Backhaul Power Allocation for Mixed FSO/RF Satellite-UAV-Ground Networks

Author(s): Dung Tran (University of Transport Technology, Vietnam); Huy Q. Nguyen (Posts and Telecommunications Institute of Technology, Vietnam); Bach Q. Tran (University of Economics Technology for Industries, Vietnam); Thang Nguyen, Hien Pham and Ngoc Dang (Posts and Telecommunications Institute of Technology, Vietnam)

Abstract: This paper investigates a GEO satellite-multi-UAV-ground network that employs free-space optical (FSO) links for satellite-to-UAV backhaul and radio-frequency (RF) links for user access in heterogeneous urban, rural, and maritime regions. A two-stage framework is proposed: each UAV uses proximal policy optimization (PPO) to learn a region-specific trajectory that maximizes the user satisfaction ratio, after which a QoS-aware weighted max-min scheme allocates the satellite optical power according to FSO channel conditions and regional priorities. The simulation results show that PPO achieves more stable convergence than DQN and maintains approximately 80-85% satisfied users, while the proposed power allocation improves the minimum satellite-UAV SNR by 3-4 dB and reduces outage probability compared with equal power allocation.

Time: 10:30-10:45

1571356216: User-Satisfaction-Aware Resource Orchestration in OIRS-Aided Multi-HAP FSO/Sub-THz Networks

Author(s): Khanh D. Dang and Hoang Le (The University of Aizu, Japan); Chuyen T. Nguyen (Hanoi University of Science and Technology, Vietnam); Anh T. Pham (The University of Aizu, Japan)

Abstract: This paper addresses user-satisfaction-aware resource allocation in optical intelligent reflecting surface (OIRS)-aided air-ground integrated networks (AGINs). The AGIN incorporates free-space optical (FSO)-based multiple high-altitude platforms (HAPs) for backhaul and sub-THz-based unmanned aerial vehicles (UAVs) for last-mile access. To enhance end-user satisfaction, we formulate a weighted satisfaction maximization problem that jointly allocates both FSO backhaul and sub-THz access resources, including the OIRS blocks, UAV transmitted power, and sub-THz bandwidth. Moreover, historical user satisfaction is considered to prioritize persistently underserved users and promote long-term service fairness. To solve this joint optimization problem, we develop a hierarchical framework that decomposes it into per-UAV resource allocation and HAP-level OIRS block allocation. Numerical results demonstrate that the proposed scheme achieves higher average user satisfaction than benchmark schemes, while the history-aware prioritization mechanism significantly improves the satisfaction of persistently underserved users. Furthermore, evaluations using real-world cloud data are provided to demonstrate the practical applicability of the proposed framework under realistic cloud conditions.

Time: 10:45-11:00

1571356596: Adaptive Multi-View Fusion Based on Normal-Anomalous Mean Score Separation for Federated Graph Anomaly Detection

Author(s): Yutaka Hatazawa and Takuji Tachibana (University of Fukui, Japan)

Abstract: This paper focuses on the integration of multi-view anomaly scores in MV-FGAD, a federated graph anomaly detection method, and proposes an adaptive score fusion method that determines the weights of Attribute-aware Anomaly Learning, Structure-aware Anomaly Learning, and Weak Anomaly-aware Dynamic Learning for each client based on the separation between the mean anomaly scores of normal and anomalous nodes. Experiments on five graph datasets show that the proposed method achieves higher AUROC than the original MV-FGAD on four datasets: Reddit, Amazon, Amazon-all, and YelpChi. Furthermore, an analysis of the view weights confirms that different weights are assigned across datasets and clients. These experimental results indicate the potential effectiveness of adaptive score fusion that considers client-specific view characteristics.

Time: 11:00-11:15

1571308729: Intelligent Resource Management with Integration of LEO Satellites and RAN for Maritime Scenarios

Author(s): Longyu Zhou (United Arab Emirates University, United Arab Emirates); Shengyu Zhang (Xidian University, China); Yundi Deng and Supeng Leng (University of Electronic Science and Technology of China, China); Chao Wang (Xidian University, China); Tony Quek (Singapore University of Technology and Design, Singapore)

Abstract: The Maritime Internet of Things (IoT) has emerged as an attractive paradigm for addressing complex maritime scenarios, including maritime transportation. Nonetheless, it is difficult to implement real-time cargo transportation due to the limited sensing and communication resources in steamships and the complexity of maritime environments. To address the problem, we propose LEO-RAN, an intelligent framework that integrates Radio Access Network (RAN) with Low Earth Orbit (LEO) satellites. To support the framework, we first propose a Lightweight Meta-Learning-based Environment Sensing (LML-ES) algorithm, deployed in the non-RealTime RAN Intelligent Controller (non-RT RIC), to collaborate sensing resources of LEO satellites and steamships for accurate maritime observation and safe transportation. Based on the sensing results, we then propose a Particle Swarm Optimization-based multi-Trajectory Planning (PSO-TP) algorithm, deployed in the near-RT RIC, to jointly adjust positions and velocities of steamships for low-latency cargo transportation. The system simulation results demonstrate that our solution improves sensing accuracy by 20% while reducing system latency by 17% on average compared to state-of-the-art benchmarks.

Time: 11:15-11:30

1571315552: Spatially-Partitioned and Event-Triggered IABCO-Based Clustering Method for FANETs

Author(s): Toki Yamamoto and Naomi Kuze (Wakayama University, Japan)

Abstract: Clustering for Flying Ad Hoc Networks (FANETs) has been addressed using swarm intelligence (SI)-based optimization, such as Improved Artificial Bee Colony Optimization (IABCO), but existing studies overlook the computation delay of this optimization, during which UAVs continue to move and the network topology changes. We propose a spatially-partitioned and event-triggered IABCO-based clustering method in which the field is divided into several partitions, and IABCO is applied independently within each partition, which reduces overall computation delay. Through simulation

experiments, the proposed method sustains a PDR of 84.1% with 80 UAVs, versus 39.8% for the original IABCO.

Time: 11:30-11:45

1571332923: System-Level Performance Evaluation of Frequency Reuse Schemes in Multi-UAV Wireless Networks

Author(s): Kosuke Asai and Fumiaki Maehara (Waseda University, Japan)

Abstract: This paper investigates the impact of frequency reuse schemes on outage probability, system throughput, and fairness in multi-UAV wireless networks. Users are clustered by the k-means++ algorithm, and each UAV is deployed at the centroid of the corresponding cluster. Three frequency reuse schemes are compared: the 1-cell reuse scheme, the 3-cell reuse scheme, and soft frequency reuse (SFR). In addition, both AWGN and Rician fading environments are considered to evaluate the effects of UAV altitude and the number of UAV base stations under more realistic propagation conditions. The results show that the impact of Rician fading is limited and that the qualitative trends are largely consistent with those under the AWGN environment. Furthermore, while the 1-cell reuse scheme is advantageous at low altitudes, SFR improves the average throughput under high-altitude conditions when the user distribution is relatively concentrated. On the other hand, SFR may slightly degrade fairness, indicating a trade-off between throughput and fairness.

Time: 11:45-12:00

1571356696: Failure Detection and Notification by Cooperative Watchdog in Wireless Multihop Networks

Author(s): Hiroaki Higaki and Yuto Isomura (Tokyo Denki University, Japan)

Abstract: For failure resilient wireless multihop networks, failure detection and notification of an intermediate wireless node are critical. Until now, a watchdog method and its variations have been proposed to detect and notify miss-forwarding of data messages by an intermediate wireless node. However, a failed wireless node behaves unusually not only in data message forwarding but also in failure notification. That is, unexpected failure notification control messages may be transmitted by a failed wireless node. In order to solve this problem, this paper proposes a novel cooperative watchdog method. Here, each intermediate wireless node and its observation node cooperatively observe its next-hop intermediate wireless node and observe each other for detection of a mistakenly transmitted failure notification control message. A proposed method for detection of incorrect data message transmissions and failure notification control message transmissions contributes to realize failure resilient wireless multihop networks.

TECHNICAL SESSIONS

Technical Session 4: Signal Processing for Communications-II

13:30-15:30 Nov. 12, 2026 | 2F Meeting Room 1

Session Chair: Yanhong Xu, Xi'an University of Science and Technology, China

Time: 13:30-13:45

1571354668: ES-Trained Adaptive-Gain Control for Distributed Clock Synchronization

Author(s): Xiaorui Zhang, Yi Tao, Zihan Ni, Xuyang Zhang, Zizheng Hua, Rui Zhang, Gaofeng Pan and Shuai Wang (Beijing Institute of Technology, China)

Abstract: Distributed clock synchronization is required in time-coordinated wireless networks, but fixed-gain methods often lose accuracy when network and measurement conditions change. This paper proposes an Evolution Strategies (ES)-trained adaptive-gain framework, where each node uses a shared lightweight neural policy to adjust frequency and offset correction gains from local residuals and previous actions. The policy is trained offline with network-level synchronization error and is deployed online using only neighbor timestamp/frequency observations and piggybacked compensation states. Across 40 independently trained and validation-selected policies, all 800 test runs converge, with an average steady-state RMSE of 0.241 μs and an average convergence round of 15.58. After being frozen for deployment, the learned controller outperforms classical baselines and a REINFORCE-trained MLP in most tested network, noise, packet-loss, and inactive-node scenarios.

Time: 13:45-14:00

1571322849: Diffusion-Based Wrapped Interferogram Denoising for Improved SNAPHU Phase Unwrapping

Author(s): Jeungwoo Ham and Haewoon Nam (Hanyang University, South Korea); Jaerock Kwon (University of Michigan - Dearborn, USA)

Abstract: Phase unwrapping is a fundamental step in interferometric synthetic aperture radar (InSAR) processing, but its accuracy strongly depends on the quality of the input wrapped interferogram. This paper investigates a diffusion-based wrapped interferogram denoising front-end for improving the Statistical-Cost Network-Flow Algorithm for Phase Unwrapping (SNAPHU). Rather than replacing SNAPHU with a learning-based phase unwrapping network, a conditional denoising diffusion probabilistic model (DDPM) is trained to restore terrain-noise-corrupted wrapped phase images. The denoised interferogram is then passed to SNAPHU using the same configuration as the raw noisy input. Experiments on simulated 256 × 256 single-channel wrapped phase data show that the proposed preprocessing reduces the mean SNAPHU RMSE from 3.0333 rad to 1.9003 rad on 10,000 test samples, corresponding to a 37.35% reduction in the dataset-level mean RMSE. In addition, the proposed method achieves lower RMSE in 89.82% of the evaluated cases, with an average per-sample RMSE reduction of 48.52%. These results demonstrate that diffusion-based wrapped phase denoising can serve as an effective preprocessing module for robust SNAPHU-based InSAR phase unwrapping.

Time: 14:00-14:15

1571347719: Signal Subspace Learning for Wireless Local Map Inference with Change Detection

Author(s): Shutaro Kohaba and Takahiro Matsuda (Tokyo Metropolitan University, Japan); Yoshiaki Nishikawa, Eiji Takahashi, Takeo Onishi, Toshiki Takeuchi and Kazushi Muraoka (NEC Corporation, Japan)

Abstract: This paper proposes a wireless local map inference method with signal subspace change detection for safe driving assistance. Repeated landmark estimation for local map construction incurs high computational cost. To avoid unnecessary re-estimation, estimated signal subspaces, which compactly represent the propagation environment, are compared to detect environmental changes. However, observation noise can produce different estimated signal subspaces even in the same environment. We therefore propose a dual-branch convolutional neural network (CNN) that jointly estimates a noise-robust signal subspace and the number of propagation paths. The proposed method substantially improves signal subspace estimation performance and efficiently updates the wireless local map by re-estimating landmarks only at detected change points.

Time: 14:15-14:30

1571356241: Unsupervised Wireless Protocol Analysis using Sub-Nyquist Sampling

Author(s): Kento Sugiyama and Jin Mitsugi (Keio University, Japan)

Abstract: This paper proposes an unsupervised wireless protocol analysis framework using sub-Nyquist sampling. This work is motivated by the growing demand for low-complexity, passive wireless sniffers to monitor the wireless protocol interaction between an access point and wireless terminals in scenarios where full reconstruction of the signal is unnecessary. The proposal performs joint time-frequency clustering of wireless commands after extracting signal segments from a series of sub-Nyquist sampled data, through the Fractional Fourier Transform (FRFT). Evaluated on 1,000 measured backscatter communication signals across four commands, the proposed framework outperforms the naive MSM and naive Wasserstein single-domain baselines, maintaining near-perfect accuracy even with the sampling rate 2.5 times below the Nyquist rate.

Time: 14:30-14:45

1571349312: Measurement-Driven Site-Specific Channel Emulation: A Closed-Loop Validation Framework

Author(s): Shaobo Gu and Weihao Zhang (Southeast University, China); Lijian Xin (Purple Mountain Laboratories, China); Jie Huang and Cheng-Xiang Wang (Southeast University, China & Purple Mountain Laboratories, China)

Abstract: Conventional channel emulators are commonly configured based on standardized channel models for testing. However, such models may fail to capture site-specific channel characteristics in emerging frequency bands and complex communication environments. This paper proposes a measurement-driven channel emulation framework that derives emulator configurations from measured channel data without relying on predefined channel models. Specifically, a measurement campaign is performed at 7 GHz in a suburban environment, from which channel impulse responses (CIRs) are obtained. Dominant multipath components (MPCs) are identified from the CIRs and mapped to the tap configurations of a tapped-delay-line (TDL) hardware channel emulator. The emulator-generated channels are captured using the same measurement setup and compared with the original measurements for validation. Experimental results show that the emulation framework reconstructs the dominant structures of the measured delay power spectral densities (PSDs) while preserving their temporal and spatial dispersion characteristics, thereby supporting repeatable and site-specific channel testing in the laboratory.

Time: 14:45-15:00

1571362941: Fourier Transform Based Modulation and Demodulation of Long Pulse Radar Waveforms

Author(s): Yunpeng Ma and Shaoming Wei (Beihang University, China)

Abstract: Long pulse radar waveforms have been widely employed in modern radar systems to achieve high energy transmission while maintaining excellent range resolution. However, the inherent coupling between pulse duration and range resolution imposes significant constraints on traditional radar design. This paper presents an investigation of long pulse radar waveform modulation and demodulation techniques grounded in Fourier transform theory, with particular emphasis on linear frequency modulation (LFM) and nonlinear frequency modulation (NLFM). The theoretical foundation of Fourier transform based processing demonstrates how frequency domain analysis enables the separation of range information from long duration pulses. The demodulation strategy incorporates both time-domain and frequency-domain processing chains, enabling robust extraction of target parameters from received echoes. The results demonstrate that Fourier transform based processing achieves near theoretical compression ratios while maintaining excellent sidelobe suppression performance.

Time: 15:00-15:15

1571315088: Uplink Low PAPR Multi-layer DFT-s-OFDM Transmission for 6G

Author(s): Juan Liu, Xiaolin Hou, Wenjia Liu, Xu Zhang and Lan Chen (DOCOMO Beijing Communications Laboratories Co., Ltd., China)

Abstract: Fifth-generation (5G) New Radio (NR) takes multi-carrier waveform orthogonal frequency division multiplexing with cyclic prefix (CP-OFDM) with high spectral efficiency (SE) as the core waveform, and only supports single-layer single-carrier waveform discrete Fourier transform spreading OFDM (DFT-s-OFDM) with high power efficiency (PE) when uplink coverage is limited. For sixth-generation (6G), uplink coverage enhancement is one of the most important research directions in study item (SI). To improve uplink coverage across all spectral efficiency ranges, multi-layer DFT-s-OFDM is under study for 6G uplink. However, the main challenge of multi-layer DFT-s-OFDM is the superposition of multi-layer signals, which significantly increases the peak-to-average power ratio (PAPR). In this paper, we propose a low-PAPR multi-layer DFT-s-OFDM transmission scheme. The core idea is to introduce time-domain layer-based delay shifts to reduce the time-domain overlap and superposition of multi-layer signals, thereby reducing PAPR. Two implementation methods are developed and validated: time-domain upsampling combined with layer-based cyclic shifts (CSs), and frequency-domain subcarrier-based phase rotations. Simulation results show that, compared to traditional multi-layer DFT-s-OFDM, the proposed scheme achieves PAPR gains of 1.4 dB and 1.2 dB for the 2-layer and 4-layer cases, respectively, without any signal-to-noise ratio (SNR) loss. Furthermore, throughput gains of 30% and 60% are obtained for the corresponding cases.

Time: 15:15-15:30

1571316085: REST-CPNC: Hybrid MAP-Neural XOR Demapping for Full-Duplex Physical-Layer Network Coding

Author(s): Jianwen Sun, Yuto Lim (Japan Advanced Institute of Science and Technology, Japan)

Abstract: Full-duplex physical-layer network coding (FD-PNC) can compress two-way relay exchange, but an OFDM relay must detect a desired two-user superposition while its own queued downlink waveform leaks back as packet-correlated residual self-interference (RSI). This paper formulates the

relay receiver as RSI-conditioned XOR posterior estimation: the target is the XOR posterior of the two coded packets conditioned on the received grid, pilot information, and relay reference, not separate recovery of both packets. We propose REST-CPNC, an RSI-aware neural MAP-XOR demapper with LDPC-compatible soft network-coded output. A finite-alphabet likelihood supplies calibrated MAP-XOR logits conditioned on the delayed relay reference and estimated RSI state, and a compact neural residual branch corrects mismatch from imperfect cancellation, channel-estimation error, and finite-grid effects. In a practical OFDM/QPSK/LDPC resource-grid simulator, REST-CPNC improves XOR demapping reliability, LDPC decoding stability, and payload-normalized exchange throughput over strong model-based and neural baselines. Robustness tests further show improved resilience to RSI-estimation error, near-far imbalance, and unseen RSI profiles, demonstrating the value of conditioning the neural demapper on relay-side RSI information.

TECHNICAL SESSIONS

Technical Session 5: Wireless Communications-II

13:30-15:30 Nov. 12, 2026 | 2F Meeting Room 2

Session Chair: Tongxing Zheng, Xi'an Jiaotong University, China

Time: 13:30-13:45

1571311572: Dual Cross-Attention Transformer for Space-Time-Frequency Channel Prediction

Author(s): Zhixiang Li, Zhixuan Li, Xuefei Zhang, Yanzhao Hou and Xiaofeng Tao (Beijing University of Posts and Telecommunications, China)

Abstract: Accurate channel prediction is essential for mitigating channel aging and reducing feedback overhead in massive multiple-input multiple-output (MIMO) systems. However, existing methods typically decouple space and frequency dimensions and focus on pure data-driven fitting, thereby losing critical joint space-time-frequency (STF) dependencies and neglecting intrinsic physical characteristics in the angle-delay domain, resulting in poor robustness against noise. Motivated by these limitations, we propose a dual cross-attention Transformer for channel prediction in the STF domain. The proposed model first employs three-dimensional (3D) convolutions to directly capture coupled STF correlations, and utilizes a Transformer architecture to achieve parallel prediction. Subsequently, a dual cross-attention module is designed to bidirectionally fuse high-dimensional features from the original STF domain and sparse features from the angle-delay domain, thereby enhancing noise robustness. Finally, a patch-wise reconstruction module is employed to restore the abstract token sequences back into physically meaningful predicted CSI. Extensive experiments demonstrate that the proposed method achieves an average NMSE reduction of 47.9% over all baselines, exhibiting superior noise robustness and strong generalizability. Furthermore, comprehensive simulations confirm its practical communication efficacy, while ablation experiments validate the effectiveness of each proposed module and illustrate the trade-off between prediction performance and computational cost.

Time: 13:45-14:00

1571356694: Reliable and Low-Power LoRa Communication Using Multiple Receivers with a common MAC address

Author(s): Mitsuho Ishikawa and Jin Mitsugi (Keio University, Japan)

Abstract: Tracking small animals with LoRa requires low-power terminals without compromising communication reliability. This paper proposes assigning a 16-bit common Media Access Control (MAC) address to multiple fixed receivers and having a terminal specify that MAC address as the destination, so that a single transmission can be received by multiple receivers while still enabling ACK-based delivery confirmation and retransmission control. An analytical model of the expected number of transmissions is derived and confirmed by Monte Carlo simulation, and the method is evaluated through a field communication experiment, an ACK interference experiment, and energy consumption measurements using a commercial LoRa module. The simulation reveals that the proposal can make its total expected energy consumption lower than broadcast's when the required success probability is high. The field experiment demonstrated that the proposed method achieves a higher reception success rate than broadcast (80.6% vs. 61.9% at one site).

Time: 14:00-14:15

1571305775: Spatial Multiplexing Over Filter-and-Forward Cooperative Relaying

Author(s): Satoshi Denno and Yafei Hou (Okayama University, Japan)

Abstract: This paper proposes new filter-and-forward cooperative relaying for spatial multiplexing for improving frequency utilization efficiency, i.e., transmission speed, because the proposed filter-and-forward relaying takes only 2 time slots to send the signal from the base station to the destination terminal in 2-hop relaying systems, despite of the number of the relays. The frequency domain filters are applied to the proposed filter-and-forward cooperative relaying to improve the transmission performance. The performance of the proposed filter-and-forward cooperative relaying is evaluated by computer simulation. The filter-and-forward cooperative relaying achieves a gain of about 12 dB at the BER of 1.0E-4 compared with that without the frequency domain filtering.

Time: 14:15-14:30

1571348915: Energy-Efficient 3D Deployment of Circularly Orbiting UAV Base Stations for Air-to-Ground Communications

Author(s): Ziyan Wang and Takahiro Matsuda (Tokyo Metropolitan University, Japan); Ryotaro Taniguchi and Wataru Yamada (NTT Corporation, Japan)

Abstract: Unmanned aerial vehicle base stations (UAV-BSs) can provide flexible air-to-ground (A2G) communication services in temporary and emergency scenarios. Circularly orbiting UAV-BSs are attractive because rotary-wing UAVs can reduce propulsion power by moving at an appropriate speed rather than hovering. However, circular orbit design has a tradeoff: a larger orbit radius can reduce propulsion power, whereas it may decrease the worst-case A2G communication quality and reduce the number of feasible orbits in urban environments. This paper proposes an energy-efficient 3D deployment framework for circularly orbiting UAV-BSs. Unlike the altitude-fixed circular orbit model, the proposed framework allows each UAV-BS to select one of two altitude layers and jointly optimizes the orbit center, orbit radius, and altitude. Two deployment schemes are considered: a genetic algorithm (GA)-based scheme that jointly optimizes the orbit center, radius, and altitude, and a two-stage scheme that further refines the GA solution using a potential game. The proposed framework is evaluated in terms of energy efficiency, total propulsion power, and average A2G communication capacity. Simulation results show that the proposed potential-game refinement improves the energy efficiency by approximately 19.3% compared with the GA-only scheme, while increasing the average A2G communication capacity and reducing the total propulsion power.

Time: 14:30-14:45

1571346525: Hardware-Aware Analytical Modeling of 2-Bit RIS-Assisted Wireless Links: A Closed-Form Efficiency Factor Approach

Author(s): Gunja Vijaya Raju, Venkata Mani Vakamulla (National Institute of Technology Warangal, India)

Abstract: Most RIS link models assume an ideal (loss-less) phase shifter, which is a hard to achieve practical solid-state component. This work begins with the very fundamental unit cell itself: a 2-bit design at 5.84 GHz, full-wave simulated, with complete phase coverage of 360◦, and reflection loss of less than 0.55 dB in all states. An amplitude loss and phase quantization are merged into a single efficiency factor, ηeff, and a system-level model is developed by using obtained S-parameters from the optimised unit cell, thus allowing a realistic prediction of the SNR without having to perform repeated full-wave simulations. The SNR gain of the surface over a blocked LOS link, the scaling of the array gain

with N2, and the constant 2.6 dB degradation at any of the tested power levels and distances, demonstrate that the surface is equivalent to a continuous-phase array in the idealized scenario. This gap is not constant; at 60◦ off-axis it rises to 7.0 dB which is believed to be a result of the electromagnetic response of the unit cell and not due to geometric foreshortening. Even in the case of the coarse 2-bit RIS hardware, it is seen that most of the gain of an ideal surface is retained, and the remaining open challenge is the design of wide-angle codebook for near-optimal, low complexity deployment.

Time: 14:45-15:00

1571332624: A Model-Agnostic Composite FSO Channel: Diversity Order, Aperture Averaging, and the Inadmissibility of Density-Fidelity Surrogates

Author(s): Dhairya Kansal and Sainath Bitragunta (Birla Institute of Technology and Science Pilani, India)

Abstract: Turbulence distributions for free-space optical (FSO) links are routinely validated by density-domain measures such as mean-squared error or Kolmogorov distance. We show these carry essentially no information about link reliability. A composite channel ($h=h_l h_a h_p$) with Kim attenuation, aperture-averaged turbulence and Farid – Hranilovic pointing errors is shown to reduce exactly to a single bounded kernel, so Gamma – Gamma, Málaga, AEKM and moment-matched (MM) lognormal statistics share one irradiance grid and one quadrature. Each small-signal exponent (d_a) gives the composite diversity order $\min(d_a,\xi^2)/2$, with da = min(α,β), min(1,α) and αμ respectively. At identical mean and scintillation index, Gamma-Gamma, α-η-κ-μ and their common MM surrogate then show diversity orders 3.67, 0.78, 12.5 and bit error rates spanning thirteen orders of magnitude at 40 dB, and on the same (α,β) grids the density MSE proves weakly anticorrelated with the surrogate's BER error ($r=-0.42,-0.62$). Under a diversity-order risk we show that lognormal surrogates are inadmissible in the decision-theoretic sense, dominated by an exponent-matched Gamma surrogate, however small their density-domain error.

Time: 15:00-15:15

1571313818: Low Probability of Target Detection in Wireless Sensing by Harnessing Reconfigurable-antenna based Reflectors

Author(s): Yifan Zhang (Aalto University, Finland); Zhentian Zhang (The Hong Kong Polytechnic University, Hong Kong, China); Riku Jäntti (Aalto University, Finland); Yichuan Wang (Xi'an University of Technology, China); Xingwang Li (Henan Polytechnic University, China); Tuo Wu (South China University of Technology, China)

Abstract: In this paper, we introduce low probability of target detection (LPTD) as a new security objective for wireless sensing systems, where the existence of a target is concealed from passive wardens. Unlike conventional communication security and covert communication, LPTD aims to protect the sensed target itself from malicious detection, rather than concealing transmitted signals or communication activities. Specifically, we propose a reconfigurable-antenna-based reflector-assisted target covertness scheme, where passive reflectors deployed around the target are harnessed as artificial scattering sources to confuse the warden. By adjusting their reflection coefficients, these reflectors reshape the local scattering environment and mask the target-induced echo. We then analyze the warden's optimal detection strategy and derive the false-alarm and missed-detection probabilities, followed by a closed-form expression for its minimum total detection error probability. Numerical results validate the analysis and show that sufficient cooperation among reflectors can increase the warden's minimum total detection error probability to approximately 0.94 – 0.96, making target

detection close to random guessing.

Time: 15:15-15:30

1571356648: LiGig: A Four-Stream LiFi System over COTS WiFi Using Shared-Oscillator Synchronization

Author(s): Yuheng Zhang and Bin Yuan (University of Chinese Academy of Sciences, China); Lu Lu (Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences & University of Chinese Academy of Sciences, China); Yongsheng Gong (Technology and Engineering Center for Space Utilization, China)

Abstract: This paper presents LiGig, a multi-gigabit 4×4 multiple-input multiple-output (MIMO) Light Fidelity (LiFi) prototype built over commercial WiFi 6E chipsets. Replicating optical frequency-conversion front-ends with independent local oscillators introduces path-dependent carrier-frequency offsets (CFOs), violating the common-CFO assumption of commercial receivers. LiGig shares one local oscillator among the four branches at each end and calibrates the remaining inter-end mismatch. The prototype reports an aggregate physical-layer (PHY) rate of 2882.4 Mbps with four spatial streams and 1.7 – 1.8 Gbps Transmission Control Protocol (TCP) throughput, demonstrating multi-gigabit optical MIMO feasibility and compatibility with the commercial WiFi hardware and software stack.

TECHNICAL SESSIONS

Technical Session 6: Emerging Technologies, Applications, and Services

13:30-15:15 Nov. 12, 2026 | 2F Meeting Room 3

Session Chair: Kai Liang, Xidian University, China

Time: 13:30-13:45

1571316795: Improving Road-Hazard Segmentation Quality via SAM-Guided Output Refinement

Author(s): Han-Gu Kim and Dong Seog Han (Kyungpook National University, South Korea)

Abstract: In intelligent transportation systems, road-hazard outputs are often used as binary masks or connected components rather than continuous anomaly-score maps. However, even when open-world anomaly segmentation models rank anomalous pixels well, their fixed-threshold masks can still contain fragmented false positives and noisy connected components. This paper presents a SAM-guided output refinement method, implemented as structure-guided disagreement suppression (SGDS), for improving fixed-threshold road-hazard segmentation quality.

Mask2Anomaly remains the only source of anomaly scores, while MobileSAM, a lightweight SAM variant, is used only to generate class-agnostic structural references. SGDS measures how well Mask2Anomaly-derived mask regions overlap with MobileSAM object-like masks and attenuates weakly supported regions to suppress fragmented false positives. We further explore evidence protected SGDS (eSGDS), which reduces suppression in regions with strong raw Mask2Anomaly scores. On a 200-image road anomaly subset with pixel-level annotations, SGDS improves fixed-threshold mIoU from 0.3544 to 0.4080, a 15.1% relative gain over the frozen baseline. It also improves precision from 0.3692 to 0.4368, while reducing false-positive pixels by 22.6% and predicted connected components by 51.6%. These results show that structural support can make fixed-threshold Mask2Anomaly masks more compact and less fragmented without adding new anomaly evidence.

Time: 13:45-14:00

1571356218: Caerus: Data-Plane Localized Failure Recovery for LEO Satellite Traffic Engineering

Author(s): Kun Zhang (Fudan University, China); Jingyi Qian and Lin Shang (Shanghai Spacesail Technologies Co., Ltd., China); Jin Zhao, Yue Gao and Kun Qiu (Fudan University, China)

Abstract: The rapid deployment of LEO satellite constellations has established high-throughput space-based networking as a core objective of 6G evolution. However, frequent inter-satellite link (ISL) disruptions pose significant challenges for traffic engineering (TE): link failures invalidate pre-configured path allocations and demand fast recovery to prevent performance degradation. Existing approaches lack dedicated failure-handling mechanisms and typically rely on end-to-end path reallocation, which incurs substantial control overhead and secondary congestion. To address these limitations, we propose Caerus, a TE framework featuring a localized fast failure recovery mechanism based on pre-computed local backup paths. Caerus leverages the regular structure of satellite topologies to enable autonomous data-plane rerouting without controller intervention, preserving path continuity and allowing learning-based TE models to remain effective without retraining. Experimental results demonstrate that Caerus achieves demand satisfaction rates comparable to linear programming while maintaining low computational overhead. Compared to state-of-the-art centralized TE algorithms, Caerus reduces failure-induced congestion by 34.8% to 53.7% across medium to large-scale constellations. In a

mega-constellation of 1,584 satellites, our localized rerouting satisfies 8.9% to 41.0% more traffic demand than traditional end-to-end rerouting under failure rates of 3% to 10%.

Time: 14:00-14:15

1571316977: Semantic Extraction Framework for Goal-Oriented V2X Communication Supporting Safe Intersection Passage

Author(s): Haoran Yang, Shan Lu and Takaya Yamazato (Nagoya University, Japan)

Abstract: This paper proposes a transmitter-side semantic extraction framework for goal-oriented Vehicle-to-Everything (V2X) communication supporting safe intersection passage. Instead of transmitting raw sensory data, roadside infrastructure extracts task-relevant semantic information from video and traffic-signal sequences and organizes them into compact semantic packets for real-time driving-decision assistance. The intersection-passing problem is formulated as a set of traffic tasks under Japanese traffic regulations, and the proposed pipeline generates perception and intent semantics through object detection, object tracking, ROI-based semantic extraction, and recommended-action generation. The framework is implemented and evaluated on a CARLA-based single-vehicle dataset. Experimental results show high recommended-action accuracy within the tested task set, with a mean processing latency that remains below the frame interval of the 15 fps input video.

Time: 14:15-14:30

1571363382: A Deterministic Blockchain-Based Coordination Framework for Cooperative Overtaking in AVs

Author(s): Eranda Jayatunga (University College Dublin, Ireland & University of Ruhuna, Sri Lanka); Anupa De Silva, Anca Delia Jurcut and Nima Afraz (University College Dublin, Ireland)

Abstract: Autonomous overtaking requires fast, secure and verifiable coordination among multiple vehicles. This paper presents a deterministic, policy-driven cooperative overtaking framework implemented on Hyperledger Fabric, in which the overtaking vehicle remains in its lane while the leading vehicle moves into a suitable gap in the adjacent lane. Coordination-level feasibility is evaluated through smart contracts based on parametric constraints on speed, distance, reaction time and coordination delay, enabling transparent, auditable and consistent maneuver decisions. The framework establishes a secure and verifiable distributed coordination layer over authenticated V2V state exchanges, allowing participating vehicles to reach verifiable agreement on time-critical overtaking actions without centralized control. Performance evaluation using Hyperledger Caliper shows that the framework sustains throughput up to 350 transactions per second while maintaining maximum latency below 1 s under increasing load with appropriate block-cut parameter tuning. These results demonstrate the prototype-level feasibility of permissioned blockchain for low-latency cooperative vehicular coordination. Furthermore, the proposed approach is potentially extensible to other time-critical cooperative maneuvers including lane changing, highway merging and similar multi-vehicle coordination scenarios.

Time: 14:30-14:45

1571316528: Operational Threat Analysis and Mitigation for RPKI: A Whole-Chain Perspective

Author(s): Lei Xu, Ying Wang, Xiaoyu Ye, Ye Tao, Hang Dong and Lizhu Su (China Unicom Research Institute, China)

Abstract: The Resource Public Key Infrastructure (RPKI) has emerged as a critical security framework for mitigating prefix hijacking and route leaks in the Border Gateway Protocol (BGP). However, as RPKI

deployment scales globally, operational risks across its entire trust chain-spanning Certification Authorities (CAs), Publication Points (PPs), and Relying Parties (RPs)-pose significant threats to Internet routing stability. This paper presents a systematic, operator-oriented analysis of operational threats across the RPKI whole chain. We identify and categorize misoperation scenarios at each component, illustrate cascading failure propagation through real-world incidents including the Orange España RPKI hijack (2024) and RIPE NCC CA software failures (2023), and propose a comprehensive risk-mitigation mapping framework. Our work provides a practical operational checklist and best-practice recommendations to help network operators harden their RPKI infrastructure against both accidental misconfigurations and malicious exploitation.

Time: 14:45-15:00

1571356622: Robust Generative Steganographic Communication via Learning-based Adaptive Gain Control

Author(s): Ziyi Huang (University of Chinese Academy of Sciences, China); Lu Lu (Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences & University of Chinese Academy of Sciences, China); Congmin Lv (University of Chinese Academy of Sciences, China)

Abstract: Image steganography refers to covert communication by hiding a secret image within another image without being noticed. Diffusion-based image steganography has shown strong potential for covert communication by producing highly realistic and visually imperceptible stego images. Existing diffusion-based steganography systems typically use two diffusion pairs, which cause the generated stego image and the secret image to exhibit visual correlations, leading to potential leakage of secret information. To address this issue, we propose a novel system. Our system has a single diffusion pair and enables customizable stego images, ensuring that the stego image no longer contains visual information from the secret image. In addition, diffusion models typically complete image recovery progressively, proceeding from low-frequency structures to high-frequency details. In communication systems, channel noise can perturb the inversion trajectory at the receiver. Different frequency bands exhibit different sensitivities to the denoising behavior of diffusion networks and applying differentiated processing to different frequency bands can improve generation quality. Therefore, we design a learnable adaptive gain control network. Under a prescribed power constraint, the network adjusts the gains of different frequency components, making the transmission power better suited to frequency bands sensitivities and thereby improving reconstruction quality.

Time: 15:00-15:15

1571332545: Rainfall Retrieval from Multimodal LEO Link Observations via a Patch-Tokenized Transformer

Author(s): Dingzhong Wang, Zhitong Yin and Jiahui Mao (Shanghai Institute of Microsystem and Information Technology, China); Chong Tan (Shanghai Institute of Microsystem and Information Technology & Chinese Academy of Sciences, China); Liu Hong and Chunlei Zheng (Shanghai Institute of Microsystem and Information Technology, China); Min Zheng (Chinese Academy of Sciences, China)

Abstract: This paper investigates rainfall retrieval from real low-Earth-orbit (LEO) satellite links. We construct a multimodal LEO rainfall dataset using a Qianfan Ku-band terminal, comprising 10,194 passes, each defined as a continuous measurement sequence from one satellite overpass. The synchronized observations include downlink signal measurements, satellite-ground geometry, local meteorological observations, sky images, and rain-gauge observations. We propose a Patch-Tokenized Transformer that combines modality-wise patch embedding, a two-stage temporal-modality encoder, and query-based decoding to detect rain and estimate conditional rainfall accumulation over each pass. Under an event-disjoint protocol, the proposed model achieves the lowest rainy-pass MAE and the best rain-detection performance among the learned baselines.

POSTER SESSIONS

Poster Session 1

15:30-16:30 Nov. 11, 2026 | 2F Foyer

Board No.: P1-01

1571356629: NomaSem: Residual-Coupled Joint Learning for Multiuser Semantic Image Transmission

Author(s): Linfeng Tan, Ziyang Meng and Lichao Huo (University of Chinese Academy of Sciences, China); Jianhua He (Chinese Academy of Sciences, China); Lu Lu (Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences & University of Chinese Academy of Sciences, China)

Abstract: Non-orthogonal multiple access (NOMA) enables concurrent semantic image transmission from multiple terminals. In a reconstruction-based neural successive interference cancellation (SIC) receiver, however, the first decoded image is re-encoded before cancellation, and the regenerated continuous representation need not match the transmitted one. This mismatch appears as structured interference to the next decoder. We study this effect with frozen pretrained Swin Transformer-based joint source-channel coding (SwinJSCC) transmitters and introduce NomaSem, which backpropagates the second user's reconstruction loss through SIC and the frozen re-encoder. NomaSem (Prop) updates the first decoder, while NomaSem (Joint) also adapts the second decoder to the residual distribution. Experiments show that lower residual energy alone does not reliably improve second-user reconstruction. At 13 dB, Prop and Joint yield average second-user peak signal-to-noise ratio (PSNR) gains of 0.44 and 1.12 dB, respectively, over an image-adapted reconstruction-SIC baseline. Tests on lunar-domain images and a literature-based lunar-surface large-scale path-loss model further examine robustness without transmitter retraining or signal-to-noise ratio (SNR) feedback.

Board No.: P1-02

1571354209: Reconstruction-Free Wideband Time-Frequency Localization from Sub-Nyquist Samples

Author(s): Runyi Zhao, Yinghui Ye, Guangyue Lu (Xi'an University of Posts and Telecommunications, China); Yuhan Ruan and Yongzhao Li (Xidian University, China); Pei Xiao (University of Surrey, United Kingdom)

Abstract: Wideband monitoring requires joint time-frequency localization of intermittent transmissions, but Nyquist-rate acquisition over a wide band is costly in converter rate and interface bandwidth. Sub-Nyquist sensing usually recovers the waveform or its support first, imposing a sparsity model and support-selection that can degrade under mismatch, particularly at low signal-to-noise ratio (SNR), while compressive covariance sensing avoids both but returns one power spectrum per record, discarding time. We instead map windowed multi-coset correlations onto Nyquist-grid lags in successive overlapping windows, forming a compressive time-frequency map (CTFM) that localizes emitters without waveform or support recovery. Sliding changes the design problem: identifiability follows a circular rather than a linear ruler, lowering the floor for direct per-lag recovery to one-fifth of the Nyquist-rate, below which lag coverage rather than coset count grades designs. Against FTFR, a recent reconstruction-free baseline, CTFM raises the localization F 1 by 5-10 percentage points at every SNR from -2 to-10 dB of a -10 to-10 dB sweep, and from -6 to-6 dB, using 30% of the samples, stays

within 4 percentage points of a full-rate Blackman-Tukey estimator. A -2 3 factorial over lag span, lag taper and window overlap shows that span and taper interact at least as strongly as either acts alone. The code is released in https://github.com/RunyiZhao/Sub-Nyq-TFL.

Board No.: P1-03

1571315751: Concurrent Bluetooth Low Energy Channel Sounding via Frequency Division Multiplexing

Author(s): Jia Kong, Zhenyu Zhang, Hanlin Dong, Cheng Huang and Liu Hao (Southeast University, China)

Abstract: Bluetooth Low Energy (BLE) Channel Sounding (CS) enables accurate phase-based ranging but relies on sequential polling, resulting in severe latency and limited scalability in dense Internet of Things (IoT) networks. To address this limitation, this paper proposes a concurrent physical-layer ranging framework for BLE CS based on Frequency Division Multiplexing (FDM). By redesigning the BLE CS ranging procedure to support simultaneous multi-device phase measurements, the proposed framework reduces the required physical-layer ranging exchanges from 2NK to 2K, thereby eliminating the linear latency growth with the number of devices. An end-to-end Software-Defined Radio (SDR) prototype is implemented to validate the proposed framework in practical indoor environments. Experimental results demonstrate successful concurrent signal separation and achieve Root Mean Square Errors (RMSEs) of 0.57 m and 0.84 m for two concurrent devices. These results verify the practical feasibility of concurrent BLE CS ranging and provide a scalable low-latency solution for multi-device BLE localization.

Board No.: P1-04

1571347461: Iterative Joint Decoding and Channel Estimation for GC-LDPC-Coded MIMO Systems

Author(s): Jiyun Fu and Jian Fang (Xidian University, China); Min Zhu (Xidian University, China & ISN, China); Baoming Bai (Xidian University, China)

Abstract: This paper proposes an iterative joint decoding and channel estimation scheme for globally-coupled low-density parity-check (GC-LDPC)-coded multiple-input multiple-output (MIMO) systems over Rayleigh block fading channels. To reduce pilot overhead, decoded information is exploited to reconstruct data symbols as virtual pilots to refine the channel estimate. To improve processing throughput, the local codewords of the GC-LDPC code are decoded in parallel.

Moreover, global decoding is employed to enhance decoding reliability. The updated decoding results are then fed back to the channel estimator, enabling iterative refinement of channel estimation and decoding. Simulation results show that the proposed scheme achieves improved block error rate (BLER) performance while reducing pilot overhead.

In particular, at a BLER of 10^{-3}, the proposed scheme with four pilot symbols and three outer iterations achieves gains of approximately 1.5 dB and 0.75 dB over pilot-only estimation with six and eight pilot symbols, respectively.

Board No.: P1-05

1571339628: An Anti-Aliasing Multiuser Transmission Scheme for Low-Sampling-Rate OFDM Receivers

Author(s): Yi Chen and Xinyan Hu (Beijing University of Posts and Telecommunications, China)

Abstract: Low-cost wireless terminals are constrained by receiver sampling rate, power consumption,

and baseband-processing burden. In an OFDM receiver, sampling below the full rate required to resolve all subcarriers folds multiple subcarriers into the same discrete-frequency bin. This paper proposes a transmitter-side anti-aliasing multiuser transmission scheme for low-sampling-rate OFDM receivers. The folded subcarriers are modeled as virtual transmit antennas of an equivalent MISO channel, and linear transmit-MMSE precoding is applied at the base station to serve multiple low-sampling-rate users simultaneously. The scheme transfers multiuser separation from cost-constrained terminals to the base station, reducing terminal ADC sampling and receiver processing. Simulations over tapped-delay-line OFDM fading channels show that the proposed scheme achieves significant normalized receiver-side energy-efficiency gains with limited throughput loss in low-rate and moderate-to-high-SNR regimes.

Board No.: P1-06

1571360310: Semantic-Driven Spectrum Sensing for UAV-Assisted Cognitive Radio Networks

Author(s): Zi Wang and Fuhui Zhou (Nanjing University of Aeronautics and Astronautics, China); Qihui Wu (PLA University of Science and Technology, China)

Abstract: Spectrum sensing is of crucial importance in enabling spectrum sharing in cognitive radio networks. However, sensing performance is significantly limited in non-line-of-sight (NLoS) scenarios due to shadowing, multipath fading, and the hidden terminal problem. To tackle this issue, a local-global semantic-driven spectrum sensing (LG-SS) framework is proposed. Specifically, an unmanned aerial vehicle (UAV) establishes a favorable sensing environment, extracts semantic features from the detected signals, and transmits compact semantic data to a base station (BS). At the BS, a customized inference head is exploited to infer the spectrum status. Moreover, the framework is extended to wideband sensing through a multilabel classification design (MLC-SS). A robust design (Robust-SS) with adversarial learning and transfer learning is further proposed to improve adaptability to low sensing signal-to-noise ratio (SNR) and unseen sensing environments. Simulation results demonstrate that our proposed schemes can achieve higher probability of detection, wideband sensing performance, and robustness against low SNR conditions and new sensing environments.

Board No.: P1-07

1571356643: PAW-Lite: Lightweight Parallel-Wavelet Attention for Space Edge Semantic Communications

Author(s): Ziyang Meng and Yuheng Zhang (University of Chinese Academy of Sciences, China); Lu Lu (Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences & University of Chinese Academy of Sciences, China); Jianhua He (Chinese Academy of Science, China); Yongsheng Gong (Technology and Engineering Center for Space Utilization, China)

Abstract: Space edge networks face severe wireless channel impairments and significant computational asymmetry: resource-constrained satellite edge nodes demand lightweight onboard processing, whereas space AI data centers can assume a larger share of reconstruction computation. This poses a major challenge for reliable semantic image transmission, as existing DeepJSCC models often rely on symmetric, heavy transceivers and are difficult to deploy on space edge nodes. To tackle these issues, we propose PAW-Lite, a lightweight parallel-wavelet semantic communication framework tailored for asymmetric space edge communications. PAW-Lite employs a compact encoder at the edge satellites using DSConv and MBConv blocks, while assigning channel equalization and heavy semantic decoding to the space AI data center. At its core, the Parallel-Wavelet Attention (PAW) module performs discrete wavelet transform (DWT) multi-band decomposition to process heterogeneous wavelet subbands in parallel, capturing rich cross-channel and spatial-frequency semantics without early feature fusion.

Extensive simulations over low-SNR fading channels demonstrate that PAW-Lite achieves robust reconstruction while drastically reducing onboard encoder parameters from 14.103M to 0.724M (94.9%↓), FLOPs from 34.462G to 5.821G (83.1%↓), and GPU latency from 6.89 ms to 1.95 ms (a 3.5× speedup) compared to SwinJSCC. These results demonstrate PAW-Lite's potential for practical AI-native space semantic communications.

Board No.: P1-08

1571333101: SIW-Fed Millimeter-Wave Wideband Circularly Polarized Butterfly-Shaped Crossed-Dipole Antenna

Author(s): Changhong Zhang, Qingsong Yang and Yu Shao (Chongqing University of Posts and Telecommunications, China)

Abstract: This paper presents a novel millimeter-wave (MMW) wideband circularly polarized (CP) butterfly-shaped crossed-dipole antenna fed by a substrate integrated waveguide (SIW). The primary radiator employs four flared sector-shaped main patches with slotted perturbation edges, which effectively lowers the input Q-factor and alters surface current paths for improved polarization purity. To overcome the bandwidth limitation of conventional crossed-dipoles, four non-contacting sector parasitic patches are innovatively loaded to excite additional high-order resonances via gap capacitive coupling, remarkably extending both the axial-ratio (AR) and impedance bandwidths. An integrated SIW-to-DSPSL tapered transition serves as an efficient planar balun, supplying stable 180° differential excitation while maintaining an ultra-low profile of 0.155λ0. Simulation results demonstrate a -10 dB impedance bandwidth of 38.3% (20.8-30.7 GHz) and a 3 dB AR bandwidth of 32.3% (21.7-30.1 GHz) with high band overlap. Across the passband, the radiation efficiency exceeds 90%, with a peak realized gain of 8.5 dBi. Featuring compact structure, broad bandwidth, and ease of planar integration, this antenna is highly promising for 5G MMW wireless systems.

Board No.: P1-09

1571348979: Encrypted Semantic Communications with Hierarchical Latent Protection

Author(s): Jiahui Liu and Yuan Qiong (Beijing Electronic Science and Technology Institute, China); Xincheng Zhou and Jintao Huang (Beijing Institute of Technology, China); Rongna Xie (Beijing Electronic Science and Technology Institute, China)

Abstract: Encrypted semantic image transmission combines confidentiality and integrity verification for compact learned representations over bandwidth-constrained wireless links. When authentication is introduced, its tags and error-protection redundancy consume semantic payload, while rejected blocks remove structured latent content from reconstruction. We propose SwinESC, an encrypted semantic communication framework that separates the representation into an independently decodable Core and a Core-conditioned Residual. The Core supports independent reconstruction, while the Residual uses the remaining budget to supplement image detail. Both layers use stream-cipher encryption, while the Core is further partitioned into authenticated and channel-coded blocks. Spatially interleaved Core domains disperse block rejection across the latent grid, where Latent Mosaic Recovery (LMR) estimates missing values before decoding. Experimental results demonstrate that SwinESC models trained at a single signal-to-noise ratio (SNR) retain recoverable Core-dominated content under severe channel impairment.

Board No.: P1-10

1571356452: Cross-Domain Joint Spectral Shaping for PAPR Reduction in DFT-s-OTFS

Author(s): Huicheng Zhang and Yiyue Xiang (Beijing Institute of Technology, China); Yang Zhang (China Satellite Network Innovation CO LTD, China); Zhigang Yu (China Academy of Electronics and Information Technology, China); Ying Wang (Samsung Research China-Beijing, China); Neng Ye (Beijing Institute of Technology, China)

Abstract: Discrete Fourier transform-precoded orthogonal time frequency space (DFT-s-OTFS) can reduce the peak-to-average power ratio (PAPR) of conventional OTFS through Doppler-domain symbol spreading. However, coherent superposition of the resulting time-domain pulses may still produce large instantaneous power peaks. This paper proposes a cross-domain joint spectral shaping scheme that applies symmetric spectral extension and three-tap spectral shaping along the Doppler axis in the delay-Doppler domain and the frequency axis in the time-frequency domain. A net-gain-based optimization is formulated to jointly account for PAPR and bit error rate (BER) performance under fixed spectral efficiency. Simulations validate the analytical model and parameter trends. Compared with DFT-s-OTFS, the proposed scheme achieves a 6 dB PAPR reduction at a complementary cumulative distribution function (CCDF) of 10^{-3}, with a 4 dB signal-to-noise ratio penalty at a BER of 10^{-4}, yielding a Net Gain of 2 dB.

Board No.: P1-11

1571317061: Layered Deep Interference-Cancelling Precoding for MIMO Broadcast Systems

Author(s): Yiding Li, Zijian Liang, Kai Niu and Ping Zhang (Beijing University of Posts and Telecommunications, China)

Abstract: This paper proposes an LQ-embedded deep interference-cancelling network (LQ-DICNet) for the Multiple-Input Multiple-Output Broadcast Channel (MIMO BC). The network operates over triangularized MIMO channels and precodes messages layer by layer by pre-cancelling causal interference from previous layers in an end-to-end optimized form. Each transmitter layer is conditioned on the current symbol, the accumulated causal interference, and the local diagonal coefficient, while each decentralized receiver uses its local observation and diagonal channel information. We train the system with structured sampling over symbols and channels together with a linear transmit-power regularizer. Experiments over Rayleigh and Rician MIMO BC channels show that LQ-DICNet improves the learned transceiver baseline and remains competitive with constructive ZF/VP baselines at the tested native SNR operating points.

Board No.: P1-12

1571314679: Task-Driven Dynamic Networking for Collaborative Agent Communications in 6G

Author(s): Baoyu Wang, Yitong Liu and Hongwen Yang (Beijing University of Posts and Telecommunications, China); Kaiyue Wang (China Mobile Research Institute, China)

Abstract: Future 6G edge-agent networks require distributed terminals to collaboratively execute sensing, communication, and computation tasks. As task demand increases, direct single-terminal service may enter a capability-collapse regime in which individual terminals can no longer satisfy task requirements. Existing studies generally optimize resource allocation over fixed collaboration structures, while collaboration-structure adaptation for capability aggregation remains largely unexplored. To address this challenge, this paper proposes a task-driven dynamic networking framework under a fixed total sensing/bandwidth/computation (S/B/C) budget. The proposed framework treats collaboration-structure adaptation as a capability-aggregation mechanism by jointly optimizing

serving-terminal selection, cluster-head/member organization, S/B/C resource allocation, and event-triggered regrouping. We further develop Resource-Competition-aware Hierarchical Graph MAPPO (RC-HG-MAPPO) as an adaptive controller to implement the proposed framework. Simulation results demonstrate that the proposed task-driven dynamic networking framework improves the weighted completion rate (WCR), while RC-HG-MAPPO achieves a 2.39× higher weighted completion rate than direct/no-clustering service and outperforms the feature-based dynamic heuristic by 12.6%.

Board No.: P1-13

1571314732: AI Technology Research for LEO Satellite Phased Array Terminals

Author(s): Zihan Zhang (Elton Academy, Canada); Na Wang (Xinyuan Liheng (Beijing) Technology Co., Ltd., China)

Abstract: Low Earth Orbit (LEO) satellite networks serve as core infrastructure for 6G space-air-ground integrated communication systems, offering global coverage and low-latency transmission. However, high-dynamic orbital movement, time-varying channels and complex electromagnetic interference severely limit the performance of traditional model-driven phased array terminals, which suffer from poor scenario adaptability and low intelligent operation efficiency, failing to meet large-scale commercial networking requirements. To address these issues, this paper introduces artificial intelligence (AI) to reconstruct the control paradigm of LEO phased array terminals. A three-layer collaborative intelligent architecture integrating terminal edge intelligence, satellite-ground coordination and cloud global optimization is proposed, and four core intelligent technologies covering beam tracking, adaptive anti-jamming, predictive maintenance and lightweight edge processing are summarized. Combined with recent research advances, this paper systematically analyzes key technical bottlenecks including hardware power constraints and insufficient model generalization, and predicts future development trends of space-borne intelligent communication systems. This work establishes a systematic theoretical framework for intelligent phased array terminals, providing reliable technical references for the engineering implementation of 6G space intelligent communication networks.

Board No.: P1-14

1571356646: Development and Experimental Evaluation of Person Detection System with Machine Learning and Local 5G For River Environmental Conservation

Author(s): Ryonosuke Nakadate, Yutaka Hatazawa and Takuji Tachibana (University of Fukui, Japan)

Abstract: Sustainable river environmental conservation requires efficient monitoring and management systems, particularly as inland fisheries cooperatives face shortages of personnel and financial resources. As a step toward digital infrastructure for supporting such conservation activities, this paper develops a person detection system using machine learning and local 5G. In the developed system, images captured by a webcam connected to a client are transmitted to a server over a local 5G network, and the server performs person detection using YOLOv8n. We also consider an extension of the system to federated learning and introduce a battery-aware model selection to reduce the energy consumption of battery-powered clients. Simulation results show that the proposed mechanism reduces the number of battery recharges to 0.76 times that of a baseline scheme that always uses a large model, while limiting the degradation in classification accuracy. Furthermore, outdoor experiments demonstrate that the developed system can transmit images over the local 5G network and successfully perform person detection at the server. These results demonstrate the feasibility of combining machine learning, federated learning, and local 5G to support sustainable river environmental conservation.

Board No.: P1-15

1571347674: 5G Base Stations Traffic Prediction Based on GTPC

Author(s): Pan Yao, Hairong Jia and Zelong Ren (Taiyuan University of Technology, China)

Abstract: To achieve accurate long-term traffic prediction for 5G base stations, this paper introduces a traffic prediction model named GRU-TCN-PLSTM-CA(GTPC). The Gated Recurrent Unit (GRU) is incorporated to initially extract time series information from traffic data, offering comprehensive feature representations for subsequent extraction processes. The Patch Long Short-Term Memory Network (PLSTM) integrates local and global features, thereby enhancing the model's ability to process long sequence data. Temporal Convolutional Networks (TCN) operate concurrently with PLSTM, utilizing the properties of convolutional layers to extract deep local features. Cross-Attention (CA) considers the mutual influence among various feature spaces to achieve ultimate feature fusion. The experimental results indicate that this model has a significant advantage in accuracy over existing models for long-term traffic prediction at 5G base stations, providing strong technical support for the timing control of 5G base stations, thereby effectively reducing energy consumption.

Board No.: P1-16

1571356379: On the Value of Pair-Specific Network Information for Workflow Orchestration

Author(s): Maowen Ling (Taiyuan University of Technology, China); Songlin Liu and Yumeng Chen (University of Electronic Science and Technology of China, China)

Abstract: An offline workflow orchestrator can retain pair-specific network costs or simplify them into average communication costs. Motivated by SDN-managed infrastructures with centrally available network information, we study how this choice affects task placement and workflow completion time. Fixed-route rate and delay summaries are given inputs; controller integration and network-state acquisition are outside the evaluation. An adapted edge-cover planner, information ablations, and budget-matched searches distinguish network-information value from search-policy value. In synthetic networks with increasing rate heterogeneity, gains over averaged-cost planning rise from 5.21% to 18.06%. Matched-budget comparisons favor simple order searches, indicating that detailed network information does not require a superior edge-cover policy to be useful. On two public workflow inputs, gains beyond the better initializer are below 0.3%. The results identify when preserving network-cost differences helps offline orchestration and when workflow characteristics, planning overhead, and platform assumptions limit the benefit.

Board No.: P1-17

1571313351: Energy Efficiency Optimization for PoF-Enabled Integrated Power and Data Transmission

Author(s): Yazhong Chen, Haojie Zhang, Xuan Li, Rui Zhou and Zhiguo Zhang (Beijing University of Posts and Telecommunications, China)

Abstract: The rapid advancement of the Internet of Things (IoT) and the growing emphasis on green communication networks have driven large-scale sensing systems in applications such as environmental monitoring and smart cities. However, conventional battery-dependent solutions face critical sustainability limitations from finite lifetimes, maintenance burdens, and carbon footprints. Power-over-Fiber (PoF) technology, enabling simultaneous power delivery and data transmission over a single optical fiber, offers a compelling alternative by eliminating battery waste. This paper investigates the system energy efficiency (EE) maximization problem for a PoF-enabled sensing architecture. We formulate it as a mixed-integer nonlinear fractional programming model to jointly optimize fiber

assignment, per-fiber input power, and the sampling and computation frequencies of sensing devices under power budget and latency constraints. An optimization framework is developed to transform the non-convex problem into a tractable form. Simulation results show that the proposed algorithm consistently outperforms benchmark schemes, achieving a maximum EE improvement of 37.70%, validating its effectiveness in enabling sustainable fiber-powered sensing systems.

Board No.: P1-18

1571333710: Handover Scheme for Marine IoT Sensing Networks Based on Group Decision-Making and Deep Reinforcement Learning Parameter Adaptation

Author(s): Zhirong Ding (Beijing University of Posts and Telecommunications, China); Lei Yao (China Satr Network Digital Technology Co., Ltd., China); Hongxing Li (Beijing University of Posts and Telecommunications, China); Guolin Liu and Rui Lu (China Satr Network Digital Technology Co., Ltd., China); Guochu Shou (Beijing University of Posts and Telecommunications, China)

Abstract: In wide-area and highly dynamic scenarios of the marine Internet of Things (MIoT), traditional single-terminal network handover mechanisms are prone to the ping-pong effect and fail to maintain continuous and stable network access. To tackle this issue, this paper proposes a handover scheme for marine IoT sensing networks combining group decision-making with deep reinforcement learning parameter adaptation. The scheme aggregates joint signal sensing from multiple terminals in a local area network, and adopts the group shore-based coverage ratio as the handover decision statistic to mitigate the impact of sea surface channel fluctuations on decision outcomes, thus suppressing ping-pong handovers. Furthermore, a Double Deep Q-Network (DDQN) is introduced to adaptively select handover decision parameters including the group decision threshold, hysteresis factor and time-to-trigger, enabling marine terminals to dynamically adjust decision parameters and select access modes according to environmental conditions, so as to sustain continuous and stable network connectivity. Experimental results show that the proposed scheme achieves the lowest number of handovers, ping-pong rate and handover failure rate across various marine scenarios, with the ping-pong rate reduced by more than 50% compared with the A3 handover algorithm.

Board No.: P1-19

1571314660: Enabling Lightweight and Adaptive Neighbor Discovery for Flying Ad Hoc Networks

Author(s): Yu Xia (Chongqing University of Technology, China); Ming Xu (Nanjing University of Aeronautics and Astronautics, China); Bihai Yang and Wei Liu (Chongqing University of Technology, China); Daqing Huang (Nanjing University of Aeronautics and Astronautics, China)

Abstract: Existing adaptive neighbor discovery schemes for mobile ad hoc networks dynamically adjust the sending interval of Hello messages based on local topology changes, enabling the routing protocols to cope with network dynamics caused by node mobility. However, these schemes typically use fixed empirical thresholds to evaluate whether the local topology changes are drastic or not, which naturally makes them not applicable to mobile nodes with higher speeds such as the unmanned aerial vehicles in flying ad hoc networks. To improve the adaptability of routing protocols to different degrees of topology changes, this paper proposes a lightweight and adaptive neighbor discovery scheme based on determining a dynamic threshold of neighbor change rate. In particular, it dynamically sets the threshold based on the actual degree of local topology changes, so that it can reflect the differences in topology changes caused by different node speeds. Simulation results using NS3 show that the proposed scheme can achieve higher packet delivery performance with reasonably increased Hello message overheads. Especially, the number of Hello messages required to increase 1% packet delivery

rate is equivalent to those of existing schemes. That is to say, the proposed scheme effectively balances the two conflicting objectives of improving network performance and suppressing control overhead.

Board No.: P1-20

1571356617: FO-WISE: Event-Dilution Stress Testing of Multi-Source Intrusion Detection for Power-Grid IoT

Author(s): Weiyu Niu (State Grid Shaanxi Electric Power Co., Ltd. Information and Communication Company, China); Weijun Geng, Hongzhi Guo and Yijie Xun (Northwestern Polytechnical University, China); Xin Fan (State Grid Shaanxi Electric Power Co., Ltd. Information and Communication Company, China)

Abstract: Smart grids and the power Internet of Things (IoT) deploy massive intelligent terminals that generate heterogeneous host and network telemetry, motivating multi-source intrusion detection. Conventional fusion detectors often compress events within a window into fixed-dimensional summaries, so the loss of event-level information is hard to observe under clean conditions. As benign activity increases, weak attack evidence can be diluted beyond statistical resolvability, causing architectures with similar clean-condition performance to exhibit markedly different degradation behavior. We formalize this composition pressure as event dilution and propose Fusion of Wise Event-level Representations (FO-WISE), an event-level attention framework that preserves and contextualizes per-event representations before pooling. Experiments on the AIT Log Data Set V2.1 show that FO-WISE maintains substantially stronger detection performance under severe event dilution than aggregation-based baselines.

Board No.: P1-21

1571308404: Wireless Blockchain Network: From Consensus Perspective

Author(s): Zixu Zhou, Xuefei Zhang, Caokun Wang, Jinhan Zhang and Qimei Cui (Beijing University of Posts and Telecommunications, China)

Abstract: As a foundation for establishing decentralized reliable connection between untrusted network entities, blockchain has shown great potential to be applied in 6G networks. Nevertheless, the current research on wireless blockchain network (WBN) is still in its infancy, and it remains to be investigated whether the blockchain system can be adapted to wireless environments. In particular, there is a lack of insightful viewpoint on the underlying performance of WBN, which is primarily determined by the consensus, to guide its practical deployment. To fill this gap, this paper investigates blockchain system in wireless environment to answer the question: what are the bottlenecks of consensus in WBN? Specifically, we investigate the influence of wireless communication protocol (e.g. IEEE 802.11) and network parameters (e.g. scale of the network, forwarding probability etc.) on the performance of consensus in WBN. It is found that, within a reasonable carrier sense range, WBN of diverse scales require different forwarding probabilities in order to optimize transactions per second (TPS) and consensus delay performance. On this basis, an adaptive forwarding strategy for consensus in WBN is designed to dynamically adjust the node's forwarding probability by utilizing the redundancy of the received consensus messages. The feasibility and effectiveness of the proposed strategy are verified by simulation results.

Board No.: P1-22

1571307417: Markov Chain Based Primary Node Selection for Blockchain-Based UAV Networks

Author(s): Zixu Zhou, Xuefei Zhang and Qimei Cui (Beijing University of Posts and Telecommunications,

China)

Abstract: UAVs play a crucial role in disaster relief by collecting GIS and environmental data from the affected areas. However, communication links between UAVs are highly susceptible to attacks, exposing data to the risks of incompleteness and tampering. To address these issues, blockchain technology can be employed to ensure data transparency and consistency. Among various consensus mechanisms, Practical Byzantine Fault Tolerance (PBFT) is particularly suitable for small-scale UAV networks due to its efficiency. However, the high mobility of UAVs introduces a challenge: the selected primary node may move out of communication range, leading to consensus failure, which in turn increase system overhead. In this paper, we study the impact of UAV mobility on consensus and propose a Markov chain-based primary node selection strategy. Specifically, we implement a primary node selection strategy that relies on position prediction, incorporating both current and future node centrality. Simulation results demonstrate that the proposed strategy significantly improves the consensus success rate, reduces block confirmation delay, and provides stronger robustness under varying UAV speeds. Furthermore, we find that UAV nodes need to balance the weight of current and future centrality to optimize primary node selection under different mobility conditions.

Poster Session 2

10:00-11:00 Nov. 12, 2026 | 2F Foyer

Board No.: P2-01

1571315253: BDAA: Balanced Domain-Adversarial Adaptation with AdaBN for Cross-Dataset Automatic Modulation Classification

Author(s): Jicheng Gao (Beijing Key Laboratory of Network System Architecture and Convergence, Beijing University of Posts and Telecommunications); Lijin Wang (Beijing Institute of Computer Technology and Application, China); Xiaomeng Liu (Beijing Key Laboratory of Network System Architecture and Convergence, Beijing University of Posts and Telecommunications); Weijun Hong (Beijing Laboratory of Advanced Information Network, Beijing University of Posts and Telecommunications, China)

Abstract: Automatic modulation classification (AMC) is an important signal-processing task for intelligent receivers, spectrum monitoring, and non-cooperative communications. Although deep neural networks can achieve high within-dataset accuracy, their performance often degrades sharply when models trained on public simulated data are deployed on hardware-collected signals. This paper investigates unsupervised cross-dataset AMC from RML2018 to a hardware target dataset generated by a VSG60A signal source and captured by a Tektronix RSA306B receiver. We present Balanced Domain-Adversarial Adaptation with AdaBN (BDAA), a lightweight and stable adaptation recipe that combines balanced adversarial feature alignment with post-training target domain batch-normalization adaptation. In low-level I/Q AMC, our results suggest that controlled adversarial strength ($\beta = 0.5$) provides a favorable accuracy-stability trade-off by avoiding over-suppression of modulation-sensitive structures while still enabling useful domain alignment. Experiments on nine common modulation classes over five random seeds show that source-only transfer reaches only $31.28 \pm 1.86\%$ target accuracy, whereas CNN-BDAA achieves $48.72 \pm 1.48\%$, outperforming CNN-DANN and classical UDA baselines. A segment-level target-supervised CNN oracle reaches $98.46 \pm 0.12\%$, indicating that the target domain is highly classifiable and that the central challenge is label-free simulation to-hardware

adaptation. Together with SNR-wise, target-oracle confusion matrix, t-SNE, OQPSK-specific, and complexity analyses, these results support BDAA as a practical cross-dataset AMC baseline.

Board No.: P2-02

1571352018: Robust Joint Elevation, Azimuth, and Time-Delay Estimation for 5G Single-Site Positioning in Multipath Environments

Author(s): Dawei Chen, Shijun Chen and Xiaolei Zhao (ZTE Corporation, China); Jiancun Fan (Xi'an Jiaotong University, China)

Abstract: This paper proposes Indri-ML, a robust joint estimation algorithm of elevation, azimuth and time-delay (TD), which is the key technology of single-site high-precision localization. The interested parameters can be estimated simultaneously and no additional matching is required. In this algorithm, the covariance matrix is firstly optimized to improve the robustness in a contextual manner in the initialization stage. In order to adapt to practical applications, a new iterative pattern is then designed to reduce the computational complexity. By exploiting the convergence property of the iterative optimization, a criterion is proposed to terminate the iteration adaptively. This process not only ensures effective estimation results, but also eliminates the need to estimate the multipath number in advance. Finally, the experimental results demonstrate the effectiveness of the proposed algorithm compared with traditional ones.

Board No.: P2-03

1571355816: Fourier Transform Analysis of Frequency Hopping Pulse Sequences

Author(s): Yunpeng Ma (Beihang University, China); Hongyou Jiang (Beijing Institute of Economics and Management, China)

Abstract: This paper compares the spectral characteristics of deterministic frequency-stepped and random frequency-agile pulse trains, focusing on how pulse count, duty factor, and frequency allocation affect the Fourier spectrum magnitude under a constant time-bandwidth product. For the frequency-agile case, random frequency offsets disrupt the coherent phase relationships required for constructive interference and substantially suppress structured spectral features. However, the spectrum is not unconditionally whitened: residual peaks and fluctuations can persist for small pulse counts or unfavorable random realizations, and the response becomes smoother only as statistical averaging improves with increasing pulse count. The robustness of this behavior should therefore be established through multiple independent trials with mean, standard deviation statistics. These results indicate that frequency agility effectively mitigates the spectral distortions of deterministic stepped-frequency designs, while the choice between the two architectures depends on the trade-off among spectral purity, coherent gain, artifact suppression, and system complexity.

Board No.: P2-04

1571308255: Resource Optimization under QoS Constraints for Interactive VR Services

Author(s): Yifan Nan, Dingchang Tan, Qiao Liu, Shiyong Chen and Shengqian Han (Beihang University, China)

Abstract: Aiming at the low-latency and high-reliability Quality of Service (QoS) requirements of interactive virtual reality (VR) services, this paper investigates the joint uplink (UL) and downlink (DL) bidirectional resource optimization problem under statistical QoS constraints. Firstly, based on the time-domain queuing model, a joint UL-DL reliability constraint model is constructed to characterize the statistical QoS requirements of the VR service. On this basis, with the objective of minimizing the

weighted sum UL and DL transmit power of the system, a resource optimization problem is formulated for multi-user bandwidth allocation, UL and DL transmit power configuration, as well as the allocation of reliability budgets between transmission error rate and latency violation probability. To address the established multivariate joint optimization problem, a nested resource optimization method based on Particle Swarm Optimization (PSO) is proposed. In the outer layer, the PSO algorithm is adopted to jointly optimize bandwidth resource allocation and reliability budget allocation. In the inner layer, given the allocated bandwidth and reliability budgets, the bisection method is employed to solve the optimal UL and DL transmit power while satisfying QoS constraints. Simulation results verify that the proposed method can effectively reduce the weighted sum UL and DL transmit power of the system under different user scales, QoS constraints and channel conditions. Moreover, its performance superiority becomes more prominent in scenarios with multiple users and stringent QoS requirements.

Board No.: P2-05

1571312681: Deep Reinforcement Learning Assisted Beamwidth Control and Beam Tracking Algorithm for ISAC Systems

Author(s): Yilin Chen, Haiyang Wang, Yanyun Gong, Zhicheng Yao, Haochen Liu and Jincheng Shi (Northwestern Polytechnical University, China)

Abstract: In high-mobility vehicular integrated sensing and communication (ISAC) systems, conventional model-driven beam tracking methods rely heavily on accurate motion models, which limits their adaptability to dynamic environments. To address this problem, this paper proposes a temporal-state-enhanced hybrid proximal policy optimization algorithm, termed TS-HPPO, for joint beam tracking and dynamic beamwidth control. A GRU-based temporal-state network is incorporated into the hybrid proximal policy optimization (HPPO) framework to extract temporal features from historical states, enabling coordinated and adaptive control of continuous beam-angle control and discrete active-antenna selection. Simulation results show that the proposed TS-HPPO algorithm achieves faster convergence and improved training stability compared with PPO. Under different transmit power levels, TS-HPPO attains up to 80.13% of the ideal upper bound on spectral efficiency. Moreover, it outperforms the extended Kalman filter (EKF) under various transmit-power and antenna configurations, demonstrating its effectiveness for robust beam control in high-mobility vehicular ISAC systems.

Board No.: P2-06

1571357012: Deep Learning-Enabled Secret Key Generation for FDD OFDM Systems

Author(s): Md Fazley Rabbi, Meixiang Zhang, Yuheng Wang and Fuhao Yuan (Yangzhou University, China)

Abstract: Physical layer secret key generation (PLSKG) relies on wireless channel reciprocity to establish shared secret keys between legitimate users. However, in frequency division duplexing (FDD) systems, uplink and downlink channel state information (CSI) is obtained at different carrier frequencies, making direct channel reciprocity unavailable. To address this issue, this paper presents a deep learning-based PLSKG framework for FDD orthogonal frequency division multiplexing (OFDM) systems. The framework employs a proposed Complex-Aware Dual-Path Attention Encoder-Decoder Network (CADAED-Net) to infer Bob's downlink CSI from Alice's uplink CSI, thereby improving the similarity between the channel observations of the legitimate users. A deep neural network (DNN)-based quantizer is subsequently applied to the predicted CSI and Bob's observed CSI to extract binary key bits. Performance is characterized using normalized mean squared error (NMSE), key error rate (KER), and key generation rate (KGR). An eavesdropper scenario is further considered to compare the KER of the Eve-Bob link with

that of the legitimate Alice-Bob link. Simulation results demonstrate the effectiveness of the proposed framework for CSI prediction and secret key extraction in FDD systems.

Board No.: P2-07

1571315760: Interference-Aware Adaptive Notch Control Scheme for 4 × 4 UWB-MIMO IoT Communications in Dynamic WLAN Environments

Author(s): Shenxu Wang and Zexi Song (Nanjing University of Aeronautics and Astronautics, China); Jiarui Chen (Southern University of Science and Technology, China); Qingsheng Zeng (Communications Research Centre Canada, Canada)

Abstract: Reliable medical IoT communications in hospital rooms are challenged by dynamic coexistence interference from WLAN devices in the 5.15-5.825 GHz band. This paper proposes an interference-aware adaptive notch control framework for a 4×4 UWB-MIMO receiver to improve robustness and spectrum utilization. A two-timescale hospital interference model is developed by combining day-night WLAN activity variation with a Markov-modulated packet-level ON/OFF process. An INR sensing model with estimation uncertainty is introduced, and false-alarm and mis-detection effects are incorporated into threshold design. Based on this model, a hysteretic adaptive switching rule with dwell-time and consecutive-window constraints is formulated, and the ON/OFF thresholds are optimized to maximize long-term utility that balances spectral efficiency and switching cost. Baseline schemes include fixed notch-enabled and notch-disabled modes, no-hysteresis, periodic-sensing, and oracle benchmarks. Results demonstrate that the proposed method is robust to bursty interference and sensing uncertainty, consistently outperforms conventional baselines, and approaches oracle performance under diverse hospital WLAN coexistence conditions.

Board No.: P2-08

1571356482: Passive AP-Scale Sensing from Local Temporal and Channel-State Statistics in Multi-AP WLANs

Author(s): Yulin Mi, Linlin Zhao and Mingzhu Jin (Jilin University, China)

Abstract: Knowledge of local access-point (AP) population scale provides useful environmental context for coordination and resource management in dense wireless local area networks (WLANs). This paper investigates coarse AP-scale classification using only passive observations locally available at a target AP. Seven inter-arrival-time (IAT) features and seven clear-channel assessment (CCA)/IDLE features are extracted from each 0.5-s observation window. Mean and standard-deviation aggregation over 20 consecutive windows produces a 28-dimensional AP-level representation over 10s. A fixed radial-basis-function support vector machine (RBF-SVM) achieves 86.18% scenario-grouped out-of-fold (OOF) accuracy on 48 development scenarios. After the representation and model are frozen, evaluation on 12 completely held-out scenarios yields 86.84% accuracy. A diagnostic matching the total number of stations (STAs) retains 77.89% accuracy, indicating that total station count alone does not explain the observed discriminability. However, accuracy decreases to 53.12% under a stricter traffic-controlled stress test. The results show that local timing and CCA/IDLE statistics contain useful information about coarse AP population scale under the modeled operating distribution, while the controlled stress test reveals sensitivity to traffic-distribution shifts. The method is therefore positioned as a low-overhead environmental prior rather than a traffic-independent AP counter.

Board No.: P2-09

1571352010: Deep Reinforcement Learning for Covert Communication in Active STAR-RIS Assisted Multi-User ISAC Systems

Author(s): Chaochao Lv, Yunfei Li, Yiting Luo and Folly Pacome Noa Kpodar (Anhui Polytechnic University, China)

Abstract: This paper investigates covert communication in an active simultaneously transmitting and reflecting reconfigurable intelligent surface (STAR-RIS) assisted multi-user integrated sensing and communication (ISAC) system. In this system, a base station transmits confidential information to multiple users while simultaneously sensing multiple targets, a warden attempts to detect the presence of transmission, and a friendly jammer broadcasts jamming signals with random power to enhance covertness. To address the non-convex high-dimensional optimization problem, we propose a deep reinforcement learning based joint beamforming and RIS optimization framework to maximize the covert communication rate subject to constraints on total power, covertness, and multi-target sensing performance. The alternating optimization method is adopted as the benchmark. Numerical results demonstrate that the proposed approach achieves a higher covert rate compared with the benchmark.

Board No.: P2-10

1571356474: Dual-Path Optimization for Conformal Array Pattern Synthesis: Hybrid Convex Optimization and Physics-informed Neural Network

Author(s): Jiahao Chen, Chenzhang Feng, Wentao Li and Yongqiang Hei (Xidian University, China)

Abstract: This paper addresses pattern synthesis for cylindrical conformal arrays. Two algorithms, SADCP and the physics-informed neural network (PINN), are adapted by employing the Active Element Pattern (AEP) for accurate radiation modeling. Cross-polarization (XP) constraints are integrated into both frameworks to ensure polarization purity. Results show both methods successfully achieve the desired beamforming with excellent agreement to full-wave simulations, demonstrating the SADCP's robustness and the PINN's superior computational speed.

Board No.: P2-11

1571333300: A 77-GHz Low-Sidelobe Series-Fed Patch Array Antenna With Battery-Shaped Slots for Automotive Radar Applications

Author(s): YaLing Duan, Changhong Zhang and Yu Shao (Chongqing University of Posts and Telecommunications, China)

Abstract: This paper presents a low-sidelobe 77-GHz series-fed microstrip patch array antenna employing a novel battery-shaped slot loading technique for millimeter-wave (mmWave) radar applications. The proposed antenna consists of a microstrip feed line and nine pairs of rectangular patches loaded with battery-shaped slots, which are symmetrically arranged along both sides of the feed line and excited through a series-fed structure. The introduced slots modify the surface current distribution and electric field characteristics, thereby tailoring the equivalent amplitude tapering across the array aperture and achieving sidelobe level reduction. Furthermore, a dual nonuniform spacing strategy is employed to compensate for the phase errors induced by the unequal patch dimensions and series-fed configuration, resulting in improved beam pointing accuracy. Simulation results demonstrate that the proposed antenna achieves an impedance bandwidth from 76.4 to 77.6 GHz with S11 < -10 dB, a peak realized gain of 16.28 dBi, a sidelobe level of -16.5 dB, and a total efficiency of 92% at 77 GHz. Moreover, the antenna exhibits 3-dB beamwidths of 7.7° and 74.1° in the E-plane and H-plane, respectively. Owing to its high gain, low sidelobe characteristics and simple planar configuration, the

proposed antenna provides a promising solution for 77-GHz automotive radar systems.

Board No.: P2-12

1571333532: A Low-Profile Ultra-wideband Omnidirectional circular patch antenna for Vehicle Communications

Author(s): Changhong Zhang and Liang Guohao (Chongqing University of Posts and Telecommunications, China)

Abstract: A low-profile ultra-wideband omnidirectional circular patch antenna is proposed for cellular Sub-6 GHz communications. The antenna employs a dual-layer circular patch structure integrated with symmetric shorting vias, radial slots, and a tapered coaxial feeding configuration. Through the combined effects of electromagnetic coupling, inductive loading, multimode resonance, and broadband impedance transformation, multiple resonant modes are effectively excited and merged into a continuous operating band. Owing to the rotationally symmetric configuration, the antenna maintains stable azimuthal radiation characteristics throughout the entire operating band, providing reliable horizontal coverage for vehicular communications. The simulated results show that the proposed antenna achieves a 1.7-5.2 GHz impedance bandwidth ($|S_{11}| < -10$ dB), corresponding to approximately 101% relative bandwidth, while maintaining a low profile of 12 mm (0.068 λ0 at 1.7 GHz) and a realized gain ranging from 4.8 to 10.5 dBi with high radiation efficiency across the operating band. These characteristics make the proposed antenna well suited for low-profile vehicular communication platforms supporting Sub-6 GHz cellular communications.

Board No.: P2-13

1571348054: Covert Strategies for Communication Behavior and Location in Cell-Free IoT Systems

Author(s): Yixi Liu, Zhuangzhuang Zhang and Rui Chen (China Three Gorges University, China); Xiaojun Liu (State Grid Yichang Electric Power Supply Company, China)

Abstract: In this paper, we conceive a covert cell-free Internet of Things (CF-IoT) system that simultaneously protects the communication behavior and location of the transmitter and receiver by leveraging access points (APs). Meanwhile, probabilistic covert transmission strategies based on channel state information (CSI) and AP assisted channel inversion power control (CIPC) strategies have been proposed. Moreover, the detection performance of an eavesdropper (Eve) as well as covert performance of the receiver is comprehensively analyzed. Furthermore, an optimization problem aimed at maximizing covert rate is formulated, along with the corresponding algorithm, which yields the optimal transmission energy. Simulation results demonstrate that the proposed probabilistic covert transmission strategy and relay-aided CIPC strategy are significantly higher than the continuous transmission strategy and other CIPC strategies in terms of the total detection error probability (DEP).

Board No.: P2-14

1571348066: Hardware-Aware RF Waveform Synthesis for a Programmable Metasurface under Measured Aperture Constraints

Author(s): Xinyi Wang (Southeast University, China)

Abstract: Programmable metasurfaces are increasingly considered as reconfigurable radio-frequency (RF) front ends in which the electromagnetic response of an illuminated aperture is controlled directly to generate desired spectral and waveform characteristics. Most waveform-design methods for programmable metasurfaces assume that the complex reflection coefficient can be selected freely

within an ideal response region, or that amplitude and phase can be independently assigned. In practical hardware, however, the accessible complex response is determined by the tuning components, bias networks, and aperture-level electromagnetic interactions. Consequently, the physically realizable response can differ substantially from the ideal complex-envelope space assumed during waveform design.

This work investigates hardware-aware RF waveform synthesis using a PIN-varactor programmable metasurface operating at 2.3 GHz. Each unit cell integrates a PIN-diode bias network and a varactor bias network. The two electrical control variables jointly determine the aperture-level complex reflection response.

A dense two-dimensional sweep of the two controls yields 192,000 measured complex-reflection states. The measured states provide complete phase coverage over 360°, whereas their radial amplitude coverage is strongly nonuniform: the median normalized amplitude span within a 5° phase interval is 0.391, and the convex hull occupies 32.4% of the normalized unit-disk area. Phase coverage alone is therefore insufficient to characterize the complex-envelope capability available to waveform-control algorithms.

To make this constraint usable at design time, a hardware-aware synthesis procedure is introduced in which a desired temporal complex response is first projected onto the measured aperture state set before being applied to the metasurface. The procedure converts the measured device map into a design-stage model that predicts, for any candidate waveform, both the attainable spectral distribution and the implementation error caused by the finite response set. The framework was examined using programmed temporal bias waveforms that produce time-averaged spectra with 4, 8, and 12 discrete frequency components at 1 kHz spacing. Using a common extraction procedure, the measured target-component power spreads are 1.39, 2.27, and 2.52 dB, while 80.1-85.6% of the measured power within the analysis window is delivered to the intended components. The hardware-aware model reproduces these distributions to within 0.9 dB across all three waveforms and within 0.1 dB for the twelve-component case, demonstrating that waveform fidelity on this platform is predictable from the measured aperture map rather than requiring repeated over-the-air trials.

The study establishes a practical interface between aperture-level electromagnetic characterization and waveform-control algorithms. Rather than relying only on nominal amplitude and phase tuning ranges, hardware-aware waveform synthesis can incorporate the experimentally accessible complex-response space directly into waveform design. This approach is applicable to programmable metasurface RF front ends where the desired temporal response must be reconciled with nonideal device and aperture constraints.

Board No.: P2-15

1571344376: Towards Stable and Efficient Multi-Hop Routing in FANETs: A Security-Aware Approach

Author(s): Jiarong Cui and Yijie Xun (Northwestern Polytechnical University, China); Gang Zhao (State Grid Xinjiang Electric Power Company, China); Bomin Mao (Northwestern Polytechnical University, China); Jianming Hou (State Grid Xinjiang Electric Power Company, China); Hongzhi Guo (Northwestern Polytechnical University, China); Xiaobo Wang (State Grid Xinjiang Electric Power Company, China)

Abstract: Flying Ad Hoc Networks (FANETs), as a core architecture of Unmanned Aerial Vehicle (UAV) networks, are increasingly deployed in military operations, power grid inspection, and traffic monitoring. Reliable multi-hop communication among UAVs is essential for these application scenarios. However, FANET routing faces inherent challenges such as high node mobility, rapid topology changes, and limited onboard energy. Compounding these difficulties, insider attacks pose additional security

risks by manipulating packet forwarding behavior. Existing studies have optimized link stability, routing performance and energy efficiency. Nevertheless, they pay limited attention to secure next-hop selection under insider threats. To address this problem, we propose a security-aware approach for stable and efficient multi-hop routing in FANETs. It introduces GTM-QPLEX, a graph-temporal cooperative multi-agent reinforcement learning framework that jointly optimizes link stability, routing performance, energy efficiency and forwarding security. GTM-QPLEX uses a link-survival predictor and feasible-action masking to remove unreliable or unsafe next-hop candidates. It further adopts QPLEX-based value factorization to support decentralized next-hop selection under centralized training. Experimental results demonstrate that GTM-QPLEX improves link stability, routing performance, energy efficiency and forwarding security under insider attacks.

Board No.: P2-16

1571356631: Layered Application Architecture of Emerging Optical Fiber Technologies in Power Communication Networks in the Computing-Power Convergence Era

Author(s): Wei Liu (Electric Power Planning & Engineering Institute, China); Fuwen Bai and Han Zhang (State Grid Information & Telecommunication Center (Big Data Center), China); Jun Wu and Hongyan Zhou (Yangtze Optical Fibre and Cable Joint Stock Limited Company, China)

Abstract: Computing-power convergence, as a core direction of the national "Six Networks" new-type infrastructure initiative, imposes rigid requirements on power communication networks-ultra-high capacity, ultra-long distance, ultra-low latency, and ultra-high reliability-thereby driving optical fiber communication technology to achieve a fundamental breakthrough at the fiber-medium level. Focusing on power communication networks in computing-power convergence scenarios, this paper proposes a five-layer application architecture spanning backbone ultra-long span, transmission-and-transformation low latency, distribution-and-access high density, data-center flexible deployment, and fine-grained capacity expansion for existing scenarios, and systematically reviews the technical characteristics and industrial progress of five categories of emerging optical fibers.

Board No.: P2-17

1571312362: VEC-DTS: Priority-Aware Task Scheduling for Low-Latency Authentication in Dense VANETs

Author(s): Yanyan Wu and Liangliang Wang (Shanghai University of Electric Power, China); Yiyuan Luo (Huizhou University, China); Xiujie Zhang (University of Electronic Science and Technology of China, China); Weiwei Li (Shanghai University, China); Chuankun Zhao (East China Normal University, China)

Abstract: High-Vehicle-Density Vehicular Ad Hoc Networks (VANETs) impose strict latency requirements on safety-critical message authentication, where delay is increasingly dominated by queueing and resource contention rather than cryptographic operations. Existing solutions mainly focus on cryptographic optimization or computation offloading, while overlooking scheduling inefficiency under bursty and priority-skewed workloads. A lightweight Priority-Aware Greedy Scheduling (PAGS) algorithm is designed to jointly consider message priority, queue states, and heterogeneous resource capabilities for real-time task assignment and adaptive reallocation. Experimental evaluation confirms that Vehicular Edge Computing - Dynamic Task Scheduling (VEC-DTS) maintains sub-10 ms authentication latency and high deadline compliance under different emergency traffic ratios. Compared with representative existing authentication and task scheduling solutions for VANETs, the proposed framework achieves superior latency, deadline compliance and robustness. These results demonstrate the importance of scheduling-aware authentication in high-vehicle-density VANETs.

Board No.: P2-18

1571349014: An Exploratory Study of Parallel SAT Solving for Network Routing Feasibility

Author(s): Xikun Song (Jilin University, China); Qing Li and Xingchi Chen (Pengcheng Laboratory, China); Fa Zhu (Nanjing Forestry University, China); Teng Gao (Pengcheng Laboratory, China); Kangping Wang (Jilin University, China)

Abstract: Capacity-constrained routing requires discrete path choices under shared-link limits, making Boolean satisfiability (SAT) a natural feasibility model. We present an exploratory parallel conflict-driven clause learning (CDCL) solver for SNDlib-derived routing formulas. One MiniSat worker, logically isolated from clause sharing, starts immediately; after 2 ms, four full-formula helpers and four task workers join. Two influential demands with three candidate paths define nine mutually exclusive and exhaustive tasks. Full-formula helpers exchange only unit and binary learned clauses through bounded nonblocking buffers. A common solve-time clock includes the grace interval, dispatch, sharing, and search. We evaluate 87 unique formulas from 15 SNDlib topologies in five configurations with five repeats, totaling 2175 correct runs. The directly measured proposed configuration reduces arithmetic mean solve time from 122.017 to 59.831 ms, a 2.039-fold ratio. An offline protected first-result projection takes the earlier of paired five-run median MiniSat and collaborative times, yielding a projected 2.826-fold mean-time speedup overall. On the 22 formulas whose MiniSat time is at least 10 ms, the projected speedup is 2.881-fold. This projection suggests that the protected policy can retain low-latency handling while improving the expensive tail.

Board No.: P2-19

1571356480: Responsibility-Aware Trust Management for Driver-Vehicle Separation in Shared-Vehicle Scenarios

Author(s): Yilin Wu, Junhao Liu and Guozhi Song (Tiangong University, China)

Abstract: In shared mobility, driver-vehicle bindings and behavioral trustworthiness can change. Deriving driver reputation from vehicle history may penalize a normal driver for vehicle abnormalities while concealing abnormal driver behavior behind favorable vehicle history. This paper proposes responsibility-aware trust management under a single logical roadside unit (L-RSU). Event responsibility determines separate driver and vehicle updates, while evidence availability and binding-specific session states support trust decisions after rebinding. Simulations use OMNeT++, Veins, and SUMO. Across ten paired random seeds, the vehicle-history-mapping baseline produces an additional normal-driver reputation loss of 0.1616 ± 0.0009 (mean ± sample standard deviation); no corresponding loss is observed for the proposed method under the controlled attribution setting. Abnormal driver behavior lowers driver reputation without changing vehicle reputation in these paired runs. Additional experiments examine session isolation, update attenuation with insufficient evidence, and candidate eligibility.

Board No.: P2-20

1571313116: Edge Computing Offloading and Resource Synergy Optimization for Maritime Support of Unmanned Vessel Clusters

Author(s): Zhiheng Chen (Xiamen Aids to Navigation Department, Eastern Navigation Service Center, Ministry of Transport, China)

Abstract: Aiming at the problems of time-varying communication links, limited computing resources and strong task burst in the scenario of unmanned vessel cluster navigation support, this paper constructs an air sea integrated edge computing network architecture, establishes a joint model of

communication, computing and energy consumption, and transforms the unloading and resource collaborative optimization into a constrained multi-objective nonlinear optimization problem and proves that it is NP hard. On this basis, a dual layer joint optimization strategy is proposed: the upper layer implements distributed low latency offloading decisions based on D3QN, and the lower layer implements global optimization of edge node resources based on Nash bargaining. Simulation results show that this strategy is significantly superior to existing algorithms in terms of end-to-end latency, energy consumption, task completion rate, and resource utilization. The maximum reduction in average end-to-end latency is 42.7%, and the maximum reduction in system energy consumption is 35.2%, effectively meeting the low latency and high reliability requirements of unmanned vessel cluster navigation support services.

Board No.: P2-21

1571313967: Services Practice of Dynamic Optimization of Mobile Network Quality and User Level Precision Guarantee Based on NWDAF Intelligent Perception

Author(s): Suqin Han and Wenbin Tang (ZTE Corporation, China)

Abstract: With the widespread commercialization of 5G, latency- and bandwidth-critical services including live streaming, cloud gaming and remote meeting have raised user expectations from basic connectivity to differentiated high-quality network experience. Conventional static QoS schemes feature passive congestion response, isolated RAN-core data, poor multi-vendor RAN interoperability and low resource efficiency, failing to meet the tailored quality needs of premium users and key services. This paper proposes an AI-powered end-to-end personalized QoS assurance system based on the 3GPP-standardized NWDAF. When the QoS policy is triggered, the system simultaneously pushes a dedicated network identifier to the terminal to clearly indicate that assurance is active; upon completion, the identifier automatically reverts to normal and resources are released, forming a complete closed-loop management. It forms an automated closed-loop workflow covering full-network data collection, AI load prediction, dynamic policy delivery, cross-network-element coordination and idle resource reclamation. The architecture unifies scheduling for heterogeneous RAN hardware, predicts cell congestion in advance, and dynamically provisions/releases GBR dedicated bearers for VIP subscribers and enterprise services as needed. Test results under congested conditions show a 55.48% cut in conference end-to-end latency, 243.06% higher live-stream uplink throughput, and a 16.12% drop in poor-quality duration for VIPs, eliminating playback stuttering for both services. Distinct experience stratification between ordinary and VIP users is realized, alongside improved radio resource utilization, enabling operators to shift from volume-oriented to high-value experience-driven operations.

Board No.: P2-22

1571348857: Language Models as Semantic Codecs for HD Map Updates in Capacity-Limited V2X Networks

Author(s): Laihyuk Park and Heejae Park (Seoul National University of Science and Technology, South Korea)

Abstract: Enabling real-time High-Definition (HD) map updates is a critical requirement for autonomous driving. However, current Vehicle-to-Everything (V2X) networks, designed for small Basic Safety Messages (BSMs), lack the capacity to transmit the massive 3D point cloud data (e.g., 400 kB). Such large-scale transfers not only exceed link limits but also severely interfere with critical safety traffic. To address this fundamental limitation, this paper proposes a novel, Large Language Model (LLM)-empowered 5-phase semantic V2X communication framework. The framework leverages lightweight

Small Language Models (SLMs) on the vehicle to encode massive 3D point clouds into compact semantic messages (e.g., 145 B). These minimal messages are then transmitted over the V2X link and reconstructed into 3D geometry by powerful LLMs on a server. Evaluations using the nuScenes dataset confirm that the proposed framework achieves a semantic compression ratio of over 2,800:1. Notably, the few-shot In-Context Learning (ICL) strategy ensures high-fidelity 3D reconstruction by overcoming 3D data scarcity, significantly reducing both geometric and localization errors. Furthermore, a performance evaluation on an instrumented LTE-V2X testbed demonstrates real-world communication efficiency, maintaining consistently low latency and Packet Error Rate (PER) even under high vehicle density. Crucially, the analysis confirms that the lightweight semantic messages can safely coexist with high-priority BSM traffic. The proposed framework offers a practical solution for enabling data-intensive advanced Day-2 V2X applications over current V2X network infrastructure.

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