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- Amitava Mukherjee, Amrita Vishwa Vidyapeetham, India
- Husneni Mukhtar, Telkom University, Indonesia
- Hidekazu Murata, Yamaguchi University, Japan
- Woongsoo Na, Kongju National University, South Korea
- Ayano Naito, Aichi Institute of Technology, Japan
- Jin Nakazato, Tokyo University of Science, Japan
- Dukyun Nam, Kyungpook National University, South Korea
- Seung Yeob Nam, Yeungnam University, South Korea
- Shusuke Narieda, Kyushu Institute of Technology, Japan
- Harish Narne, Dazzlon Computer Services Inc, USA
- N Nasimuddin, Institute for Infocomm Research, Singapore
- Amiya Nayak, University of Ottawa, Canada
- Anand Nayyar, Duy Tan University, Vietnam
- Vibha Negi, Microsoft, USA
- Najett Neji, Paris-Saclay University, France
- Nhan Nguyen, University of Oulu, Finland
- Tri-Hai Nguyen, Van Lang University, Vietnam
- Truong Khang Nguyen, Van Lang University, Vietnam
- Devarani Devi Ningombam, National Institute of Technology (NIT), Patna, India
- Song Noh, Incheon National University, South Korea
- Wonjong Noh, Hallym University, South Korea
- Toshiro Nunome, Nagoya Institute of Technology, Japan
- Hiroshi Oguma, National Institute of Technology, Toyama College, Japan
- Seungmin Oh, Kongju National University, South Korea
- Yuichi Ohsita, The University of Osaka, Japan
- Mai Ohta, Kogakuin University, Japan
- Yasuo Okabe, Kyoto University, Japan
- Hiraku Okada, Meijo University, Japan
- Kenko Ota, Nippon Institute of Technology, Japan
- Sangheon Pack, Korea University, South Korea
- Jeongyeup Paek, Chung-Ang University, South Korea
- Deven Panchal, AT&T, USA
- Daejin Park, Kyungpook National University (KNU), South Korea
- Daeyoung Park, Inha University, South Korea
- Hosung Park, Chonnam National University, South Korea
- Hyungbae Park, University of North Georgia, USA
- Hyunggon Park, Ewha Womans University, South Korea
- Hyunhee Park, Myongji University, South Korea
- Jaehyun Park, Pukyong National University, South Korea
- Jihong Park, Singapore University of Technology and Design, Singapore
- JoonGoo Park, Kyungpook National University, South Korea

- Ki-Hong Park, King Abdullah University of Science and Technology (KAUST), Saudi Arabia
- Laihyuk Park, Seoul National University of Science and Technology, South Korea
- Minhho Park, Soongsil University, South Korea
- Sangoh Park, Chung-Ang University, South Korea
- Sangwoo Park, King's College London, United Kingdom (Great Britain)
- Seok-Hwan Park, Hanyang University ERICA, South Korea
- Seunghyun Park, Hansung University, South Korea
- Soohyun Park, Sookmyung Women's University, South Korea
- Suwon Park, Kwangwoon University, South Korea
- Shuping Peng, Huawei Technologies, China
- Thanh Pham, Shizuoka University, Japan
- Paulo F Pinto, Universidade Nova de Lisboa, Portugal
- Gaurav Pokharkar, Arizona State University, USA
- Tony Q. S. Quek, Singapore University of Technology and Design, Singapore
- Hassaan Khaliq Qureshi, National University of Sciences and Technology, Pakistan
- Ilkyeun Ra, University of Colorado Denver, USA
- Sruthi Rachamalla, Southern Illinois University, Carbondale, USA
- Redha M Radaydeh, Texas A&M University-Commerce, USA
- Shafeeq Ur Rahaman, Monks, USA
- Griengrai Rajchakit, Maejo University, Thailand
- Luca Reggiani, Politecnico di Milano, Italy
- Eric Renault, LIGM, Université Gustave Eiffel, CNRS, ESIEE Paris, France
- Seung Hyong Rhee, Kwangwoon University, South Korea
- Mohammed Ridouani, Hassan 2 University Casablanca - ESTC, Morocco
- Joel J. P. C. Rodrigues, Senac Fac of Ceará, Brazil
- Nuno Rodrigues, Instituto Politécnico de Bragança, Portugal
- Heejun Roh, Inha University, South Korea
- Harald Rohde, Nokia, Germany
- Roberto Rojas-Cessa, New Jersey Institute of Technology, USA
- Simon Pietro Romano, University of Napoli Federico II, Italy
- Xiaojun Ruan, California State University, East Bay, USA
- Ansa Shermin S, Bits Pilani K K Birla Goa Campus, India
- Yatendra Sahu, IIIT Bhopal, India
- Masato Saito, University of the Ryukyus, Japan
- Chathura Sarathchandra, InterDigital Europe, United Kingdom (Great Britain)
- Nurul I. Sarkar, Auckland University of Technology, New Zealand
- Sohail Sarwar, NAMAL University, Pakistan
- Koya Sato, The University of Electro-Communications, Japan
- Kwang-deok Seo, Yonsei University, South Korea
- Junhee Seok, Korea University, South Korea
- Peer Azmat Shah, Higher Colleges of Technology, United Arab Emirates
- Vrajesh Sharma, Panjab University, Chandigarh, India
- Kuei-Ping Shih, Tamkang University, Taiwan
- Dong-Joon Shin, Hanyang University, South Korea
- Dongwan Shin, New Mexico Tech, USA
- Jitae Shin, Sungkyunkwan University, South Korea
- Oh-Soon Shin, Soongsil University, South Korea
- Seokjoo Shin, Chosun University, South Korea
- Soo Young Shin, Kumoh National Institute of Technology, South Korea
- Wonjae Shin, Korea University, South Korea
- Yoan Shin, Soongsil University, South Korea
- Shigeo Shioda, Chiba University, Japan
- Joni W. Simatupang, Indonesia Defense University, Indonesia
- Paulo Simões, University of Coimbra, Portugal
- Seppo Sirkemaa, , Finland
- Jungmin So, Sogang University, South Korea
- Insoo Sohn, Dongguk University, South Korea
- Ho Kyung Son, ETRI, South Korea
- Yongseok Son, Chung-Ang University, South Korea
- Taewon Song, Dongguk University, South Korea
- Yujae Song, Yeungnam University, South Korea
- Ignacio Soto, Universidad Politécnica de Madrid, Spain
- Arun Kumar SP, Google, Ireland
- Andrej Stefanov, IBU Skopje, Macedonia, the former Yugoslav Republic of
- Wei-Tsung Su, National Ilan University, Taiwan
- Young-Joo Suh, Pohang University of Science and Technology (POSTECH), South Korea
- Himal A Suraweera, University of Peradeniya, Sri Lanka
- Matsuura Takafumi, Nippon Institute of Technology, Japan
- Mikiko Sode Tanaka, Hirotsaki University, Japan
- Akihito Taya, The University of Tokyo, Japan
- Ajay Lotan Thakur, Oracle, USA
- Anurag Thantharate, University of Missouri Kansas City, USA
- Pratik Thantharate, SUNY Binghamton, USA
- Hoang Thi Huong Giang, Tokyo City University, Japan
- Ljiljana Trajković, Simon Fraser University, Canada
- Gia Khanh Tran, Institute of Science Tokyo, Japan
- Kazuya Tsukamoto, Kyushu Institute of Technology, Japan
- Van Dat Tuong, Hanoi University of Science and Technology, Vietnam
- Ihsan Ullah, Yuan Ze University, Taiwan
- Adriaan J. van Wijngaarden, Bell Laboratories, Nokia, USA
- Athanasios V. V. Vasilakos, University of Agder, Norway
- Sivapriya Vellaichamy, Georgia Institute of Technology, USA
- Dario Vieira, EFREI, France
- Carlos Alberto Vieira Campos, Federal University of the State of Rio de Janeiro, Brazil
- Shibiao Wan, University of Nebraska Medical Center, USA
- Lei Wang, Dalian University of Technology, China

- Sheng-Wei Wang, National United University, Taiwan
- You-Chiun Wang, National Sun Yat-Sen University, Taiwan
- Charles H. P. Wen, National Yang Ming Chiao Tung University, Taiwan
- Carlos Becker Westphall, Federal University of Santa Catarina, Brazil
- Michal Wodczak, Samsung Electronics, Poland
- Huai-Kuei Wu, Asia Eastern University of Science and Technology, Taiwan
- Longfei Wu, Fayetteville State University, USA
- Xin-Wen Wu, University of Mary Washington, USA
- Yik-Chung Wu, The University of Hong Kong, Hong Kong
- Qin Xin, University of the Faroe Islands, Faroe Islands
- Li Xu, Fujian Normal University, China
- Sugang Xu, National Institute of Information and Communications Technology, Japan
- Tianhua Xu, University of Warwick, United Kingdom (Great Britain)
- Yao Xu, Georgia Southern University, USA
- Miki Yamamoto, Kansai University, Japan
- Ryo Yamamoto, The University of Electro-Communications, Japan
- Kenichi Yamazaki, Shibaura Institute of Technology, Japan
- Satoshi Yamazaki, Tokai University, Japan
- Guanhua Yan, Binghamton University, USA
- Heecheol Yang, Chungnam National University, South Korea
- Kazuto Yano, ATR, Japan
- Muhammad Azfar Yaqub, Free University of Bolzano, Italy
- Chia-Hung Yeh, National Taiwan Normal University, Taiwan
- Chun-Chao Yeh, National Taiwan Ocean University, Taiwan
- Chai Kiat Yeo, Nanyang Technological University, Singapore
- Younghwan Yoo, Pusan National University, South Korea
- JinYi Yoon, Inha University, South Korea
- Seokhoon Yoon, University of Ulsan, South Korea
- Seunghyun Yoon, Korea Institute of Energy Technology, South Korea
- Joo-Sang Youn, Dongeui University, South Korea
- Meng Yu, Governors State University, USA
- Ji-Hoon Yun, Seoul National University of Science and Technology, South Korea
- Rachid Zagrouba, University of Tunis El Manar, Tunisia
- Sherali Zeadally, University of Kentucky, USA
- Hans-Juergen Zepernick, Blekinge Institute of Technology, Sweden
- Liqiang Zhang, Indiana University South Bend, USA
- Peiyong Zhang, China University of Petroleum (East China), China
- Juzi Zhao, San Jose State University, USA

Message from ICUFN2026 Committees

On behalf of the ICUFN 2026 Committee Chairs, we are delighted to welcome all of you to Milan, Italy, from July 7th to 10th, 2026, for the seventeenth International Conference on Ubiquitous and Future Networks (ICUFN 2026). Since 2009, ICUFN has served as an international forum for sharing advanced research and promoting collaboration in ubiquitous and future communications and networking technologies.

This year, we received 720 paper submissions from around 20 countries worldwide. After a rigorous review process, 285 papers were selected for presentation. The accepted papers have been organized into 21 technical oral sessions, 4 poster sessions, and 17 workshop sessions, covering a wide range of topics such as B5G and 6G communications, AI and its applications, security, military and defense communications, services, applications, and other emerging technologies.

We sincerely appreciate all authors for their valuable contributions. We also thank the Technical Program Committee members, reviewers, workshop organizers, session chairs, keynote and tutorial speakers, and all committee members for their dedicated efforts in preparing a high-quality conference program.

We would also like to express our gratitude to KICS and Politecnico di Milano, as well as our technical co-sponsors, IEEE, IEEE Communications Society, and IEICE Communications Society. Our special thanks go to our patrons and sponsors, including ETRI, Samsung, LG Electronics, KT, LG U+, and other supporting organizations, for their generous support.

We hope all participants will enjoy the technical program of ICUFN 2026, actively exchange ideas with colleagues from around the world, and experience the beauty, history, and culture of Milan.

We look forward to welcoming you to Milan for ICUFN 2026.

Sincerely,



Sungrae Cho
Chung-Ang University, South Korea



Sunwoo Kim
Hanyang University, South Korea



Hamid Reza Karimi
Politecnico di Milano, Italy

ICUFN 2026 Organizing Committee Chairs



Seokjoo Shin
Chosun University,
South Korea



Youn-Hee Han
Korea Univ. of Technology
and Education, South Korea



Hien Quoc Ngo
Queen's University Belfast,
UK



Suguru Kameda
Hiroshima Univ.,
Japan



Mikio Hasegawa
Tokyo University of
Science, Japan

ICUFN 2026 TPC Chairs

ICUFN 2026 Program at a Glance

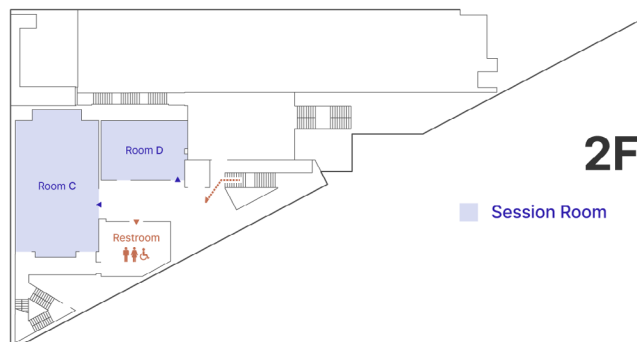
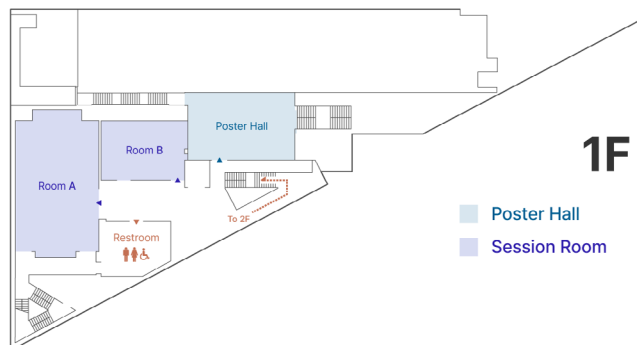
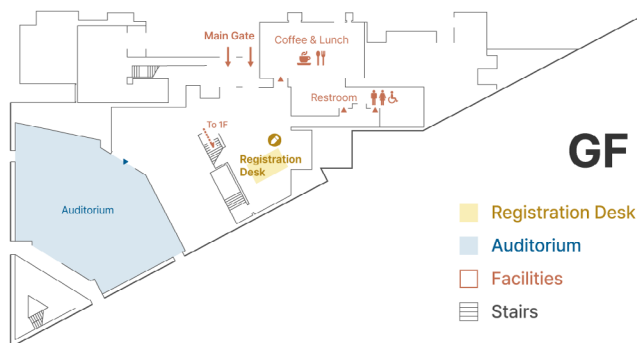
July 06, 2026 (Monday)				
Duration	Room A			
10:00 ~ 12:00	AI-Driven Strategic Planning Workshop for ICUFN (Invitation Only)			
12:00 ~ 14:00	Break			
14:00 ~ 17:00	ICUFN 2026 Committee Meeting (IAC/SC/OC)			

July 07, 2026 (Tuesday)				
Duration	1st Floor		2nd Floor	
	Room A	Room B	Room C	Room D
13:00 ~ 18:00	Registration			
13:00 ~ 14:40	Workshop W1 5G & 6G Communications Networks and Big Data 1 Chair: Prof. Laihyuk Park (Seoul National University of Science and Technology, South Korea)	Workshop W2 International Workshop of AICT (Artificial Intelligence Converged Technology) 1 Chair: Prof. Myoung Jin Lee (Chonnam National University, South Korea)	Workshop W3 International Workshop on Intelligent Vehicles Chair: Prof. Dong Seog Han (Kyungpook National University, South Korea)	Workshop W4 Workshop on Smart System Security Chair: Prof. Junbeom Hur (Korea University, South Korea)
14:40 ~ 15:00	Coffee Break			
15:00 ~ 16:40	Workshop W5 5G & 6G Communications Networks and Big Data 2 Chair: Prof. Woongsoo Na (Kongju National University, South Korea)	Workshop W6 International Workshop of AICT (Artificial Intelligence Converged Technology) 2 Chair: Prof. Myoung Jin Lee (Chonnam National University, South Korea)	Workshop W7 International Workshop on Next Generation OCC and FSO Chair: Prof. Yeong Min Jang (Kookmin University, South Korea)	Workshop W8 Korea-Finland Joint Research Program on Semantic Communication Chair: Prof. Hyowoon Seo (Sungkyunkwan University, South Korea)
16:40 ~ 16:50	Break			
16:50 ~ 18:30	Workshop W9 5G & 6G Communications Networks and Big Data 3 Chair: Prof. Laihyuk Park (Seoul National University of Science and Technology, South Korea)	Workshop W10 International Workshop of AICT (Artificial Intelligence Converged Technology) 3 Chair: Prof. Jeck-Chae Euom (Chonnam National University, South Korea)	Workshop W11 Next-Generation Intelligent Sensing and Communications Chair: Prof. Jingon Joung (Chung-ang University, South Korea)	Workshop W12 Workshop on Smart Radio for IoT Era 1 Chair: Prof. Takeo Fujii (The University of Electro-Communications, Japan)

July 08, 2026 (Wednesday)					
Duration	1st Floor		2nd Floor		1st Floor
	Room A	Room B	Room C	Room D	Poster Hall
09:00 ~ 18:00	Registration				
09:00 ~ 10:40	Workshop W13 5G & 6G Communications Networks and Big Data 4 Chair: Prof. Woongsoo Na (Kongju National University, South Korea)	Workshop W14 Smart Mobility Connectivity Chair: Prof. Ji-Woong Choi (DGIST)	Workshop W15 Workshop on RISE ICT-ABB Chair: Prof. Joon-Goo Park (Kyungpook National University, South Korea)	Workshop W16 Workshop on Smart Radio for IoT Era 2 Chair: Prof. Osamu Takyu (Shinshu University, Japan)	
	Break				
10:40 ~ 11:00	Opening Ceremony (Location: Auditorium, Ground Floor)				
	Opening Address: Prof. Sungrae Cho, Organizing Committee Chair (Chung-Ang University, South Korea) Welcome Address: Prof. Hamid Reza Karimi, Organizing Committee Chair (Politecnico di Milano, Italy) TPC Reports: Prof. Seokjoo Shin, TPC Chair (Chosun University, South Korea) Chair: Prof. Hyowoon Seo (Sungkyunkwan University, South Korea)				
11:00 ~ 12:00	Keynote Speech I				
	Task Offloading in Mobile Edge Computing for Internet of Things Prof. Ning Zhang (University of Windsor, Canada) Chair: Prof. Sunwoo Kim (Hanyang University, South Korea)				
12:00 ~ 13:30	Break				
13:30 ~ 14:10	Keynote Speech II (Location: Auditorium, Ground Floor)				
	Task-oriented Intelligent Communication for 6G and Beyond Prof. Byonghyo Shim (Seoul National University, South Korea) Chair: Prof. Mikio Hasegawa (Tokyo University of Science, Japan)				
14:10 ~ 15:00	Tutorial 1 (Location: Auditorium, Ground Floor)			ICT Express Award Ceremony (Location: Room A, 1st Floor)	
	ISAC for Physical-Layer Authentication in 6G Networks Prof. Stefano Tomasin (University of Padova, Italy) Chair: Prof. Hyowoon Seo (Sungkyunkwan University, South Korea)			Chair: Prof. Yeong Min Jang (Kookmin University, South Korea)	
15:00 ~ 15:20	Coffee Break				
15:20 ~ 17:00	Workshop W17 The International Workshop on Beyond-5G Networks: AI-Native RAN and Intelligent ISAC Chair: Prof. Sunwoo Kim (Hanyang University, South Korea)	Technical Session 01 Security, Military, and Defense 1 Chair: Prof. Taehoon Kim (Hanbat National University, South Korea)	Technical Session 02 Communications and Networks for B5G and 6G 1 Chair: Dr. Muhammad Azfar Yaqub (Free University of Bozen-Bolzano, Italy)	Technical Session 03 AI and Its Applications 1 Chair: Prof. Suk-seung Hwang (Chosun University, South Korea)	Poster P1 Chair: Prof. Yeon Ho Chung (Pukyong National University, South Korea)
	Conference Banquet (Location: Radisson Blu Hotel, Milan)				
18:00 ~ 21:00	Banquet Remarks: Prof. Sunwoo Kim, Organizing Committee Chair (Hanyang University, South Korea) and Selma Boumerdassi, TCIIN Chair (Université Paris 8, France) Awards Ceremony: Prof. Youn-Hee Han, TPC Chair (Korea University of Technology and Education, South Korea) Gala Performance (Opera and String Trio) Chair: Prof. Hyowoon Seo (Sungkyunkwan University, South Korea)				

July 09, 2026 (Thursday)					
Duration	1st Floor		2nd Floor		1st Floor
	Room A	Room B	Room C	Room D	Poster Hall
09:00 ~ 18:00	Registration				
09:00 ~ 10:40	Technical Session 04 Security, Military, and Defense 2 Chair: Prof. Insoo Sohn (Dongguk University, South Korea)	Technical Session 05 Communications and Networks for B5G and 6G 2 Chair: Prof. Yonggang Kim (Kongju National University, South Korea)	Technical Session 06 Communications and Networks for B5G and 6G 3 Chair: Prof. Sumin Jeong, (Kumoh National Institute of Technology, South Korea)	Technical Session 07 AI and Its Applications 2 Chair: Prof. Taesoo Jun (Kumoh National Institute of Technology, South Korea)	Poster P2 Chair: Prof. Eunkyung Kim (Hanbat National University, South Korea)
10:40 ~ 10:50	Break				
10:50 ~ 12:30	Technical Session 08 Security, Military, and Defense 3 Chair: Prof. Taesoo Jun (Kumoh National Institute of Technology, South Korea)	Technical Session 09 Communications and Networks for B5G and 6G 4 Chair: Ji-Woong Choi (DGIST, South Korea)	Technical Session 010 Communications and Networks for B5G and 6G 5 Chair: Prof. Insoo Sohn (Dongguk University, South Korea)	Technical Session 011 AI and Its Applications 3 Chair: Prof. Jin-Woo Jung (Dongguk University, South Korea)	Poster P3 Chair: Prof. Eunkyung Kim (Hanbat National University, South Korea)
12:30 ~ 14:00	Break				
14:00 ~ 14:50	Tutorial 2 Edge Network Intelligence for Distributed AI and Service Automation Prof. Guido Maier & Prof. Sebastian Troia (Politecnico di Milano, Italy) Chair: Prof. Hyosu Kim (Chung-Ang University, South Korea) <i>(Location: Auditorium, Ground Floor)</i>				
14:50 ~ 15:20	Coffee Break				
15:20 ~ 17:00	Technical Session 012 Services, Applications, and Emerging Topics 1 Chair: Dr. Esnot Ara Tuli (University of Southern Denmark, Denmark)	Technical Session 013 Communications and Networks for B5G and 6G 6 Chair: Prof. Jing Wang (University of South Florida, USA)	Technical Session 014 Communications and Networks for B5G and 6G 7 Chair: Prof. Osamu Takyu (Shinshu University, Japan)	Technical Session 015 AI and Its Applications 4 Chair: Prof. Dong Seong Kim (Kumoh National Institute of Technology, South Korea)	Poster P4 Chair: Prof. Jung Hoon Lee (Hankuk University of Foreign Studies, South Korea)

July 10, 2026 (Friday)			
Duration	1st Floor		2nd Floor
	Room A	Room B	Room C
09:00 ~ 12:00	Registration		
09:00 ~ 10:40	Technical Session 016 Services, Applications, and Emerging Topics 2 Chair: Prof. Eisuke Kudoh (Tohoku Institute of Technology, Japan)	Technical Session 017 Communications and Networks for B5G and 6G 8 Chair: Prof. Kohei Ohno (Meiji University, Japan)	Technical Session 018 AI and Its Applications 5 Chair: Prof. Su Min Kim (Tech University of Korea, South Korea)
	Break		
10:40 ~ 10:50	Technical Session 019 Services, Applications, and Emerging Topics 3 Chair: Prof. Seokjoo Shin (Chosun University, South Korea)	Technical Session 020 Communications and Networks for B5G and 6G 9 Chair: Prof. Younghoon Park (Sookmyung Women's University, South Korea)	Technical Session 021 Communications and Networks for B5G and 6G 10 Chair: Prof. Seong Ho Chae, (Tech University of Korea, South Korea)
	Break		
12:30 ~ 14:00	ICUFN 2026 Committee Meeting (IAC/SC/OC)		
14:00 ~ 17:00			
July 11, 2026 (Saturday)			
Duration	Room A		
09:30 ~ 12:00	ICUFN Workshop on AI Convergence Technologies (AIConv 2026) (ICUFN 2026 IAC/SC/OC Members Only)		



July 08, 2026 (Wednesday), 11:00 ~ 12:00

Location: Auditorium, Ground Floor

Keynote Speech I: Task Offloading in Mobile Edge Computing for Internet of Things

Speaker: Prof. Ning Zhang, University of Windsor, Canada

Chair: Prof. Sunwoo Kim (Hanyang University, South Korea)

Abstract:

Internet of things (IoT) lays the foundation for various emerging applications. As IoT devices are generally constrained with resources, mobile edge computing is proposed whereby data generated by IoT devices can be offloaded to nearby edge servers, so that their tasks can be served locally in real-time. Due to the dynamic, heterogenous, and time-varying operating environment, it is very challenging to utilize heterogeneous resources in an efficient way to meet the service requirements. In this talk, two research works on offloading will be presented, including i) deep reinforcement learning aided dynamic task offloading for IoT; and ii) multi-agent deep reinforcement learning for offloading in vehicular edge computing. Finally, future research directions are discussed.



Biography

Dr. Ning Zhang is a Full Professor and Canada Research Chair in the Department of Electrical and Computer Engineering at University of Windsor. He received the Ph.D degree in Electrical and Computer Engineering from University of Waterloo, Canada, in Jan. 2015. After that, he was a postdoc research fellow at University of Waterloo and University of Toronto, respectively. His research interests include connected vehicles, mobile edge computing, wireless networking, and security. He is a member of Royal Society of Canada College, a Distinguished Lecturer of IEEE, and a Highly Cited Researcher (Web of Science). He serves as the Chair for IEEE Technical Committee on Cognitive Networks and the Vice Chair for IEEE Technical Committee on Big Data. He was the Editor-in-Chief (EIC) of IEEE ComSoc Technical Committees Newsletter (TCN) and is the Founding EIC of Journal of Pervasive Intelligence and Internet of Things. He also serves/served as an Associate Editor of IEEE Transactions on Mobile Computing, IEEE Communications Surveys and Tutorials, IEEE Internet of Things Journal, and IEEE Transactions on Cognitive Communications and Networking.

July 08, 2026 (Wednesday), 13:30 – 14:10

Location: Auditorium, Ground Floor

Keynote Speech II: Task-oriented Intelligent Communication for 6G and Beyond

Speaker: Prof. Byonghyo Shim, Seoul National University, South Korea

Chair: Prof. Mikio Hasegawa (Tokyo University of Science, Japan)

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 wireless communication systems. Real-world demonstrations will be presented to illustrate the opportunities and challenges of AI-native wireless systems.



Biography

Byonghyo Shim (Fellow, IEEE) received the B.S. and M.S. degrees in control and instrumentation engineering from Seoul National University (SNU), South Korea, in 1995 and 1997, respectively, and the M.S. degree in mathematics and the Ph.D. degree in electrical and computer engineering from the University of Illinois at Urbana-Champaign (UIUC), Champaign, IL, USA, in 2004 and 2005, respectively.

From 1997 to 2000, he was an Officer (First Lieutenant) and an academic full-time Instructor with the Department of Electronics Engineering, Korean Air Force Academy. From 2005 to 2007, he was a Staff Engineer with Qualcomm Inc., San Diego, CA, USA. From 2007 to 2014, he was an Associate Professor with the School of Information and Communication, Korea University, Seoul. Since 2014, he has been with SNU, where he is currently a Professor with the Department of Electrical and Computer Engineering and the Director of the Institute of New Media and Communications. His research interests include wireless communications, statistical signal processing, and deep learning.

Dr. Shim was an Elected Member of the Signal Processing for Communications and Networking (SPCOM) Technical Committee of the IEEE Signal Processing Society. He was a recipient of the M. E. Van Valkenburg Research Award from the ECE Department, University of Illinois, in 2005, the Hadong Young Engineer Award from IEIE in 2010, the Irwin Jacobs Award from Qualcomm and KICS in 2016, the Shinyang Research Award from the Engineering College of SNU in 2017, the Okawa Foundation Research Award in 2020, the IEEE Comsoc AP Outstanding Paper Award in 2021, and the JCN Best Paper Award in 2024. He has been served as an Associate Editor for IEEE Transactions on Wireless Communications (IEEE TWC), IEEE Transactions on Communications (IEEE TCOM), IEEE Transactions on Vehicular Technology (IEEE TVT), IEEE Transactions on Signal Processing (IEEE TSP), IEEE Wireless Communications Letters (IEEE WCL), and Journal of Communications and Networks (JCN); and a Guest Editor for IEEE Journal on Selected Areas in Communications (IEEE JSAC).

July 08, 2026 (Wednesday), 14:10 ~ 15:00

Location: Auditorium, Ground Floor

Tutorial 1: ISAC for Physical-Layer Authentication in 6G Networks

Speaker: Prof. Stefano Tomasin, University of Padova, Italy

Chair: Prof. Hyowoon Seo (Sungkyunkwan University, South Korea)

Abstract:

Next-generation cellular networks will feature native Integrated Sensing and Communication (ISAC), providing unprecedented capabilities for both network-centric and third-party applications. This tutorial explores the integration of ISAC within the network infrastructure to bolster communication security and establish a trusted link between users and base stations. We demonstrate how ISAC-derived Channel Knowledge Maps (CKM) can track user mobility to verify that uplink packets originate from the legitimate user's coordinates, effectively neutralizing spoofing or impersonation attacks. We further analyze the properties of physical-layer authentication, highlighting the "unclonable" channel features that serve as robust security primitives. Finally, we provide a strategic outlook on current research and standardization trends in physical layer security (PLS).



Biography

Stefano Tomasin received the Ph.D. degree from the University of Padova, Italy, in 2003. During his studies, he did internships with IBM Research (Switzerland) and Philips Research (Netherlands). He joined the University of Padova, where he is now Full Professor. He was visiting faculty at Qualcomm, San Diego (CA) in 2004, the Polytechnic University in Brooklyn (NY) in 2007, and was with Huawei in Paris (France) in 2015. His current research interests include physical layer security, security of global navigation satellite systems, signal processing for wireless communications, synchronization, and scheduling of communication resources. He has been an Editor of the IEEE Transactions on Vehicular Technologies (2011-2016), of the IEEE Transactions on Signal Processing (2017-2020), of the EURASIP Journal of Wireless Communications and Networking (2011-2024), and of the IEEE Transactions on Information Forensics and Security (since 2020). He also serves as a Deputy Editor-in-Chief of the IEEE Transactions on Information Forensics and Security since January 2023.

July 09, 2026 (Thursday), 14:00 ~ 14:50

Location: Auditorium, Ground Floor

Tutorial 2: Edge Network Intelligence for Distributed AI and Service Automation

Speaker: Prof. Guido Maier and Prof. Sebastian Troia, Politecnico di Milano, Italy

Chair: Prof. Hyosu Kim (Chung-Ang University, South Korea)

Abstract:

Edge Network Intelligence is emerging as a key paradigm for future communication infrastructures, enabling distributed service delivery, real-time analytics, and AI-driven orchestration across cloud and edge domains. In this context, Software-Defined Wide Area Networking (SD-WAN) has evolved from a cost-effective alternative to traditional provider-managed wide-area networking solutions into a foundational enabler for intelligent edge networking and automation in enterprise and service provider environments. By decoupling the control and data planes and providing centralized policy-driven orchestration, SD-WAN enables dynamic traffic steering, automated service provisioning, real-time network analytics, and seamless integration with cloud and edge infrastructures.

This tutorial positions SD-WAN as a core enabling technology for Edge Network Intelligence, with direct relevance to emerging 6G scenarios characterized by ultra-low latency, pervasive connectivity, distributed AI, and programmable service delivery. In future 6G platforms, where networks evolve into intelligent and adaptive service fabrics, SD-WAN capabilities combined with AI/ML-driven network management can support dynamic service placement, SLA-aware routing, fine-grained traffic segmentation, adaptive resource scaling, and autonomous orchestration across distributed edge and cloud environments. The tutorial provides

a comprehensive overview of the technological foundations of Edge Network Intelligence, highlighting how SD-WAN facilitates automation, observability, and intelligent decision-making at the network edge. It will cover architectural principles, orchestration frameworks, AI-enhanced control mechanisms, and integration challenges, supported by practical use cases and experimental demonstrations that illustrate both current deployments and future research directions toward 6G intelligent networking ecosystems.

Biography



Guido Maier (Senior member IEEE), received his Laurea degree in Electronic Engineering at Politecnico di Milano (Italy) in 1995 and his Ph.D. degree in Telecommunication Engineering at the same university in 2000. Until February 2006 he has been researcher at CoreCom (research consortium supported by Pirelli in Milan, Italy), where he achieved the position of Head of the Optical Networking Laboratory. On March 2006 he joined the Politecnico di Milano as Assistant Professor. In 2015 he became Associate Professor. His main areas of interest are: optical network modeling, design and optimization; SDN orchestration and control-plane architectures; SD-WAN and NFV. He is author of more than 150 papers in the area of Networking published in international journals and conference proceedings (h-index 29) and 6 patents. He has been involved in industrial and European research projects, and is currently PI of the project WatchEDGE – NextGeneratioEU funds. In 2016 he co-founded the start-up SWAN networks, spin-off of Politecnico di Milano. He is editor of the journal Optical Switching and Routing, General Chair of DRCN 2020, DRCN 2021, IEEE NetSoft 2022 and IEEE HPSR 2025, and TPC member in many international conferences. He is IEEE Senior Member.



Sebastian Troia (member IEEE) is an Associate Professor at the Department of Electronics, Information and Bioengineering, Politecnico di Milano, Italy, and a Fulbright Fellow at the University of Texas at Dallas, USA. He received his Ph.D. in Information Technology (Telecommunications) cum laude from Politecnico di Milano in 2020 and is a partner at SWAN Networks, a Politecnico di Milano spin-off specializing in SDN/SD-WAN orchestration. His research focuses on Edge Network Intelligence and AI/ML for SDN, SD-WAN, and multi-layer optical/IP networks. He has contributed to several European projects, including H2020 Metro-Haul and NGI Atlantic, and served as an editor for the ITU-T FG-ML5G. He has authored over 80 publications and is active in TPC and organizing committees for major conferences such as IEEE ICC, GLOBECOM, NetSoft, and others. He is the founder and co-organizer of the Edge Network Softwarization (ENS) workshop series, now in its 5th edition in conjunction with IEEE NetSoft 2026. In 2025, he received the IEEE ComSoc EMEA Outstanding Young Researcher Award.

July 07, 2026 (Tuesday)

W1. 5G & 6G Communications Networks and Big Data 1

Chair: Laihyuk Park (Seoul National University of Science and Technology, South Korea)

Room A, Time 13:00~14:40

- [W1-01] Self-Directed Spectrum Allocation Framework for Integrated TN-NTN 6G Networks
Vaskar Chakma and Wooyeol Choi (Chung-Ang University, Korea (South))
- [W1-02] Implementation of a ZSM-Based Network Agent for Automated Traffic Detection and Unified Data Collection in Multi-Generation Networks
Mahn-suk Yoon (Gumi Electronics & Information Technology Research Institute, Korea (South)); Sunghun Lee (GERI, Korea (South))
- [W1-03] Two-Stage Rotor Micro-Doppler Detection in OFDM Sensing Using Mover Gating and Harmonic Signature Classification
Zahra Zarei and Chung G. Kang (Korea University, Korea (South))
- [W1-04] Energy-Aware Online Fog Scheduling for Mixed Agricultural Sensing Platforms
Trong-Minh Hoang (Posts and Telecommunications Institute of Technology, Vietnam); Thi-Thao Luu (East Asia University of Technology, Vietnam); Quang-Nam Nguyen and Quang-Khai Nguyen (Posts and Telecommunications Institute of Technology, Vietnam); Nhu-Ngoc Dao (Sejong University, Korea (South))
- [W1-05] AI-on-RAN in 6G: Architecture, Taxonomy, and Deployment Challenges for Integrated Intelligence
Jiwon Park (Chung-Ang University, Korea (South)); Yonggang Kim (Kongju National University, Korea (South)); Wooyeol Choi (Chung-Ang University, Korea (South))
- [W1-06] A Survey on Explainable Artificial Intelligence for Vehicle-to-Everything Communication Networks
Seongryool Wee, Heejae Park, SeungYeop Song and Laihyuk Park (Seoul National University of Science and Technology, Korea (South))
- [W1-07] Satellite Semantic Communication: A Survey on Architectures, Onboard Processing, and Inter-Satellite Networking
Tung Son Do, Thanh Phung Truong, The Vi Nguyen, Thi My Tuyen Nguyen, Seongjin Choi and Sungrae Cho (Chung-Ang University, Korea (South))

W2. International Workshop of AICT (Artificial Intelligence Converged Technology) 1

Chair: Prof. Myoung Jin Lee (Chonnam National University, South Korea)

Room B, Time 13:00~14:40

- [W2-01] Knowledge Graph-Based Propagation for Failure Localization in 5G Core Networks
Abubakar Isah (Chonnam National University, Korea (South) & Ahmadu Bello University Zaria, Nigeria); Ibrahim Aliyu, Seungmin Oh and Jaehyung Park (Chonnam National University, Korea (South)); Minsoo Hahn (Astana IT University, Korea (South)); Jinsul Kim (Chonnam National University, Korea (South))
- [W2-02] Cross-Modal Gated Fusion for Joint Anomaly Detection and Fault Category Diagnosis in Distributed Systems
Jihoon Lee, Juhyeon Noh and Jaehyung Park (Chonnam National University, Korea (South)); Ho Yong Ryu (ETRI, Korea (South)); Minsoo Hanh (Astana IT University, Kazakhstan); Jinsul Kim (Chonnam National University, Korea (South))
- [W2-03] Cascade Segmentation with L1-Norm Dice-Focal Loss for Tiny Lesion Detection in Medical Imaging
Sangwon Oh, Doyeon Kim, Jaeho Song, Yewon Lee, Yonggwon Won and Jinsul Kim (Chonnam National University, Korea (South))
- [W2-04] Evaluating Digital Forensic Readiness of Charging Station Management Systems Implementing OCPP
Jeck-Chae Euom (Chonnam National University, Korea (South)); Dong-Hyuk Shin (SSRC, Korea (South))
- [W2-05] A Nonlinear-Cross-Aware 13.56-MHz GaN Class-E Inverter Stage for kW-Class DC-DC Front-End Operation
Geon Kim, Ryun Kang, Dongyeong Kim, Suyeon Kim, Jewon Park, Shinwook Kim, Hyerin Lee and Myoung Jin Lee (Chonnam National University, Korea (South))

W3. International Workshop on Intelligent Vehicles

Chair: Prof. Dong Seog Han (Kyungpook National University, South Korea)

Room C, Time 13:00~14:40

- [W3-01] Does Image Deraining Improve Downstream Perception Tasks in Autonomous Driving?
George Albert Bitwire (Kyungpook National University, Korea (South)); Jung Hwan Kim (Kyungpook National University, Korea (South)); Dong Seog Han (Kyungpook National University, Korea (South))
- [W3-02] Pose-Graph Based Multi-Sensor Fusion for Indoor Mobile Robot Localization and Mapping
Lee Jin Yeong and Min Young Kim (Kyungpook National University, Korea (South))
- [W3-03] Redefinition of Inter-Message Arrival Time for Robust Controller Area Network Intrusion Detection
Rémi Bouchayer (Telecom SudParis - Institut Polytechnique de Paris, France & ECE Paris, France); Jae Yun Jun Kim (ECE Paris, France);

Hakima Chaouchi (Télécom SudParis, France); Philippe Millet (Nexter Systems, France)

- [W3-04] **A Ping-Assisted ISAC for Slot-Aware Medium Access Control for Underwater Acoustic Communications in AUV Swarms**
Yoon Kwon and Ho-Shin Cho (Kyungpook National University, Korea (South))
- [W3-05] **Socially Adaptive Robot Navigation via Emotion-Gesture Fusion**
Savina Jassica Colaco (Kyungpook National University & Center for ICT & Automotive Convergence, Korea (South)); Dong Seog Han (Kyungpook National University, Korea (South))
- [W3-06] **Natural Language-Driven Active AI Agent Camera System: LLM-Guided Semantic Anchor Modulation for Real-Time Edge Deployment**
Hyan su Bae (Electronics and Telecommunications Research Institute, Korea (South)); Jinhong Kim (Electronics and Telecommunications Research Institute (ETRI), Korea (South)); Yun-Won Choi (Electronics & Telecommunications Research Institute, Korea (South)); Jang Woon Baek (ETRI, Korea (South))

W4. Workshop on Smart System Security

Chair: Prof. Junbeom Hur (Korea University, South Korea)

Room D, Time 13:00~14:40

- [W4-01] **NFT Price-Prediction-Based Frontrunning Attack in Ethereum**
Juyeon Yi, Donghee Kim and Junbeom Hur (Korea University, Korea (South))
- [W4-02] **Exploring Potential Vulnerabilities in Decomposed Convolutional Filters for Federated Learning**
Jeawoon Jeong and Changhee Hahn (Seoul National University of Science and Technology, Korea (South))
- [W4-03] **FlatLeak-GEIA: Generative Text Inversion from Exact-KNN Score Leakage**
Junmo Kim and Changhee Hahn (Seoul National University of Science and Technology, Korea (South))
- [W4-04] **Reproducible Integrity Verification in Package Ecosystems**
Sangkyoung Park and Hyunsoo Kwon (Inha University, Korea (South))
- [W4-05] **Formal Verification of Token Replay Resistance Under DPoP for Single-Page Applications**
Jiyong Lee and Hyunsoo Kwon (Inha University, Korea (South))
- [W4-06] **Towards Bitcoin Mixer Deanonymization via Confirmation Time Prediction**
Donghee Kim and Juyeon Yi (Korea University, Korea (South)); Rihyun Kang (Ewha Womans University, Korea (South)); Junbeom Hur (Korea University, Korea (South))

W5. 5G & 6G Communications Networks and Big Data 2

Chair: Woongsoo Na (Kongju National University, South Korea)

Room A, Time 15:00~16:40

- [W5-01] **OTFS Modulation: A Promising Solution for LEO Satellite Communications**
The Vi Nguyen and Thi My Tuyen Nguyen (Chung-Ang University, Korea (South)); Tam Dinh Ton That (Chung Ang University, Korea (South)); Jaemin Kim and Sungrae Cho (Chung-Ang University, Korea (South))
- [W5-02] **Deep Learning-Based Semantic Image Communication for Satellite IoT Networks: A Survey**
Wondmagegn Ayalneh Bitew (Chung-Ang University, Korea (South)); Tam Dinh Ton That (Chung Ang University, Korea (South)); Thwe Thwe Win, Dongwook Won and Sungrae Cho (Chung-Ang University, Korea (South))
- [W5-03] **Large-Scale MIMO for Satellite Communications: Opportunities and Challenges**
Thi My Tuyen Nguyen, The Vi Nguyen, Hao Hoang Tran, Chihyun Song and Sungrae Cho (Chung-Ang University, Korea (South))
- [W5-04] **Dynamic Constellation Optimization for Quantum Key Distribution in LEO Satellite Networks**
Thanh Phung Truong, Tung Son Do, Seongjin Choi, Junsuk Oh, The Vi Nguyen and Sungrae Cho (Chung-Ang University, Korea (South))
- [W5-05] **Joint Trajectory and Scheduling Optimization for UAV-Assisted 6G Networks: A Deep Reinforcement Learning Approach with Throughput-Aol Trade-off**
Quang Tuan Do, Tung Son Do, Thanh Phung Truong, Dongwook Won and Sungrae Cho (Chung-Ang University, Korea (South))
- [W5-06] **Federated Deep Reinforcement Learning for MEC-UAV Network: A Survey**
Huy Dang Mac (Chung-Ang University, Korea (South)); Kiet Nguyen Tuan Tran (Chung Ang University, Korea (South)); Tung Son Do and Sungrae Cho (Chung-Ang University, Korea (South))
- [W5-07] **A Secure Hierarchical Federated Learning Architecture for UAV-Enabled Edge Computing Systems**
Tam Dinh Ton That (Chung Ang University, Korea (South)); Cuong Ho, Wondmagegn Ayalneh Bitew, Juyoung Kim, Junsuk Oh, The Vi Nguyen and Sungrae Cho (Chung-Ang University, Korea (South))

W6. International Workshop of AICT (Artificial Intelligence Converged Technology) 2

Chair: Prof. Myoung Jin Lee (Chonnam National University, South Korea)

Room B, Time 15:00~16:40

- [W6-01] **Uneven Learnability of Electrical Characteristics in TCAD-Derived LDMOS Surrogate Models**
Shinwook Kim, Geon Kim, Dongyeong Kim, Suyeon Kim, Jewon Park, Ryun Kang, Hyerin Lee and Myoung Jin Lee (Chonnam National University, Korea (South))

University, Korea (South))

- [W6-02] **Analysis of Total Ionizing Dose Effects in Buried Channel Array Transistors with Scaled Word-Line-Direction STI/Side-Gate Thickness**
Jewon Park, Geon Kim, Dongyeong Kim, Suyeon Kim, Shinwook Kim, Ryun Kang, Hyerin Lee and Myoung Jin Lee (Chonnam National University, Korea (South))
- [W6-03] **G-MAO: Gaze-Grounded Multi-Agent Orchestration for XR Document Understanding**
YunSu Lee and Seung-won Kim (Chonnam National University, Korea (South))
- [W6-04] **Design of Reinforcement Learning-Based Simulation Framework for Route and Energy Management of Autonomous Delivery Robots**
Ryun Kang, Geon Kim, Dongyeong Kim, Suyeon Kim, Jewon Park, Shinwook Kim, Hyerin Lee and Myoung Jin Lee (Chonnam National University, Korea (South))
- [W6-05] **Compressing the Supervised Target with Analytic Circuit Laws for Sparse-Label DRAM BLSA Margin Prediction**
Dongyeong Kim, Suyeon Kim, Jewon Park, Shinwook Kim, Ryun Kang, Hyerin Lee, Geon Kim and Myoung Jin Lee (Chonnam National University, Korea (South))

W7. International Workshop on Next Generation OCC and FSO

Chair: Prof. Yeong Min Jang (Kookmin University, South Korea)

Room C, Time 15:00~16:40

- [W7-01] **Propagation-Model Sensitivity in Urban VANETs: A SUMO-ns-3 Benchmark Across Traffic Load Scenarios**
Sang-Chul Kim and Zuoqian Zhou (Kookmin University, Korea (South))
- [W7-02] **A Stability-Driven Clustering Scheme for Uninterrupted Federated Learning in UAV Networks**
Su-Gyeong Kim and Woonghee Lee (Dongguk University, Korea (South))
- [W7-03] **RF-LiTE: An Ultra-Lightweight Linear-Attention Network for RSSI-Based Indoor Localization**
Ida Bagus Krishna Yoga Utama (Kookmin University, Korea (South)); Jaeyun Yoo (Electronics and Telecommunication Research Institute, Korea (South)); Yeong Min Jang (Kookmin University, Korea (South))
- [W7-04] **UWB PDoA-Based Localization for Vision Sensor Alignment in Optical Camera Communication**
MinJun Kim, UkHyun Jeong and Seunggho Yoo (Pukyong National University, Korea (South))
- [W7-05] **A Deep Learning-Based Vehicular Optical Camera Communication System**
Huy Nguyen and Yeong Min Jang (Kookmin University, Korea (South))

W8. Korea-Finland Joint Research Program on Semantic Communication

Chair: Hyowoon Seo (Sungkyunkwan University, South Korea)

Room D, Time 15:00~16:40

- [W8-01] **Distribution-Level AirComp for Bayesian FL**
Jun-Pyo Hong (Hongik University, Korea (South)); Hyowoon Seo (Sungkyunkwan University, Korea (South)); Kisong Lee (Dongguk University, Korea (South))
- [W8-02] **Spatial CRLBs for RIS-Aided Monostatic Self-Localization**
Eunae Choi (Chungnam National University, Korea (South)); Yu Ge (Massachusetts Institute of Technology, USA); Hyowon Kim (Chungnam National University, Korea (South))
- [W8-03] **On the Optimal Number of Participating Clients in NOMA-Based Federated Learning Under Imperfect SIC**
JongHyuk Lee and Hyowoon Seo (Sungkyunkwan University, Korea (South))
- [W8-04] **Channel Estimation for Multi-RIS Wireless Systems: A Brief Taxonomy and near-Field Perspective**
Donghyeon Ban and Hyowoon Seo (Sungkyunkwan University, Korea (South))
- [W8-05] **IoV-Assisted Semantic Communication for Occlusion-Aware Edge Autonomous Driving**
Tri Thanh Ho, Yekang Han, Seongbin Yun and Hyowoon Seo (Sungkyunkwan University, Korea (South))
- [W8-06] **A Survey on UAV-Assisted Wireless Communications for Future Networks**
Jueun Jeong, Sehyeon Kwon, Changhui Kim and Hyowoon Seo (Sungkyunkwan University, Korea (South))

W9. 5G & 6G Communications Networks and Big Data 3

Chair: Laihyuk Park (Seoul National University of Science and Technology, South Korea)

Room A, Time 16:50~18:30

- [W9-01] **A Survey for Integrating FAS, RIS, and Hybrid NOMA-MEC in 6G Wireless Network**
Kiet Nguyen Tuan Tran (Chung Ang University, Korea (South)); Huy Dang Mac, Tung Son Do and Sungrae Cho (Chung-Ang University, Korea (South))
- [W9-02] **Toward Low-Latency Privacy-Preserving Federated Learning in Fluid Antenna Systems with Homomorphic Encryption**
Cuong Ho (Chung-Ang University, Korea (South)); Tam Dinh Ton That and Kiet Nguyen Tuan Tran (Chung Ang University, Korea (South)); Huy Dang Mac, Junsuk Oh, Donghyun Lee, Chihyun Song and Sungrae Cho (Chung-Ang University, Korea (South))
- [W9-03] **A Survey on Caching in Semantic Communication**
Thwe Thwe Win, Wondmagegn Ayalneh Bitew, Cuong Ho, Junsuk

Oh, Juyoung Kim and Sungrae Cho (Chung-Ang University, Korea (South))

[W9-04] Toward End-to-End Intent-Based Networking for 6G: Architectures, Challenges, Recent Advances, and Future Directions

Dongwook Won and Thanh Thien-An Dang (Chung-Ang University, Korea (South)); Tam Dinh Ton That (Chung Ang University, Korea (South)); Wondmagegn Ayalneh Bitew, Hao Hoang Tran, Seungchan Lee and Juyoung Kim (Chung-Ang University, Korea (South)); Kiet Nguyen Tuan Tran (Chung Ang University, Korea (South)); Sungrae Cho (Chung-Ang University, Korea (South))

[W9-05] Robust PRACH Preamble Detection Using GATv2-Based Graph Learning for 5G/6G Networks

Viet Anh-Huy Le, Anh-Tien Tran, Thanh Thien-An Dang and Sungrae Cho (Chung-Ang University, Korea (South))

[W9-06] Toward Event-Driven Per-UE xApps in Open RAN near-RT RIC

Thanh Thien-An Dang, Dongwook Won, Juyoung Kim, Viet Anh-Huy Le, Jaemin Kim and Sungrae Cho (Chung-Ang University, Korea (South))

[W9-07] Vacuum QoS Constraints in Constrained DRL-URLLC Simulations: Root Causes, Detection, and Remedies

Hao Hoang Tran, The Vi Nguyen, Thi My Tuyen Nguyen, Dongwook Won, Junsuk Oh and Sungrae Cho (Chung-Ang University, Korea (South))

W10. International Workshop of AICT (Artificial Intelligence Converged Technology) 3

Chair: Prof. Ieek-Chae Euom (Chonnam National University, South Korea)

Room B, Time 16:50~18:30

[W10-01] A New Dual-Engine Error Recovery Scheme for High-Reliability HBM

Keonwoo Kim and Heonjun Min (Inha University, Korea (South)); Jungin Park (Hyundai Motor Company, Korea (South)); Young-woo Lee (Inha University, Korea (South))

[W10-02] WTM-Aware Shift Direction Selection for Low Power Bidirectional Scan Testing

Donghyun Kim and Juhyun Park (Inha University, Korea (South)); Jungin Park (Hyundai Motor Company, Korea (South)); Young-woo Lee (Inha University, Korea (South))

[W10-03] AI-Based Prediction of Coupling Effects on Transistor Switching Performance in DRAM

Suyeon Kim, Geon Kim, Dongyeon Kim, Shinwook Kim, Jewon Park, Ryon Kang, Hyerin Lee and Myoung Jin Lee (Chonnam National University, Korea (South))

[W10-04] Communication-Aware Adaptive Decentralized Traffic Signal Control via Broadcast Gate

Minjun Choi, Geonmin Kim, Hyeonji Jang, Md Ilias Bappi and Kyungbaek Kim (Chonnam National University, Korea (South))

[W10-05] Surrogate-Assisted Boundary Search Importance

Sampling for Failure Probability Estimation of Offset-Compensated Sense Amplifiers

Hyerin Lee, Geon Kim, Dongyeon Kim, Suyeon Kim, Jewon Park, Shinwook Kim, Ryon Kang and Myoung Jin Lee (Chonnam National University, Korea (South))

W11. Next-Generation Intelligent Sensing and Communications

Chair: Prof. Jingon Joung (Chung-ang University, South Korea)

Room C, Time 16:50~18:30

[W11-01] Autoregressive Model-Based Signal Reconstruction for OCDM-Induced Interference Mitigation in FMCW-Based Sensing Systems

Heekwon Yoon and Seongwook Lee (Chung-Ang University, Korea (South))

[W11-02] Velocity Disambiguation and Doppler-Induced Interference Mitigation for SC-OFDM Systems in High-Mobility Scenarios

Yeong Choi and Seongwook Lee (Chung-Ang University, Korea (South))

[W11-03] AI-Based Estimation of the Active Relay Count Using Received Power

Geun Won Choi, Eui-Rim Jeong and Soyeon Jeon (Hanbat National University, Korea (South))

[W11-04] Experimental Validation of Random Phase Rotation for SC-FDE Systems in BRN Environments

Deuk-Han Lee, Soyeon Jeon, Geun Won Choi and Eui-Rim Jeong (Hanbat National University, Korea (South))

[W11-05] DNN-Based 3D Relative Positioning Using Inter-Node Distances in Indoor Environments

Euna Ko, Deuk-Han Lee, Geun Won Choi and Eui-Rim Jeong (Hanbat National University, Korea (South))

[W11-06] Low-Cost Wideband Intelligent Reflective Surface Using Vanadium Dioxide Switches with Magneto-electric (ME) Dipole Resonance for 6G Communications

Hyojin Jang, Junghyeon Kim and Sungjoon Lim (Chung-Ang University, Korea (South))

[W11-07] Fully Additive Manufacturing of 2.5D RF Circuits

Seyeon Park, Junghyeon Kim and Sungjoon Lim (Chung-Ang University, Korea (South))

W12. Workshop on Smart Radio for IoT Era 1

Chair: Prof. Takeo Fujii (The University of Electro-Communications, Japan)

Room D, Time 16:50~18:30

[W12-01] Robust mmWave Beam Tracking with Bounded Updates Against CAM Latency and Location Errors

Jin Nakazato, Yuki Sasaki, Ryoichi Nori, Keishi Hijikata, Mayu

Selena Horiuchi and Mikio Hasegawa (Tokyo University of Science, Japan); Haruki Osaki and Tetsuya Iye (Kozo Keikaku Engineering Inc., Japan); Kazuki Maruta (Tokyo University of Science, Japan); Rui Dinis (Universidade Nova de Lisboa & Nova IT, FCT-UNL, Portugal)

[W12-02] A Study on Predicting Channel Occupancy Rate of New Terminals Using Occupancy Rate Notification in WLAN
Kazuki Kuwabara and Osamu Takyu (Shinshu University, Japan); Takeo Fujii (The University of Electro-Communications, Japan)

[W12-03] Value-Aware Packet Dropping with Dynamic Threshold Control Based on Queue Congestion Using Programmable Data Planes
Midori Kawaguchi (Kyushu Institute of Technology, Japan); Yuzo Taenaka (Nara Institute of Science and Technology, Japan); Kazuya Tsukamoto (Kyushu Institute of Technology, Japan)

[W12-04] Obstacle-Aware Interpolation for Real-Time Radio Map Generation in Smart Factories
Tatsuki Omori, Tatsuya Hatagi, Taketo Kakimoto, Masataka Miyake and Suguru Kameda (Hiroshima University, Japan)

[W12-05] Evaluation of the Impact of Timing Synchronization Errors in Synchronized SS-CDMA Under Massive Connectivity
Sho Kanazawa, Tomokazu Watanabe, Toshiki Ouchi, Masataka Miyake and Suguru Kameda (Hiroshima University, Japan)

[W12-06] Comparative Evaluation of Required Satellite Count for OTFS and OFDM in LEO Communications
Nozomi Nakai, Ryo Arimura, Kensuke Kawaguchi, Masataka Miyake and Suguru Kameda (Hiroshima University, Japan)

July 08, 2026 (Wednesday)

W13. 5G & 6G Communications Networks and Big Data 4

Chair: Woongsoo Na (Kongju National University, South Korea)

Room A, Time 09:00~10:40

[W13-01] A Survey on LLM-Based Network Resource Optimization
Junyoung Park (Kongju-National University, Korea (South)); Woongsoo Na (Kongju National University, Korea (South))

[W13-02] A Survey of AI-Based Resource Management and QoS Modeling in 6G Space-Air-Ground Integrated Networks: A Three-Axis Taxonomy
Minjae Go and Woongsoo Na (Kongju National University, Korea (South))

[W13-03] Toward Fusion Intelligence of Open Radio Access Network with Federated Learning: A Survey
Junsuk Oh, Donghyun Lee, Chunghyun Lee, Dongwook Won, Jaemin Kim, Chihyun Song, Hao Hoang Tran, Thanh Phung Truong, Thwe Thwe Win and Thi My Tuyen Nguyen (Chung-Ang University, Korea (South)); Tam Dinh Ton That (Chung Ang University, Korea (South)); Sungrae Cho (Chung-Ang University, Korea (South))

[W13-04] A Comparative Study of WiFi CFR Based Human Activity Recognition Using Time Series Classification Model
Gwangun Yu and Yonggang Kim (Kongju National University, Korea (South))

[W13-05] Research Trends in Channel Estimation for Dynamic Metasurface Antennas
Donghyun Lee, Junsuk Oh, Chihyun Song and Sungrae Cho (Chung-Ang University, Korea (South))

[W13-06] A Survey on O-RAN Architectures: Scheduler, and Beamforming
Chihyun Song, Junsuk Oh, Donghyun Lee, Jaemin Kim, Dongwook Won and Sungrae Cho (Chung-Ang University, Korea (South))

W14. Smart Mobility Connectivity

Chair: Prof. Ji-Woong Choi (DGIST, South Korea)

Room B, Time 09:00~10:40

[W14-01] Traffic-Burst-Resilient Queue-Adaptive Load Balancing for Edge-Assisted Autonomous Vehicles
Hanyoung Park (Daegu Gyeongbuk Institute of Science and Technology, Korea (South)); Ho-Jun Lee (Seoul National University of Science and Technology, Korea (South)); Yongjae Jang (Daegu Gyeongbuk Institute of Science and Technology, Korea (South)); Ji-Woong Choi (DGIST, Korea (South))

[W14-02] Infrastructure-Free V2V Key Repair for Threshold BLS Signatures in Autonomous Vehicle Platoons
Sangwoo Cho, Woosang Im and Gihyeon Shin (Daegu Gyeongbuk Institute of Science and Technology, Korea (South)); Young-Sik Kim (Daegu Gyeongbuk Institute of Science and Technology (DGIST), Korea (South))

[W14-03] Vehicle Speed-Aware Jammer-Resilient Receiver for Multi-User MIMO V2X Systems
Hanyoung Park and Yongjae Jang (Daegu Gyeongbuk Institute of Science and Technology, Korea (South)); Ji-Woong Choi (DGIST, Korea (South))

[W14-04] Learning-Based Resource Allocation in 5G NR Mode-2 Sidelink for Industrial AGV and AMR Communications
Mahmoud Elsharief, Kiwoong Park and Han-Shin Jo (Hanyang University, Korea (South))

[W14-05] EMC Testing Configuration and Performance Assessment for in-Vehicle Cellular Communication Systems
Juhyeok Kim, Seunggon Park, Junhee Park, Hwankyung Song, Hyok Lee and Wonsun Chung (Korea Automotive Technology Institute, Korea (South))

[W14-06] What Will Target Applications of AI-RAN Be?
Jeongho Kwak (Korea University), Dongho Ham (DGIST)

W15. Workshop on RISE ICT-ABB

Chair: Joon-Goo Park (Kyungpook National University, South Korea)

Room C, Time 09:00~10:40

[W15-01] Toward a Korean-Specific 6G NTN: Trends, Limitations, and Key Enabling Technologies
Byungchan Kwon (Kyungpook National University & Korea Aerospace Research Institute, Korea (South)); Eunjeong Jo and Hoki Baek (Kyungpook National University, Korea (South))

[W15-02] High-Resolution Multi-Human Micro-Doppler Sensing with OFDM-Based ISAC
Yunhwa Shin (Kyungpook National University, Korea (South)); Sangwoo Shin (Kyungpook National University, Korea (South)) & WCSL, Korea (South)); Woo Hyun Jee, Subin Cho and Jeongsik Choi (Kyungpook National University, Korea (South))

[W15-03] A RSSI Attenuation Model Considering Incident Angle and Wall Thickness in Indoor Environments
Hwang Jun Gyu (Kyungpook National University, Korea (South)); Kim Sae-Wan (Gumi Electronics & Information Technology Research Institute, Korea (South)); JoonGoo Park (Kyungpook National University, Korea (South))

[W15-04] PMCW Radar Interference Mitigation Using Phase-Randomization and Coherent Accumulation
Hyeonjun Shin (Kyungpook National University, Korea (South)); Seungha Ryu (Kyungpook National University, Korea (South), Korea (South)); Jeongsik Choi (Kyungpook National University, Korea (South))

[W15-05] A Study for Increasing Commercial Temperature Sensor Accuracy Without Specialized Equipment Using Algorithmic Calibration
YunSoo Jeon (Kyungpook National University, Korea (South)); Jeongmin Kim, Chiseung Roh and Chanho Han (KyungPook National University, Korea (South))

[W15-06] Development of an Integrated Control and Management System for Software-Defined Camera
Jinhong Kim (Electronics and Telecommunications Research Institute (ETRI), Korea (South)); Yun-Won Choi (Electronics & Telecommunications Research Institute, Korea (South)); Jang Woon Baek (ETRI, Korea (South)); Hyan su Bae (Electronics and Telecommunications Research Institute, Korea (South)); Dongkyun Kim (Kyungpook National University, Korea (South))

W16. Workshop on Smart Radio for IoT Era 2

Chair: Prof. Osamu Takyu (Shinshu University, Japan)

Room D, Time 09:00~10:40

[W16-01] Cooperative Terrestrial Radio Source Localization Using a LEO Satellite and HAPS
Kotaro Sugimura (University of Electro-Communications, Japan); Takeo Fujii (The University of Electro-Communications, Japan); Osamu Takyu (Shinshu University, Japan); Kei Inage (Tokyo Metropolitan College of Industrial Technology, Japan)

[W16-02] Adaptive Channel Selection and Traffic Allocation for IEEE 802.11be MLO Using a Distributed Spectrum Management Database

Koichi Eto, Daiki Nobayashi and Takeshi Ikenaga (Kyushu Institute of Technology, Japan)

[W16-03] Dynamic Transmission Switching Using Multiple Wi-Fi Links for Bulk Data Transfer on Mobile Vehicles
Nobuki Sumitomo, Daiki Nobayashi and Takeshi Ikenaga (Kyushu Institute of Technology, Japan)

[W16-04] Store-and-Forward-Based Data Transfer Control for ROS 2 Topic Communication in Mobile Nodes
Tomohiko Sannomiya, Daiki Nobayashi and Takeshi Ikenaga (Kyushu Institute of Technology, Japan)

[W16-05] Adaptive Payload Length Control for Uplink Communications in LoRa-Based LEO Satellite IoT Networks
Sakutaro Anzai and Daiki Nobayashi (Kyushu Institute of Technology, Japan); Kenichi Takizawa (National Institute of Information and Communications Technology, Japan); Kazuya Tsukamoto, Takeshi Ikenaga and Nova Khamsah (Kyushu Institute of Technology, Japan); Goshi Sato (NICT, Japan)

W17. The International Workshop on Beyond-6 Networks: AI-Native RAN and Intelligent ISAC

Chair: Prof. Sunwoo Kim (Hanyang University, South Korea)

Room A, Time 15:20~17:00

[W17-01] Isolation-Enhanced Shared-Radiator Antenna Enabling Wide-Angle Beam Scanning for IBFD-Based 6G Communication
Jun-Hyeon Kang, Myeong-Jun Kang, Jaehoon Cho and Sunwoo Kim (Hanyang University, Korea (South))

[W17-02] Joint Acquisition and Satellite Identification with Search Space Reduction in Opportunistic LEO-PNT
Wonyoung Choi, Duhui Yang and Sunwoo Kim (Hanyang University, Korea (South))

[W17-03] Double Layer DSO Based Joint Positioning and Beam Synthesis in UAV Swarms
Seyeon Lee (Hanyang University, Korea (South)); Seongkwon Yoon (Hanyang University, Seoul, South Korea, Korea (South)); Hongseok Jung and Sunwoo Kim (Hanyang University, Korea (South))

[W17-04] Geometry-Guided Self-Supervised Learning for Label-Free 3D Indoor Radio Sensing
Seungwoo Han, Hongseok Jung and Sunwoo Kim (Hanyang University, Korea (South))

[W17-05] ML-Based Multiple BS Beam Tracking and Positioning with Digital Twin
Donggeon Kim, Woongbin Doh, Hyunwoo Park and Sunwoo Kim (Hanyang University, Korea (South))

[W17-06] Bluestein-Based DAFT Implementation on FPGA for AFDM
Hyeryeon Jung, Adam P Dubs and Sunwoo Kim (Hanyang University, Korea (South))

July 08, 2026 (Wednesday)**01. Security, Military, and Defense 1***Chair: Prof. Taeheon Kim (Hanbat National University, South Korea)***Room B, Time 15:20~17:00**

- [01-01] **Bounded Uncertainty-Aware EIS-Based SoH for Mission-Critical Autonomous Systems**
Mauro Danesi, Chiara Arcieri, Andrea Pirisi, Emanuele Ogliari and Riccardo Enrico Zich (Politecnico di Milano, Italy)
- [01-02] **Energy-Sustainable Federated AI Services for Ubiquitous Remote Patient Monitoring in Battery-Constrained IoMT**
Chigozie Athanasius Nnadiakwe (Kumoh National Institute of Technology, Korea (South)); Simeon Okechukwu Ajakwe (Kyungdong University, Global Campus, Korea (South)); Josiah Ayoola Isong, Jae-Min Lee and Dong Seong Kim (Kumoh National Institute of Technology, Korea (South))
- [01-03] **Robust Invertible Image Steganography for Noisy Channel Transmission**
Wei Bingxin and Haewoon Nam (Hanyang University, Korea (South))
- [01-04] **Improving TTP Mapping Accuracy in CTI Reports Using Structured RAG Query Configuration**
Seoyeon Kim, Saewoom Lee, Seul-Ki Choi, Taehyeon Kim and Taeun Kim (Korea Internet & Security Agency, Korea (South))
- [01-05] **Transformer-Based Digital Twin for Stem Cell Differentiation Forecasting with Mechanistic ODE Benchmarking**
Victor Ikenna Kanu, Ihunanya Udodiri Ajakwe and Josiah Ayoola Isong (Kumoh National Institute of Technology, Korea (South)); Simeon Okechukwu Ajakwe (Kyungdong University, Global Campus, Korea (South)); Dong Seong Kim (Kumoh National Institute of Technology, Korea (South))

02. Communications and Networks for B5G and 6G 1*Chair: Dr. Muhammad Azfar Yaqub (Free University of Bozen-Bolzano, Italy)***Room C, Time 15:20~17:00**

- [02-01] **A Resilience-Enhancing Approach to Reducing Traffic Downtime Under Consecutive Failures in Backbone Networks**
Trung Van Vu, Thien Van La, Quyet Hoang Dinh, Huong Van Tran, Trang Hanh Nguyen and Tho Dinh Luong (Viettel High Technology Industries Corporation, Vietnam)
- [02-02] **TATM: A Proactive Flow-Aware Buffer Allocation Framework for Efficient Micro-Burst Absorption in Commodity Switches of 5G Networks**
Tien Duy Bui, Huong Van Tran, Thien Van La, Quyet Hoang Dinh and An Duc Nguyen (Viettel High Technology Industries Corporation, Vietnam)

- [02-03] **Pilot-Data Power Allocation in Multi-Cell Multi-RIS Networks**
Sungyun Oh, Sangho Kim and Heejeung Yu (Korea University, Korea (South))
- [02-04] **Integrated Sensing and Communications in 6G: A Review of Recent Advances and Challenges**
Duc-Nghia Vu (Viettel High Technology Industries Corporation, Vietnam); Duc Tai Truong (Viettel High-Technology Industries Corporation, Vietnam); Tu Anh Nguyen (Viettel High Technology Industries Corporation, Vietnam); Tung Van Tran (Viettel Group, Vietnam); Tuan Duc Vu (Viettel High Technology, Viettel Group, Vietnam); Tuyen Duc Nguyen (Viettel High Technology Industries Corporation, Vietnam)
- [02-05] **Joint Power Allocation for NDP, Pilot and Data Phases in ISAC-PLS Systems**
Ji Min Park, YoungHoon Kim, Junseok Lee and Heejeung Yu (Korea University, Korea (South))

03. AI and Its Applications 1*Chair: Prof. Suk-Seung Hwang (Chosun University, South Korea)***Room D, Time 15:20~17:00**

- [03-01] **The Role of AI and Machine Learning in Next-Generation Governance, Risk, and Compliance (GRC) Platforms**
Saikrishna Tarakampet (California's Correctional Healthcare Services, USA); Subhash Tatavarthi (Kasmo, USA); Ganesh Puvvula (USA)
- [03-02] **Deployment-Oriented Targetless Radar-Camera Extrinsic Auto-Calibration for Fixed Roadside Monitoring**
Sun Hong Jung, Seung Yun Noh, Chan Gyu Park and Jae Wook Jeon (Sungkyunkwan University, Korea (South))
- [03-03] **Dual-Distance-Based Goal Representation Learning**
Nahyeon Kwon and Junghyun Kim (Sejong University, Korea (South))
- [03-04] **Retraining Data Poisoning Attacks on Drift Adaptive Anomaly Detection for Industrial Control Systems**
Jung Kyu Seo, JuHyeon Lee and Jung Taek Seo (Gachon University, Korea (South))
- [03-05] **CCGP: A Cooperative Coevolutionary Cartesian Genetic Programming Algorithm for Finite State Machine Synthesis**
Siyu Lin and Huikun Huang (Jinan University, China); Xin Yuan Zhang (JINAN University, China); Jun Zhang (Hanyang University, Ansan, South Korea)

July 09, 2026 (Thursday)**04. Security, Military, and Defense 2***Chair: Prof. Insoo Sohn (Dongguk University, South Korea)***Room A, Time 09:00~10:40**

- [04-01] **Secure and Resilient Cyber-Physical Supply Networks for Critical Infrastructure a Design Framework for Military Mobility and Mission-Critical Operations**
Franco Maciariello (Universitas Mercatorum, Italy & Arts & Humanities Centro Studi Avanzati per l'Intelligenza, Italy); Fabrizio Benelli (Universitas Mercatorum, Italy); Veronica Elena Bocci (Vice President European Railway Clusters Initiative (ERC)) ASBL Brussels, Belgium); Eddi Lorenzi and Claudio Salvadori (New Generations Sensors srl, Italy)
- [04-02] **Multi-Dimensional Vulnerability Analysis of LM Safety Guards via Role-Goal-Format Decomposition**
Jin Seong Kim, Han Ju Lee, Hyeon-Jin Jeong and Seok-Hwan Choi (Yonsei University, Korea (South))
- [04-03] **An Empirical Study on the Privacy Effects of Model Merging in Vision Language Models**
Han Ju Lee and Jin Seong Kim (Yonsei University, Korea (South)); Chansu Han and Geon-Kyu Bang (National Institute of Information and Communications Technology, Japan); Seok-Hwan Choi (Yonsei University, Korea (South)); Takeshi Takahashi (National Institute of Information and Communications Technology, Japan)
- [04-04] **Mutual Coupling-Aware Spatially Selective Beamforming for RIS-Assisted Physical Layer Secure Transmission**
Sumin Jeong (Kumoh National Institute of Technology, Korea (South))
- [04-05] **Pure-LBVR: A PureChain-Anchored Storage Fabric with Latency-Bounded Verifiable Retrieval for Safety-Critical Federated Systems**
Josiah Ayoola Isong (Kumoh National Institute of Technology, Korea (South)); Paul Angelo Oroceo (Kumoh National Institute of Technology, Korea (South)); Jae-Min Lee and Dong Seong Kim (Kumoh National Institute of Technology, Korea (South))

05. Communications and Networks for B5G and 6G 2*Chair: Prof. Yonggang Kim (Kongju National University, South Korea)***Room B, Time 09:00~10:40**

- [05-01] **Distortion-Aware LLR for OFDM Systems with PAPR Reduction in LEO Satellite Link**
Hee Ju Kwak, Somin Park and Cheolwoo You (Myongji University, Korea (South))
- [05-02] **UAV Trajectory Planning for RIS-Assisted Data Collection**
Pei-Fa Sun and Sang-Woon Jeon (Hanyang University, Korea (South))
- [05-03] **Holographic-ELAA-Enabled near-Field ISAC: A Sensing-Centric Beamforming Design**

Kangyu Gao (Hanyang University, Korea (South)); Sung Ho Chae (Kwangwoon University, Korea (South)); Sang-Woon Jeon (Hanyang University, Korea (South))

- [05-04] **A Hierarchical Multi-RAT MEC Framework with LLM-Based EC Method**

Zhaokun Shao and Kangyu Gao (Hanyang University, Korea (South)); Zhi-Hui Zhan (Nankai University, China); Sang-Woon Jeon and Jun Zhang (Hanyang University, Korea (South))

- [05-05] **Machine Learning-Based Secure Beam Selection Under Beam Squint for mmWave LEO Satellite Communication Systems**

Minjeong Kang and Jung Hoon Lee (Hankuk University of Foreign Studies, Korea (South))

06. Communications and Networks for B5G and 6G 3*Chair: Prof. Sumin Jeong, (Kumoh National Institute of Technology, South Korea)***Room C, Time 09:00~10:40**

- [06-01] **CSI-Free Gamma CDF-Based Distributed User Scheduling for IRS-Aided Multi-User Systems**
Jae Hyun Park, Junsu Kim and Su Min Kim (Tech University of Korea, Korea (South))
- [06-02] **Evaluation of GNSS Delay Compensation for GEO and LEO Satellite Communications: Impact of Seasonal Variations and Sky View Factor**
Takuma Nagai and Hiroshi Oguma (National Institute of Technology, Toyama College, Japan); Suguru Kameda (Hiroshima University, Japan)
- [06-03] **Design and Validation of NCR Coverage Virtualization for End-to-End Network Slicing**
Seung-Que Lee, JunHwan Lee and Moon-Sik Lee (Electronics and Telecommunications Research Institute, Korea (South))
- [06-04] **A 5G Testbed for AI-and-RAN on AI Edge: Design and Performance Evaluation**
Tae-il Jung (KyungHee University, Korea (South)); Hyun-Min Yoo and Een-Kee Hong (Kyunghee University, Korea (South)); Jeehyeon Na and Kyung Sook Kim (ETRI, Korea (South))
- [06-05] **CV Quantum Communications with Angular Rejection Filtering: Modeling and Security Analysis**
Mohammad Taghi Dabiri (Qatar University, Qatar); Meysam Ghanbari (Hamad Bin Khalifa University, Qatar); Rula Ammuri (Professionals for Smart Technology, Jordan); Saif Al-Kuwari (Hamad Bin Khalifa University, Qatar); Mazen Omar Hasna (Qatar University, Qatar); Khalid A. Qarage (Hamad Bin Khalifa University & College of Science and Engineering, Qatar)

07. AI and Its Applications 2*Chair: Prof. Taesoo Jun (Kumoh National Institute of Technology, South Korea)***Room D, Time 09:00~10:40**

- [07-01] Unified Accident Anticipation and Explainable Report Generation via Self-Supervised Vision-Conditioned Language Modeling
Ahmed Dawod Mohammed Ibrahim, Muhab Ramadan A Alakroot, Zhengyu Shang and Jang-Eui Hong (Chungbuk National University, Korea (South))
- [07-02] Communication-Aware Multi-Agent Reinforcement Learning for Cooperative UAV Swarm Decision-Making in Smart City Surveillance
Mingyu Shin and Soyi Jung (Ajou University, Korea (South))
- [07-03] PASTEL: Pose-Aware Spatio-Temporal Event Localization of Interactions in Multi-View Retail Videos
Sungwoo Byeon, Junwon Son and Rakwon Choi (Safe AI, Korea (South)); Junho Shin and Seokjun Lee (Focus AI, Korea (South)); Wonsuk Kim (Safe AI, Korea (South))
- [07-04] Offline Neighbor Cell List Planning for Cold-Start Mitigation Using Machine Learning and Radio Frequency Coverage Data
Tiago Afonseca (ISCTE - Instituto Universitário de Lisboa, Portugal); Ricardo Costa and Joao Martins (Multivision, Portugal); Gabriela Soares and Luis Nunes (Iscte, Portugal); Pedro Sebastião (ISCTE-IUL, Portugal)
- [07-05] Natural Language-Driven Analytics for Networked Photovoltaic Systems Using LLM-Based Agents
Mattia Fontana and Marcello Polenghi (Universitas Mercatorum, Italy)

08. Security, Military, and Defense 3

Chair: Prof. Taesoo Jun (Kumoh National Institute of Technology, South Korea)

Room A, Time 10:50~12:30

- [08-01] Homogeneous vs. Heterogeneous UAV Fleets for Critical Infrastructure Surveillance: An Event-Driven Monte Carlo Simulation Under Environmental Network Stress
Alberto Croci and Marco Luigi Dinapoli (Politecnico di Milano, Italy); Luca Bettocchi and Sara Cavagna (Polytechnic Institute of Milan, Italy); Gabriel Felipe Martinez, Andrea Pirisi and Riccardo Enrico Zich (Politecnico di Milano, Italy)
- [08-02] Fingerprint Reconstruction from Biometric Templates Using Context Aware Minutiae Representation
Aleksandar Mijatović, Peter Peer and Tim Oblak (University of Ljubljana, Slovenia)
- [08-03] ISO/SAE 21434-Compliant Asset Modelling for TARA of Electric Vehicle BMS
Esmot Ara Tuli and Mubashrah Saddiq (University of Southern Denmark, Denmark); Mehmet Emre Aslaci and Abdullah Hocaoglu (MEAtec Engineering Ltd., Turkey)
- [08-04] LAVA-Control: Stable Cost-Aware Intelligence Density Adaptation for Distributed IDS in Heterogeneous IoT Networks

Jonathan Mukisa Kalibbala (Kumoh National Institute of Technology, Gumi, Korea (South)); Dong Seong Kim and Jae Min Lee (Kumoh National Institute of Technology, Korea (South))

- [08-05] PureChain-Based Real-Time Intrusion Detection for Secure Industrial Humanoid IIoT Communication
Hamza Ibrahim, Love Allen Chijioke Ahakonye, Jae Min Lee and Dong Seong Kim (Kumoh National Institute of Technology, Korea (South))
- [08-06] A Study of a Frequency-Separation-Based and Access-Controlled Reversible Video de-Identification System for Edge Environments
Ye-Lim Kim, Sunoh Yun, In-nea Wang, Kang-Woo Lee and Junho Jeong (Dongguk University, Korea (South))

09. Communications and Networks for B5G and 6G 4

Chair: Prof. Ji-Woong Choi (DGIIST, South Korea)

Room B, Time 10:50~12:30

- [09-01] A Compact Wideband Vivaldi Probe Antenna for 6G OTA Measurement Systems
Cheol Yoon (tech University of Korea, Korea (South)); Chul Woo Lee, Hwa-Choon Lee and Woo Su Kim (Tech University of Korea, Korea (South))
- [09-02] Adaptive Registration Procedure for Roaming Scenarios in IP Multimedia Subsystem
Lam Nguyen The, Huy Duc Nguyen, Hieu Minh Do, Van Minh Nguyen and Vuong Ngo (Viettel High-Technologies Industries Corporation, Vietnam)
- [09-03] Performance Investigation of Turbo Coded Underwater Acoustic Multihop Networks
Andrej Stefanov (IBU Skopje, Macedonia, the former Yugoslav Republic of)
- [09-04] Maximum a Posteriori Generative Channel Estimation for Massive MIMO Systems
Moonil Kim (Sogang University, Korea (South)); Il-Min Kim (Queen's University, Canada); Jaewoo So (Sogang University, Korea (South))
- [09-05] Pure-FAN: An Explainable AI for Cross-Layer Intrusion Detection in Flying Adhoc Networks
Odinachi Udemezuo Nwankwo (Kumoh National Institute of Technology, Korea (South)); Muhammad Rasyid Redha Ansori (NS Lab Inc., Korea (South)); Gifar Arif Haryadi, Dong Seong Kim and Jae Min Lee (Kumoh National Institute of Technology, Korea (South))

010. Communications and Networks for B5G and 6G 5

Chair: Prof. Insoo Sohn (Dongguk University, South Korea)

Room C, Time 10:50~12:30

- [010-01] Deep Learning-Based Detection for Multi-Mode OTFS with Index Modulation
Soo Young Shin and Adnan Tariq (Kumoh National Institute of Technology, Korea (South))

Technology, Korea (South)

- [O10-02] **LEEV: Load-Aware and Energy-Efficient VNF Deployment in NFV-Enabled Networks**
You-Chiun Wang (National Sun Yat-Sen University, Taiwan); Pei-Chin Tsai (National Sun Yat-sen University, Taiwan)
- [O10-03] **Deep Reinforcement Learning for Handover Optimization in 5G Networks**
Damianos Diasakos and Vasileios Kokkinos (University of Patras, Greece); Christos J Bouras (University of Patras - ELKE, Greece); Apostolos Gkamas (University of Ioannina, Greece); Philippos Pouyioutas (University of Nicosia, Cyprus)
- [O10-04] **Data-Driven Coverage and Capacity Optimization in Mobile Networks Using Bayesian Optimization**
Gonçalo Couto (ISCTE, Portugal); Joao Martins and Sameer Ibraimo (Multivision, Portugal); Gabriela Soares (Iscte, Portugal); Pedro Romano (ISCTE, Portugal); Pedro Sebastião (ISCTE-IUL, Portugal)
- [O10-05] **Adaptive PSO Algorithm for Cooperative Multi-UAV Path Planning in Disaster Relief**
Haris Muhammad and Haewoon Nam (Hanyang University, Korea (South))

011. AI and Its Applications 3

Chair: Prof. Jin-Woo Jung (Dongguk University, South Korea)

Room D, Time 10:50~12:30

- [O11-01] **From Synchronized Testbed to MaskForceNet: End-To-End Force Estimation for Neurovascular Guidewires**
Jae Eun Ko, Dae Hwan Ko, Man Jae Shin, Jiwon Pak, Ju Young Oh, Su Lim Kang, Ji Yean Kwon and Sung Min Kim (Dongguk University, Korea (South))
- [O11-02] **Toward 6G-Ready Uplink Resource Control: Standard-Aware RB Coordination and MADRL-Based Power Control**
Jung-Min Son, Joon-Young Park and Young-Chai Ko (Korea University, Korea (South))
- [O11-03] **SecReviewAgent: Context-Aware Security Review of Infrastructure-as-Code Using Persistent Architecture Memory**
Naga Krishna Reddy Muppidi, Veera Ravindra Divi and Sneha Gullapalli (USA); Rambabu Pasumarthy (GITAM Deemed to Be University, India)
- [O11-04] **A Hybrid Attention Network with Cumulative Source Aggregation for Single Image Super-Resolution**
Dong-Hyun Kim, In-Uk Joung, Dong-Myung Kim and Jae-Won Suh (Chungbuk National University, Korea (South))
- [O11-05] **Predictive Maintenance for a Hydraulic System on a Vehicle Using LSTM-Based Autoencoder**
Billel Hakem (KNDS France & Conservatoire National Des Arts et Métiers, ECE PARIS, France); Jae Yun Jun Kim (ECE Paris, France); Samia Bouzeffrane (CNAM, France); Philippe Millet (Nexter Systems, France)

012. Services, Applications, and Emerging Topics 1

Chair: Dr. Esmot Ara Tuli (University of Southern Denmark, Denmark)

Room A, Time 15:20~17:00

- [O12-01] **Schedulability Analysis of Global EDF, RM, and DM on Multicore FreeRTOS Kernel**
Chaeun Lee, Seong Hyeon Lim, Young Soo Do, Sung Bhin Oh, Young Min Kim, Beom Gi Suh and Jae Wook Jeon (Sungkyunkwan University, Korea (South))
- [O12-02] **AI-Agent Framework for Sales Risk Identification and Objection Handling Support in Live Commerce**
Jiho Kim, Sangmin Park and Yooshin Kwon (Chung-Ang University, Korea (South)); Heongi Kim and Hyeonjae Cheon (GS Retail Co. Ltd, Korea (South))
- [O12-03] **Adaptive Traffic-Aware Load Balancing Mechanism in Data Center Networks Using P4 Switches**
Hsueh-Wen Tseng (National Chung-Hsing University, Taiwan); Ruei-Yu Wu (National Taiwan University of Science and Technology, Taiwan); Yu-Cheng Chang (National Chung Hsing University, Taiwan)
- [O12-04] **Asynchronous Pulse Code Multiple Access Toward Underwater Massive IoT Using VLF Electromagnetic Waves**
Iruru Ouchi and Mayu Selena Horiuchi (Tokyo University of Science, Japan); Ferdinand Peper (National Institute of Information and Communications Technology, Japan); Kenji Leibnitz (NICT, Japan); Naoki Wakamiya (Osaka University, Japan); Kiyoshi Egawa (Kyowa Electronic Instruments, Japan); Maki Arai (Shibaura Institute of Technology, Japan); Jin Nakazato and Mikio Hasegawa (Tokyo University of Science, Japan)
- [O12-05] **A Survey on Caching Systems in Serverless Computing**
Donghyeon Kim and Sangoh Park (Chung-Ang University, Korea (South))
- [O12-06] **A Survey on Optimization Techniques for on-Device Large Language Model Inference**
Mingyu Jo and Sangoh Park (Chung-Ang University, Korea (South))

013. Communications and Networks for B5G and 6G 6

Chair: Prof. Jing Wang (University of South Florida, USA)

Room B, Time 15:20~17:00

- [O13-01] **Congestion-Aware Mobility Robustness Optimization: A Multi-Vendor Approach in Live Networks**
Tiago Faria (ISCTE - Instituto Universitário de Lisboa, Portugal); Joao Martins and Sameer Ibraimo (Multivision, Portugal); Gabriela Soares (Iscte, Portugal); Nuno Souto (ISCTE, Portugal); Pedro Sebastião (ISCTE-IUL, Portugal)
- [O13-02] **Low-Overhead User Scheduling for IRS-Assisted Uplink NOMA Exploiting Dumb Antennas**
Min Jae Jang, Junsu Kim and Su Min Kim (Tech University of Korea, Korea (South))

- [013-03] **Graph-Based Optimization of Physical Cell Identifiers and Root Sequence Indexes in 4G/5G Networks**
Pedro Trogeira Cruz (ISCTE - Instituto Universitário de Lisboa, Portugal); Ricardo Costa, Sameer Ibraimo and Joao Martins (Multivision, Portugal); Américo Correia (ISCTE, Portugal); Pedro Sebastião (ISCTE-IUL, Portugal)
- [013-04] **Characterizing Bottleneck Shifts in Semantic Communication Under Channel Variations and Device Heterogeneity**
Hideharu Sakata (Kyushu Institute of Technology, Japan); Yuzo Taenaka (Nara Institute of Science and Technology, Japan); Kazuya Tsukamoto (Kyushu Institute of Technology, Japan)
- [013-05] **Coverage Enhancement in Disaster Communication Networks via Active RIS-Assisted UAV Deployment**
Yong-Jin Song and Juyeong Baek (Ajou University, Korea (South)); Hyung-sub Kim and Jeehyeon Na (ETRI, Korea (South)); Jung Mo Moon (Electronics and Telecommunications Research Institute, Korea (South)); Minsoo Jeong (Electronics and Telecommunications Research Institute (ETRI), Korea (South)); Howon Lee and Bang Chul Jung (Ajou University, Korea (South))

014. Communications and Networks for B5G and 6G 7

Chair: Prof. Osamu Takyu (Shinshu University, Japan)

Room C, Time 15:20~17:00

- [014-01] **Evaluating the Effectiveness of PLIM Mapping Design Using past Monthly Data**
Atsuhiko Tokita and Osamu Takyu (Shinshu University, Japan); Koichi Adachi (Keio University, Japan); Mai Ohta (Kogakuin University, Japan); Takeo Fujii (The University of Electro-Communications, Japan)
- [014-02] **Guaranteed Interference and Minimum-Allocation Constraints with Throughput Maximization for Local 5G Scheduling via ILP**
Haruka Sakamoto and Osamu Takyu (Shinshu University, Japan); Kohei Akimoto (Akita Prefectural University, Japan)
- [014-03] **A Fast and Accurate Two-Stage Sketch Framework for Heavy Hitter Detection**
Shang-Chen Li, Yeim-Kuan Chang and Shih-Hsuan Liu (National Cheng Kung University, Taiwan)
- [014-04] **Efficient TCAM like Prefix Design and the Implementation Using Various Types of Memory on FPGA for Multi-Dimensional Packet Classification**
Pin-Hsun Chiu, Yeim-Kuan Chang and Shih-Hsuan Liu (National Cheng Kung University, Taiwan)
- [014-05] **Fast and Scalable Dynamic Spectrum Allocation Using a Coherent Ising Machine**
Manato Hosokawa and Jin Nakazato (Tokyo University of Science, Japan); Maki Arai (Shibaura Institute of Technology, Japan); Takesue Hiroki (NTT Corporation, Japan); Kazuyuki Aihara (The University of Tokyo, Japan); Mikio Hasegawa (Tokyo University of Science, Japan)

015. AI and Its Applications 4

Chair: Prof. Dong Seong Kim (Kumoh National Institute of Technology, South Korea)

Room D, Time 15:20~17:00

- [015-01] **Comparing Structure-to-Property Models Under Shared MatBench Protocol**
Euseong Kim, Junhee Seok and Youngseo Hwang (Korea University, Korea (South))
- [015-02] **GATv2+LP: GATv2-Based WSS Topology Design with Link Pruner for Datacenter Network**
Takashi Miyamura (Senshu University, Japan)
- [015-03] **Low-Invasive Parameters-Based Machine Learning Models with XAI for Chronic Endometritis Prediction**
Vincent Peter C Magboo, Ma Sheila A Magboo, Christian Jesse Q. Bonifacio, Ma. Estela Leonila H. Malunes and Alexine Johnieco D. Salazar (University of the Philippines Manila, Philippines)
- [015-04] **Grid-Aware Lightweight Machine Learning for Maneuver Prediction at Intersections Toward Proactive V2N Handover in 5G/B5G Networks**
Heriansyah Heriansyah (Johannes Kepler University of Linz, Austria & Institut Teknologi Sumatera, Indonesia); Gabriele Kotsis (Johannes Kepler University Linz, Austria)
- [015-05] **Retrieval-Augmented Department Routing of Civil Complaints Using a Work-Item Knowledge Base**
JongHeon Baek, Doyeop Kim, Dahee Lee, In-nea Wang, Kang-Woo Lee and Junho Jeong (Dongguk University, Korea (South))

July 10, 2026 (Friday)

016. Services, Applications, and Emerging Topics 2

Chair: Prof. Eisuke Kudoh (Tohoku Institute of Technology, Japan)

Room A, Time 09:00~10:40

- [016-01] **Indoor Positioning Using Multiple Sensing Data with Likelihood-Based Fusion of Top Two Sensor Candidates**
Miku Kosugo and Eisuke Kudoh (Tohoku Institute of Technology, Japan)
- [016-02] **Efficient Digital Twin Construction in Vehicular Networks via Distance-Based NOMA Pairing**
Shih-Fan Chou, Ying Chen, You-Sen Chang and Yu-Chen Kuo (National Taiwan University of Science and Technology, Taiwan)
- [016-03] **Hybrid Network-Side Geolocation for MDT Using Timing Advance and WkNN**
Alexandre Rodrigues (ISCTE-IUL, Portugal); Joao Martins and Sameer Ibraimo (Multivision, Portugal); André Glória, Gabriela Soares and Pedro Sebastião (ISCTE-IUL, Portugal)
- [016-04] **PLCA-Aware One-to-Many Diagnostic Transport over 10BASE-T1S Edge Networks**

Minsoo GU, Young Soo Do, Beom Gi Suh, Young Min Kim, Jae Hun Kang and Jae Wook Jeon (Sungkyunkwan University, Korea (South))

[016-05] TSN Scheduling for Deterministic Control over 10BASE-T1S in Zonal Automotive Architectures

Jae Hun Kang, Young Soo Do, Chan Gyu Park, Sung Bhin Oh, Dong min Seok, Beom Gi Suh, Minsoo GU and Jae Wook Jeon (Sungkyunkwan University, Korea (South))

017. Communications and Networks for B5G and 6G 8

Chair: Prof. Kohei Ohno (Meiji University, Japan)

Room B, Time 09:00~10:40

[017-01] Energy-Saving Method for Bluetooth Low Energy Beaconing Using Tug-of-War Dynamics

Reona Nomura (Tokyo University of Science, Japan); Song-Ju Kim (SOBIN Institute LLC, Japan); Ryosuke Isogai (Seiko Future Creation Inc., Japan & National Institute of Information and Communications Technology, Japan); Yoshifumi Yoshida (Seiko Future Creation Inc, Japan); Hiroyuki Yasuda (The University of Tokyo, Japan); Maki Arai (Shibaura Institute of Technology, Japan); Jin Nakazato and Mikio Hasegawa (Tokyo University of Science, Japan)

[017-02] Toward Low-Overhead and Reliable Available Bandwidth Estimation for Adaptive Link Selection in Vehicular Environments

Kakeru Tanida, Daiki Nobayashi, Takeshi Ikenaga and Kazuya Tsukamoto (Kyushu Institute of Technology, Japan); Kazuya Okada (Toyota Motor Corporation, Aichi, Japan)

[017-03] Reinforcement Learning Based Sensitivity Control for Spatial Reuse in IEEE 802.11ax WLANs

Kuei-Ping Shih, Yi-Ting Lin and En-Hsiang Chou (Tamkang University, Taiwan); San-Yuan Wang (I-Shou University, Taiwan)

[017-04] Location-Assisted Random Access for Static IoT in LEO Satellite Networks

Taecheon Kim (Hanbat National University, Korea (South)); Kyungmin Park (Electronics and Telecommunications Institute, Korea (South)); Seong Ho Chae (Tech University of Korea, Korea (South)); Inkyu Bang (Hanbat National University, Korea (South))

[017-05] Enhanced Contention-Based Random Access for 5G NR and Beyond: Supporting NES

Jisoo Park (Electronics and Telecommunications Research Institute, Korea (South)); Jaemin Ahn (Chungnam National University, Korea (South)); JunHwan Lee (Electronics and Telecommunications Research Institute, Korea (South))

018. AI and Its Applications 5

Chair: Prof. Su Min Kim (Tech University of Korea, South Korea)

Room C, Time 09:00~10:40

[018-01] A Lightweight Python-Based Framework for Detecting False Information Attacks in Vehicular Ad Hoc Networks Using Isolation Forest

Hassan Mistareehi (Murray State University, USA); Shafika Moni (Embry Riddle Aeronautical University, USA); Abdelatif H. Aboualy and Jason Owen (Murray State University, USA)

[018-02] Evaluation of Neural Network Architectures for Intrusion Detection in Resource-Constrained Embedded Network Systems

Hassan Mistareehi, Rizwan Syed, Ezana Fekadu and Zheng Zhang (Murray State University, USA); Abdulrahman Yerali (MSU, USA); Md Sultan Al Nahian (Pennsylvania State University, Harrisburg, USA)

[018-03] HybridFraudNet: A Dual-Branch CNN-GNN Architecture for Healthcare Insurance Fraud Detection

Subhash Tatavarthi (Kasmo, USA); Venkatasatayaravikiran Bikkavolu, Sneha Gullapalli, Raghunath Reddy Koilakonda and Veera Ravindra Divi (USA)

[018-04] Autocorrelation-Based Window Size Selection for Multivariate IoT Time-Series

Nahye Ki, Dongje Yang and Su Sik Bang (Tech University of Korea, Korea (South))

[018-05] LiDAR-Supervised Monocular Depth Estimation via Cross-Modal Supervision

HyeHyeon Park (Sungkyunkwan University & Automation Lab, Korea (South)); Young Hoon Suh, Sun Hong Jung and Jae Wook Jeon (Sungkyunkwan University, Korea (South))

019. Services, Applications, and Emerging Topics 3

Chair: Prof. Seokjoo Shin (Chosun University, South Korea)

Room A, Time 10:50~12:30

[019-01] Analysis of Runtime Client-Join Disturbance in a Micro XRCE-DDS Client-Agent Architecture

Sang Joon Shin, Sung Bhin Oh, Young Soo Do, Beom Gi Suh, Seung Uk Son, Chan Gyu Park, Young Min Kim and Jae Wook Jeon (Sungkyunkwan University, Korea (South))

[019-02] Impact of Service Disciplines on Performance of Wireless Powered Sensor Networks

Mingfu Li, Tzu-Feng Wang, Yen-Chen Yeh and Fang-Shuo Chang (Chang Gung University, Taiwan)

[019-03] An Improved Human Detection Scheme Using UWB Impulse Response and Grayscale Image Classification

Rion Hirata and Kohei Ohno (Meiji University, Japan)

[019-04] An Efficient Image Dehazing Algorithm Using Wavelength-Based Transmission Rate Estimation for Edge Applications

Yu-Hsuan Lee (Multimedia Circuit and System Lab, Department of Electrical Engineering, Yuan-Ze University, Taiwan); Yen-Chi Huang (Yuan Ze University, Taiwan)

[019-05] Soft Decision-Based Adaptive Weighted Focus Measure for Multi-Focus Image Fusion

Hoon-Seok Jang (Korea Electronics Technology Institute, Korea (South)); Junsu Park (Kunsan National University, Korea (South));

Choi Ju-Hwan (Korea Electronics Technology Institute, Korea (South))

020. Communications and Networks for B5G and 6G 9

Chair: Prof. Seong Ho Chae, (Tech University of Korea, South Korea)

Room B, Time 10:50~12:30

- [020-01] Adaptive Image Transmission Control Based on Wireless Communication Quality for Wide-Area Monitoring with Autonomous Mobile Robots
Masaki Haruta, Daiki Nobayashi, Kazuya Tsukamoto and Takeshi Ikenaga (Kyushu Institute of Technology, Japan)
- [020-02] Flow Fairness Control Using AI-Based Congestion Control Algorithm Estimation on Programmable Data Plane Network
Yuya Kotoku, Daiki Nobayashi and Takeshi Ikenaga (Kyushu Institute of Technology, Japan)
- [020-03] Distributed Uplink Transmission Control for Collision Avoidance in LoRa-Based LEO Satellite Communications
Kouta Tamura, Nova Khamsah, Daiki Nobayashi, Kazuya Tsukamoto and Takeshi Ikenaga (Kyushu Institute of Technology, Japan); Goshi Sato (NICT, Japan); Kenichi Takizawa (National Institute of Information and Communications Technology, Japan)
- [020-04] Data Encoding Based Transmission Control for Out of Area Leakage Suppression in Spatio-Temporal Data Retention System
Yuma Yoshioka, Daiki Nobayashi, Kazuya Tsukamoto and Takeshi Ikenaga (Kyushu Institute of Technology, Japan); Myung Lee (CUNY, City College, USA)
- [020-05] Shared Data Intelligence-Driven Multi-Task Prediction for Efficient Resource Utilization in 6G Networks
Kamrul Hasan and Seong Ho Jeong (Hankuk University of Foreign Studies, Korea (South))

021. Communications and Networks for B5G and 6G 10

Chair: Prof. Younghoon Park (Sookmyung Women's University, South Korea)

Room C, Time 10:50~12:30

- [021-01] Adaptive Encryption Control for Wireless-Congestion-Aware Medical IoT Communications
Kazutaka Kaneko (Kyushu Institute of Technology, Japan); Dirceu Cavendish (UCLA/Kyushu Institute of Technology, USA); Daiki Nobayashi and Takeshi Ikenaga (Kyushu Institute of Technology, Japan)
- [021-02] Programmable Data Plane-Based TCP Multi-Queue Scheduling Scheme Using RTT and CCA Classification
Ryota Murakami, Daiki Nobayashi and Takeshi Ikenaga (Kyushu Institute of Technology, Japan)
- [021-03] Traffic Steering Technology Using Multiple Non-3GPP Access Lines Based on the 3GPP Standards in the Internet

of Vehicles

Taichi Hayashi, Daiki Nobayashi, Kazuya Tsukamoto and Takeshi Ikenaga (Kyushu Institute of Technology, Japan); Naoya Kaneko (Toyota Motor Corporation, Japan & Tokyo University of Agriculture and Technology, Japan); Koji Takeoka (Toyota Motor Corporation, Japan)

- [021-04] Performance Analysis of FSF-LoRa Under Overlapping Transmissions: From Link-Level Interference to System-Level Throughput
Ryoya Saito (University of Electro-Communications, Japan); Koichi Adachi (Keio University, Japan)
- [021-05] Enhancing Data Dissemination in RSSI-Based Spatio-Temporal Data Retention Systems Using Information Centric Networking
Tomoki Suda, Daiki Nobayashi, Takeshi Ikenaga and Kazuya Tsukamoto (Kyushu Institute of Technology, Japan); Makoto Misumi and Ryo Nakamura (Fukuoka University, Japan)

July 08, 2026 (Wednesday)

Poster P1

Chair: Prof. Yeon Ho Chung (Pukyong National University, South Korea)

Poster Hall, Time 15:20~17:00

- [P1-01] **A Study on Enhancing the Quantitative Evaluation Framework for Assessing Cyber Incident Response Capabilities in Nuclear Facilities**
Dongjun Choi, Ju Hyeon Lee and Jung Taek Seo (Gachon University, Korea (South))
- [P1-02] **Vector Vortex Beam Steering in OAM-Multiplexed Quantum Optical Wireless Communication Systems**
Fayshal Ahmed and Yeon Ho Chung (Pukyong National University, Korea (South))
- [P1-03] **Implementation of Resource-Efficient QAM Modulator with Decoupled Gain Scaling for 5G NR Systems**
Youngil Jeon (Electronics and Telecommunications Research Institute, Korea (South)); Hyungsik Ju (ETRI, Korea (South)); JunHwan Lee (Electronics and Telecommunications Research Institute, Korea (South))
- [P1-04] **Automotive Ethernet Physical Layer Degradation Diagnosis Using Built-in PHY Diagnostics: Experimental Proof-of-Concept**
Sung Bhin Oh, Young Soo Do, Seong Hyeon Lim, Beom Gi Suh and Young Min Kim (Sungkyunkwan University, Korea (South)); Sang Uk Han, Hyeon Keun Hong and Jong Joo Kang (Hyundai Mobis, Korea (South)); Jae Wook Jeon (Sungkyunkwan University, Korea (South))
- [P1-05] **Pilot-Aided Diffusion Model-Based Channel Estimation for OFDM-MIMO Systems**
Doyeong Kim (Tech University of Korea, Korea (South)); Yujae Song (Yeungnam University, Korea (South)); Seong Ho Chae (Tech University of Korea, Korea (South))
- [P1-06] **CDC-Optimized Integrity Verification Architecture for 10 Gbps High-Speed Serial Links**
Joomyung Jung, Hyeonrae Kim and Oh Hyuk Jun (Kwangju University, Korea (South))
- [P1-07] **Dual-Certificate Architecture for Secure IoT-to-Blockchain RWA Tokenization**
Aygun Salimova (Ajou University, Korea (South)); Ki-Hyung Kim (Ajou University, Korea (South) & AJ, Korea (South))
- [P1-08] **AdaFed: Adaptive Selective Aggregation for Heterogeneous Federated Learning in Autonomous Driving**
Sunjun Hwang and Hwang Dohyun (Yonsei University, Korea (South))
- [P1-09] **Optimizing Security and Efficiency in Edge-Cloud Collaborative Environments: A Service-Aware Privacy Protection Approach**
Jihwan Lee (Dream Security Co., Ltd., Korea (South)); Myoung Sun Oh (Dream Security Co., Ltd., Korea (South)); Minyoung Park and Geonyoung Lee (Dream Security Co., Ltd., Korea (South))
- [P1-10] **Latency in Real-Time 3D Volumetric Streaming: A Comprehensive Study**
Seungwoo Hong (Convergence Networking Research Team/ETRI, Korea (South)); HoSun Yoon (ETRI, Korea (South)); Seong Moon (Principal Researcher, Korea (South)); Inayat Ali (Electronics and Telecommunications Research Institute (ETRI), Korea (South))
- [P1-11] **ProtoConNet: Prototypical Meta Learning for Out-of-Distribution Detection in Radar Modulation with Supervised Contrastive Loss**
Juhyoung Sung (Korea Electronics Technology Institute (KETI), Korea (South)); Kyung-Won Park (Korea Electronics Technology Institute, Korea (South))
- [P1-12] **The Layer Transferability Profile: Mapping Feature Hierarchies in Pretrained Vision Models**
Sanghyuk R Choi, Chanho Gu, Seongrok Kim, Donghwan Hwang, Donghun Ryu, Chiyoung Kim, Seokhyun Kim and Minhyeok Lee (Chung-Ang University, Korea (South))
- [P1-13] **Adaptive Energy-Aware Machine Learning Framework for Fault Monitoring in Network-on-Chip Architectures**
Shaheerullah and Sung Won Kim (Yeungnam University, Korea (South))
- [P1-14] **Comparisons with Snapping Shrimp Noise Detection for UWA-OFDM Systems**
Bogeun Seo, Sanjin Park and Hojun Lee (Hoseo University, Korea (South))
- [P1-15] **PhysHD-Dehaze: Orthogonal and Uncertainty-Aware Dehazing for Challenging Environments**
Hira Khan and Sung Won Kim (Yeungnam University, Korea (South))
- [P1-16] **Study on Cybersecurity for LLM Systems**
Insoo Sohn (Dongguk University, Korea (South)); Juphil Cho (Kunsan National University, Korea (South))
- [P1-17] **PQMigrate: A Backward-Compatible Post-Quantum Migration Blueprint for Wallets and Light Clients**
Collins Izuchukwu Okafor, Love Allen Chijioke Ahakonye, Dong Seong Kim and Jae Min Lee (Kumoh National Institute of Technology, Korea (South))
- [P1-18] **LLM-Assisted Network Management for Digital Twin-Enabled 5G Systems**
YuKai Wang and Janghee Woo (Hanyang University, Korea (South)); Gyeong-June Hahm (Electronics and Telecommunications Research Institute, Korea (South)); Kyung-yul Cheon (ETRI/Electronics and Telecommunications Research Institute, Korea (South)); Hyecheon Kwon (Electronics Telecommunications Research Institute, Korea (South)); Seungkeun Park (Electronics and Telecommunications Research Institute/ETRI, Korea (South)); Sang-Woon Jeon (Hanyang University, Korea (South))
- [P1-19] **Enhancing Bitcoin Mining Using Quantum Search Space Expansion and Non-Unitary Operator**
Yeonsong Suh and Younghoon Park (Sookmyung Women's University, Korea (South))

[P1-20] **Process-State-Aware Remote MEC GPU Sharing for Vision-Guided Collaborative Robotic Welding**
Woo-Sung Jung, Taehyun Yoon, Dongkoo Shon and Daeseung Yoo (Electronics and Telecommunications Research Institute, Korea (South))

July 09, 2026 (Thursday)

Poster P2

Chair: Prof. Eunkyung Kim (Hanbat National University, South Korea)

Poster Hall, Time 09:00–10:40

[P2-01] **Weighted Knowledge Distillation with DisturbLabel for Robust Learning**
Doyoung Koh, Taehoon Kim, Sehun Lee and Namgi Kim (Kyonggi University, Korea (South))

[P2-02] **SpikeGuard-LF: Conformal Spike-Lazy Forests for Wireless Sensor Network Intrusion Detection**
SooYoung Jang and Eunkyung Kim (Hanbat National University, Korea (South))

[P2-03] **Topology-Aware Decision Transformer for End-to-End Entanglement Request Scheduling in Quantum Networks**
Yeong-Jun Seok, DeaGun Kang and Youn-Hee Han (Korea University of Technology and Education, Korea (South))

[P2-04] **ZittoBATT-250: Synthetic Abuse Data for Safer Smart Battery Early Warning Systems**
Mohamed Abubakar Dini Rage (Network Systems Laboratory, Korea (South)); Sium Bin Noor, Judith Nkechinyere Njoku, Taesoo Jun, Dong Seong Kim and Jae Min Lee (Kumoh National Institute of Technology, Korea (South))

[P2-05] **Multimodal Deep Learning-Based Anomaly Action Recognition in Multiple Physical Security Domains**
Dongchil Kim (Korea Electronics Technology Institute (KETI), Korea (South)); Chang Mo Yang (Korea Electronics Technology Institute, Korea (South))

[P2-06] **Lightweight CNN Model Design Using Bayesian Optimization and Truncated Singular Value Decomposition for SNR Estimation**
Abdullah Al Mahbub (Chosun University, Korea (South)); Ijaz Ahmad (Korea University, Korea (South)); Seokjoo Shin (Chosun University, Korea (South))

[P2-07] **Design of Nonlinear Chirp for Multi-Node Identification in Extremely Band-Limited Underwater Communications**
Haeseong Kwon and Bogeun Seo (Hoseo University, Korea (South)); Hyunjin Shin (STX Engine, Korea (South)); Hojun Lee (Hoseo University, Korea (South))

[P2-08] **Carbon-Aware Traffic Steering for TN-NTN Scenario via Graph Attention Reinforcement Learning**
Junyoung Kim and Soyi Jung (Ajou University, Korea (South))

[P2-09] **Middleware Topology Comparison for Automotive Zonal Architectures: Zenoh, DDS, and Zenoh-Bridged DDS**
Beom Gi Suh, Sung Bhin Oh, Young Soo Do, Seung Uk Son, Young Min Kim, Chaeun Lee, Chan Gyu Park and Jae Wook Jeon (Sungkyunkwan University, Korea (South))

[P2-10] **Edge-AI Enabled Real-Time Multi-Camera Casualty Detection and Tracking for Military IoT**
Sium Bin Noor (Kumoh National Institute of Technology, Korea (South)); Mohamed Abubakar Dini (Network Systems Laboratory, Korea (South)); Jae Min Lee, Dong Seong Kim and Jung Hyeon Kim (Kumoh National Institute of Technology, Korea (South))

[P2-11] **Federated Learning Assisted Slot Specific SB SPS Scheduling for Distributed CV2X Networks**
Muneeb Muhammad (Sang Ji University, Korea (South)); Kwangman Ko (Sangji University, Korea (South))

[P2-12] **Evaluating AMP for Automotive Gateways**
Chan Gyu Park, Beom Gi Suh, Seong Hyeon Lim, Sung Bhin Oh, Young Soo Do, Young Min Kim, Chaeun Lee and Jae Wook Jeon (Sungkyunkwan University, Korea (South))

[P2-13] **Hybrid Session-Based UEBA for AWS Environment**
Doo-Hwan Choi (Pusan National University, Korea (South)); Geonwoo Yoon (Pusan National University, Korea (South)); Jae-Seok Kim and Yoon-Ho Choi (Pusan National University, Korea (South))

[P2-14] **Web Visualization Performance Optimization Techniques Using CityGML 3.0-Based Multi-LoD Generation and Hierarchical 3D Tiles Structures**
Sohyeon Park (SUNDOSOFT, Korea (South)); Sungho Cho (SUNDOSOFT, Korea (South)); Joohyuk Park, Dawoon Jeong, Eunseo You and Isu Kim (SUNDOSOFT, Korea (South))

[P2-15] **A Scalable Distributed Data Pipeline and Network Architecture for High-Resolution Carbon Spatial Mapping**
Seungho Jo, Inho Choi, Mira Park and Taeyoung Jung (Sundosoftware, Korea (South))

[P2-16] **Cooperative Swarm Drone Interception via Dual-Reward CTDE MARL in Airbase Defense**
Muhammad Zacky Asy'ari and Soo Young Shin (Kumoh National Institute of Technology, Korea (South))

[P2-17] **SMT: SBOM and Merkle Tree Based Integrity Verification for Serverless Environments**
Jieon Lee, Won-Bin Kim and Daehye Seo (Sangmyung University, Korea (South))

[P2-18] **SLA-Aware Resource Allocation for V2X Network Slicing via SAC-Based O-RAN xApp**
Muhammad Ashar Tariq and Deepak Singh (Kyungpook National University, Korea (South)); Muhammad Saad Malik (Daegu Gyeongbuk Institute of Science and Technology, Korea (South)); Chaehyeon Kim, Dayun Jang and Dongkyun Kim (Kyungpook National University, Korea (South))

Poster P3

Chair: Prof. Eunkyung Kim (Hanbat National University, South Korea)

Poster Hall, Time 10:50~12:30

- [P3-01] **Quantum-Resistant RLWE Based Authentication Scheme for Space-Air-Ground-Integrated Network**
Seokmo Jung and Hyeongeun Lim (Kyungpook National University, Korea (South)); Chae Kim (Kyungpook University, Korea (South)); YoungHo Park (Kyungpook National University, Korea (South))
- [P3-02] **Cryptanalysis and Countermeasures of "Lightweight and Anonymous Authentication Scheme for Medical Internet of Things Services"**
Hyeongeun Lim, Seokmo Jung, Taehun Kim and YoungHo Park (Kyungpook National University, Korea (South))
- [P3-03] **False Negative Minimization in Isolation Forest Using Distribution-Based Dynamic Contamination Adjustment**
Haim Lee, Won-Bin Kim and Daehee Seo (Sangmyung University, Korea (South))
- [P3-04] **An Embedded Real-Time System for Human Trajectory Prediction Using ROS 2**
Jihong Jeong, JunWoo Nam, Han Geyol Lee and Jongtae Rhee (Dongguk University, Korea (South)); Pavel Stasa (VSB - Technical University of Ostrava, Czech Republic); Jin-Woo Jung (Dongguk University, Korea (South))
- [P3-05] **Battery-Aware Scheduling for Multi-Receiver Laser Wireless Power Transfer in IoT Systems**
Hee June Lee, Su Min Kim and Junsu Kim (Tech University of Korea, Korea (South))
- [P3-06] **Efficient Foreground Reconstruction via Mask-Guided Adaptive Multi-View Stereo**
Sung-Won Cho, Min Hee Jo and Jin-Woo Jung (Dongguk University, Korea (South))
- [P3-07] **Diffusion Model-Based Network Traffic Synthesis for Private 5G Network**
Noh-sam Park (Electronics and Telecommunications Research Institute, Korea (South)); Mi-Kyung Han and Jonghoon Lee (ETRI, Korea (South))
- [P3-08] **Deep Learning-Based Parking Lot Tailgating Detection and Prevention System Using a Corner Sub-Camera**
Minseok Choi and Jaejoon Kim (Daegu University, Korea (South))
- [P3-09] **Teacher-Anchored Worst-Case Stability Distillation for Membership Privacy**
Hyeon-Jin Jeong, Seok-Won Hong, Jae-Hwan Jeong and Seok-Hwan Choi (Yonsei University, Korea (South))
- [P3-10] **A Study on an Edge AI-Based Disaster AX Platform Architecture for Climate-Related Disaster Response in Island Regions**
NunSol Park (NIA (National Information Society Agency), Korea (South)); Donghee Kim (National Information Society Agency, Korea

(South)); JinKyu Yang (NIA, Korea (South)); Eunju Kim (National Information Society, Korea (South))

- [P3-11] **Performance Analysis of the AOA Estimation Algorithm Based on Orthogonal Array**
Tae-yun Kim and Suk-seung Hwang (Chosun University, Korea (South))
- [P3-12] **Property-Aligned Conditional Material Generation in Diffusion Models via Auxiliary Prediction**
Youngseo Hwang, Junhee Seok and Euseong Kim (Korea University, Korea (South))
- [P3-13] **High-Speed Tiny Object Detection Using Synthetic Datasets on Resource-Constrained Hardware**
DongHyuk Heo, JiChan Park, YeongUng Bae and SeungHee Lee (Hanwha Aerospace, Korea (South)); JongSue Bae (Hanwha Corporation R&D Center, Korea (South))
- [P3-14] **Energy-Accuracy Balanced Indoor Positioning Using Tabular Q-Learning and Dynamic Kalman Filter**
Hyeon Min Kim and Young-Bae Ko (Ajou University, Korea (South))
- [P3-15] **Protection Distance Estimation for Coexistence of Mobile Communication and Fixed Microwave Systems in the 4.4-4.8 GHz Band**
Ho Kyung Son (ETRI, Korea (South)); Hyunduk Kang (Electronics and Telecommunications Research Institute (ETRI), Korea (South))
- [P3-16] **Maximum Likelihood Finite Memory Structure Filter Based Target Tracking Using Finite Nonlinear Measurements**
Pyung Soo Kim (Tech University of Korea, Korea (South)); Joo-Sang Youn (Donggeui University, Korea (South))
- [P3-17] **The Dual Steer Mobile System for Integrated TN and NTN in 6G**
HyunKyung Yoo (Electronics and Telecommunications Research Institute, Korea (South)); Namseok Ko (ETRI, Korea (South)); Sung Hyuk Byun (Electronics and Telecommunications Research Institute, Korea (South))
- [P3-18] **Simulation Validation of a Next-Generation Security Architecture for the Adaptive AutoSAR Platform Integrating an AI-Based Intrusion Detection System(AI-IDPS) and Hybrid Access Control(FA-RBAC)**
Youngjin Kim (Telecommunications Technology Association, Korea (South))
- [P3-19] **Domain-Adapted Language Models for Latent State Inference from Unstructured Text: A Comparative Study of Clinical Sepsis Prediction and Affective Processing**
Seohyun Yoo, Yewon Kwon, Jaehong Kim, Yeonho Jo, Jaehyuk Cho (Jeonbuk National University, Korea (South))

Poster P4

Chair: Prof. Jung Hoon Lee (Hankuk University of Foreign Studies, South Korea)

Poster Hall, Time 15:20~17:00

- [P4-01] **Score-Based Generative Model for Wireless Channel Estimation**
Seungcheol Oh and Joongheon Kim (Korea University, Korea (South))
- [P4-02] **LASA: Latency-Aware Safety Arbitration for Vision-Language-Action Autonomous Driving**
Young Hoon Suh and Hyo Jin Park (Sungkyunkwan University, Korea (South)); HyeHyeon Park (Sungkyunkwan University & Automation Lab, Korea (South)); HyeJun Hong (SungKyunKwan University, Korea (South)); Seung Yun Noh, Sun Hong Jung and Jae Wook Jeon (Sungkyunkwan University, Korea (South))
- [P4-03] **A Three-Plane Agentic AI Architecture for Patient-Centered Multimodal Maternal Health Monitoring**
Ahnna Lee (Yonsei University, Korea (South) & Yonsei University College of Medicine, Korea (South)); Hyan Kwon, Suhra Kim, Jung Heui Kim, Seng Chan You and Ja-Young Kwon (Yonsei University College of Medicine, Korea (South))
- [P4-04] **Dimension-Selected Orthogonal Particle Swarm Optimization for High-Dimensional Problems**
Zhi Xing, Huan Zhang and Hu Jin (Hanyang University, Korea (South))
- [P4-05] **A Study on RS-Assisted RAIDDR for Metadata-Aware Memory Reliability in Future Network Infrastructure**
Taeuk Ha and Sang-Hyo Kim (Sungkyunkwan University, Korea (South))
- [P4-06] **An ISAC-Inspired Medium Access Control Protocol for Propagation-Aware Underwater Sensor Networks**
Ho-Shin Cho and Tae Jin Kwon (Kyungpook National University, Korea (South))
- [P4-07] **Design of an on-Device AI-Based Autonomous Manufacturing System for Machining Processes**
Mahn-suk Yoon (Gumi Electronics & Information Technology Research Institute, Korea (South) & 구미전자정보기술원, Korea (South)); Sunghun Lee (GERI, Korea (South))
- [P4-08] **Real Time Food Vision Inspection on Raspberry Pi 5 and Jetson Orin Nano with Throughput Comparison**
Taehun Kang, Yunsang Cho, YongSeok Cho and Ju-Hyuck Han (Konyang University, Korea (South))
- [P4-09] **CNN-Based Detection of Nonstationary Micro-Doppler Sidebands Under Cluttered Slow-Time Dynamics**
Zahra Zarei and Chung G. Kang (Korea University, Korea (South))
- [P4-10] **Heading-Aware Multi-Agent Exploration for Human Search via Merged-Map Coordination**
Muhammad Imad and Soo Young Shin (Kumoh National Institute of Technology, Korea (South))
- [P4-11] **Applying ML-DSA's NTT to SMAUG-T Polynomial**

Multiplication: Feasibility Analysis and Performance Comparison

Kim Ye Jin, Kim Dong Hyeon and Dong-Chan Kim (Kookmin University, Korea (South))

- [P4-12] **The Council of Experts: A Heterogeneous Rational-Aware Framework for Robust Energy Forecasting**
Ali Aouto (ICT Convergence Research Center, Kumoh National Institute of Technology, Korea (South)); Dong Seong Kim (Kumoh National Institute of Technology, Korea (South))
- [P4-13] **Failure-Aware Adaptive Recovery Policy for Vehicle OTA Updates**
Young Min Kim, Sung Bhin Oh, Young Soo Do, Beom Gi Suh, Chaeun Lee, Seung Uk Son, Chan Gyu Park and Jae Wook Jeon (Sungkyunkwan University, Korea (South))
- [P4-14] **Multi-Input Model for TENS Stimulation Intensity Classification and Prediction Using ECG, EMG and Personal Characteristics**
Seunghui Kim, Sunghun Lee and Daechang Kim (Dongguk University, Korea (South)); SungMin Kim (Dongguk University-Seoul, Korea (South))
- [P4-15] **HG-Probe: A Safety-Bounded Evidence Layer for LLM-Guided Web/API Security Testing**
Jimin Yang (Gyeongbuk Software Meister High School, Korea (South))
- [P4-16] **Minke Whale Whistle Generation for Underwater Biomimetic Communication Using Flow Matching**
Minho Kim, Sanghwa Lee and Seunghwan Seol (Inha University, Korea (South)); Geun-Ho Park and Jongmin Ahn (Agency for Defense Development, Korea (South)); Jaehak Chung (Inha University, Korea (South))
- [P4-17] **Coordinated SLIPT and TDD Optimization for Energy-Deprived Seabed Sensors Using Meta-Learning Enabled ROV**
Yongtaek Woo (Yeungnam University, Korea (South) & Ai System Implementation Lab, Korea (South)); Sang-Woon Jeon (Hanyang University, Korea (South)); Seong Ho Chae (Tech University of Korea, Korea (South)); Yujae Song (Yeungnam University, Korea (South))
- [P4-18] **Quantitative Privacy Evaluation and Lightweight Edge Blockchain-Based Application Architecture for Intelligent Home Environments**
Tai Yeon Ku and Wan-Ki Park (ETRI, Korea (South))
- [P4-19] **An Efficient and Theoretically-Completed Variant of CASCADE Error Correction Protocol for QKD**
Heejeung Won, Jieun Ryu and Ju-Sung Kang (Kookmin University, Korea (South)); Yongjin Yeom (Kookmin, Korea (South))
- [P4-20] **An Energy Influence Based Indoor Lighting Control Method to Maximize Natural Light Utilization**
SeungTaek Oh and JaeHyun Lim (Kongju National University, Korea (South))

Location

Aula Magna Carassa e Dadda, Building BL28
Politecnico di Milano, Bovisa Campus
Via Lambruschini 4, Building BL28
20156 Milan (MI), Italy



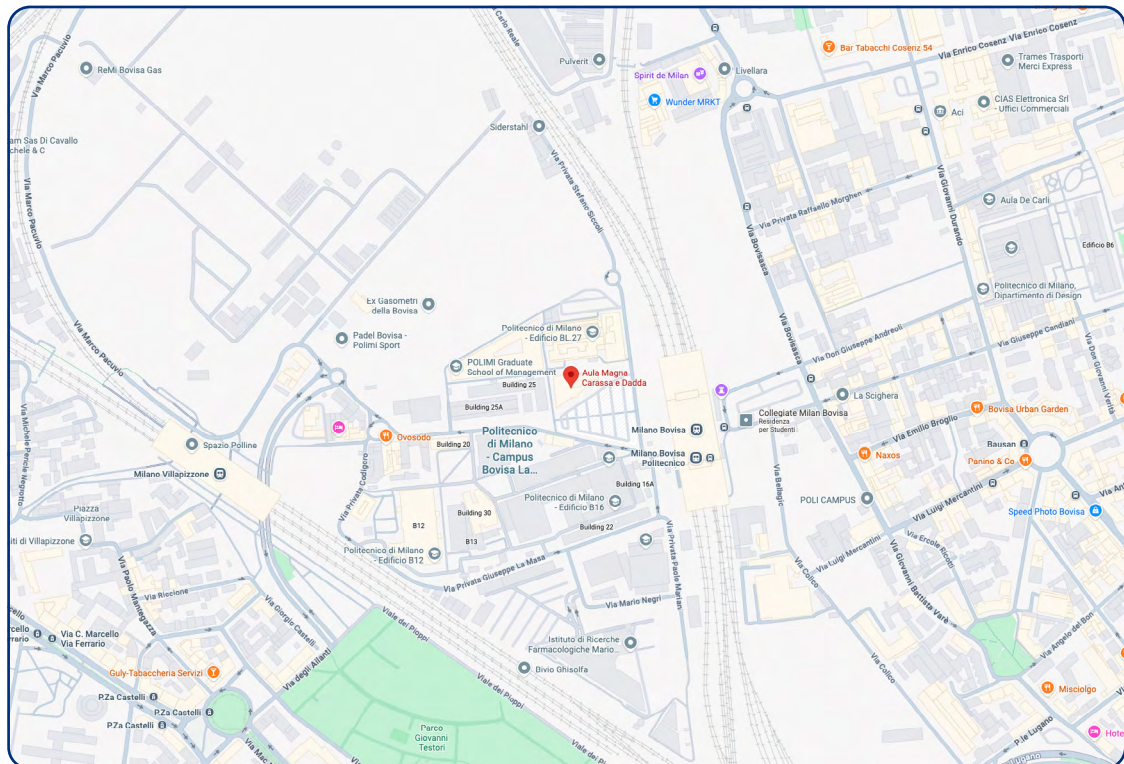
Introduction

ICUFN 2026 in Milan will be held at the Aula Magna Carassa e Dadda, located in Building BL28 on the Bovisa Campus of Politecnico di Milano, which will serve as the main conference venue. The conference banquet venue will be announced at a later date, with further details to be provided closer to the event.

Founded in 1863, Politecnico di Milano is widely recognized as one of Europe's leading universities in engineering, architecture, and industrial design. The Bovisa Campus is a key hub for innovation and applied research, hosting a wide range of departments and research centers focused on advanced technologies and interdisciplinary collaboration.

The campus offers a vibrant and dynamic academic environment, strengthened by close ties with industry and a diverse international community. With a large student body that includes a significant proportion of international students, the university promotes a global perspective alongside excellence in education and research.

Map



Banquet Hotel

Radisson Blu Hotel Milan

Introduction

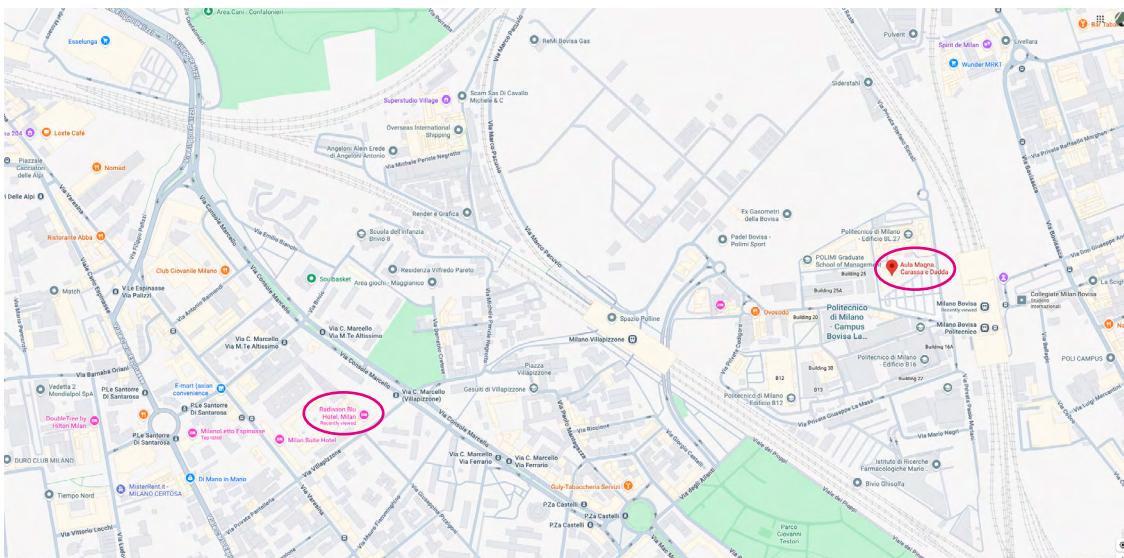
A stylish 4-star hotel featuring modern design, wellness facilities (pool, gym, sauna), and high-quality business amenities.

Distance to Venue

Approximately 15–20 minutes on foot (about 1.0–1.5 km depending on route) from Bovisa Campus

Homepage

<https://www.radissonhotels.com/en-us/hotels/radisson-blu-milan>



Centro Storico

This is the historic center of Milan, dominated by the breathtaking Duomo in Piazza del Duomo, the Royal Palace, and Merchant's Square - a lively medieval square with outdoor markets, exhibitions, and live music. The neighborhood is also home to Vittorio Emanuele II, the city's oldest and most glamorous shopping center. In short, Centro Storico is a great base if you want to be close to shopping, fine dining, cultural and historical sites of Milan.



Brera

Just north of the city center, a short walk from Sforza Castle, La Scala, and several interesting museums is Brera. This neighborhood is popular with writers, poets, and artists. It has a bohemian vibe, and cobbled streets flanked by traditional houses. They're peppered with trendy art galleries, cocktail bars, and old-style trattorias which delight with Milanese treats. Brera is the perfect neighborhood for a romantic couple's break in the city.



Milan Night Walking Tour

Explore the city after dark on an amazing Milan Night Walking Tour. This superb guided tour invites you to discover incredible examples of haunting Gothic architecture after the sun goes down. Local experts will mesmerize you with stories and ancient tales as you wander Milan's piazzas and side streets. Pass the iconic Duomo, Vittorio Emanuele II Gallery, and Sforza Castle - one of Europe's largest citadels. You'll take in La Scala - one of the world's most important opera houses. See the city's charming cobbled streets as they are illuminated by the glow of the moon.



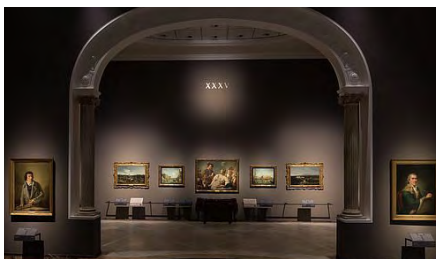
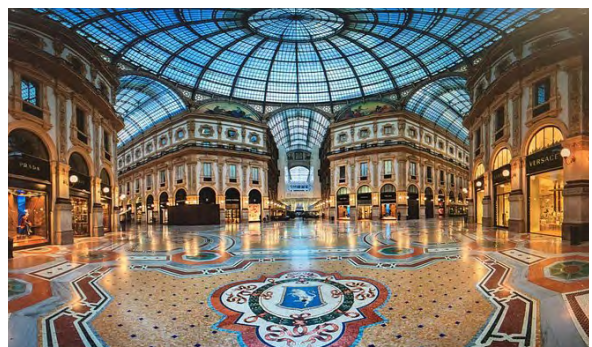
Duomo Di Milano

The centerpiece of Milan, the Duomo is one of Europe's greatest architectural and cultural landmarks. As Italy's largest church and one of the largest in the world, it took over 600 years to build. Today, the Duomo has a capacity of 40,000 people and is home to the world's second-largest organ. Admire the wide selection of religious art on display inside, or marvel at the 3000 statues that line its Gothic exterior. Be sure to join one of the available Duomo tours, which include art tours and even rooftop tours, where you might be able to see as far as the Italian Alps. – Tripadvisor



Galleria Vittorio Emanuele II

For sheer belle époque splendor, this extravagant 19th-century glass-topped, barrel-vaulted tunnel serves as a lively, noisy and colorful shopping mall, teeming with life and inviting you to people-watching from the tables that spill from the Galleria's many bars and restaurants.



Pinacoteca di Brera

See some of the world's most stunning, centuries-old paintings from Italian masters including Caravaggio and Raphael. The gallery's collection is housed in a 19th century former monastery.

Teatro Alla Scala

This world-renowned opera house was built in 1778, where many composers wrote and conducted works including such greats as Rossini, Puccini, Verdi and Toscanini.



I Navigli

Locals and travelers flock to this quaint neighborhood for its inviting atmosphere, delicious food, and great drinks. The Navigli area is centered on the two remaining canals that once encircled Milan. During the day, you can stroll along the waterfront to spot beautiful street art and visit historic landmarks like Vicolo dei Lavandai. Grab a spot by the Darsena pond at sunset to people-watch and relax before heading to a cozy bistro for dinner. Complete your visit with some gelato and drinks at the local pubs for a night out. The traditional Fiera di Sinigaglia flea market takes place here once a week too. – Tripadvisor



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PhysHD-Dehaze: Orthogonal and Uncertainty-Aware Dehazing for Challenging Environments

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Abstract—Dense and spatially non-homogeneous haze poses significant challenges for real-world vision systems. This paper presents PhysHD-Dehaze, a semi-supervised dehazing framework incorporating a Swin-based hierarchical encoder with SWT-IDWT feature refinement for multi-scale degradation-aware representation. A haze density-aware attention module targets heavily degraded regions, while orthogonality-constrained disentanglement separates scene content from haze interference. A lightweight physics-guided branch estimates transmission maps and atmospheric illumination to enforce restoration consistency, and an uncertainty-aware objective mitigates unreliable pseudo-supervision on unlabeled real data. Dual-discriminator adversarial training jointly enforces local and global visual fidelity. Experiments on eight synthetic and real-world benchmarks demonstrate strong restoration performance, achieving 35.18 dB PSNR / 0.988 SSIM on RESIDE Outdoor and 20.87 dB / 0.789 on NH-HAZE, along with the lowest FADE score of 0.807 on real hazy RTTS data, with improved downstream scene understanding.

Index Terms—semi-supervised dehazing, non-homogeneous haze, orthogonal disentanglement, uncertainty-aware learning.

I. INTRODUCTION

Adverse atmospheric conditions degrade outdoor imagery through light scattering and attenuation, manifesting as reduced contrast, color distortion, and loss of structural detail. Haze presents a persistent challenge owing to its spatial non-uniformity and variable optical density, significantly impairing object detection, semantic scene understanding, and autonomous navigation. Robust single-image dehazing thus remains a critical prerequisite for both image restoration and downstream perception pipelines.

Most dehazing methods are grounded in the atmospheric scattering model (ASM) [1],

$$I(x) = J(x)t(x) + A(1 - t(x)), \quad (1)$$

where $I(x)$ is the observed hazy image, $J(x)$ is the clean scene radiance, A denotes atmospheric light, and $t(x)$ is the transmission map. Early prior-based methods, notably the dark

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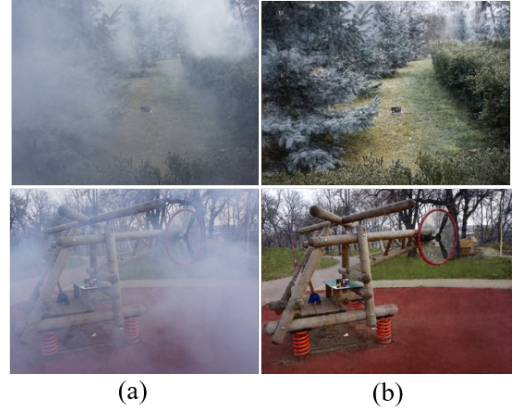


Fig. 1: (a) Non-homogeneous hazy scenes and (b) Dehazed by PhysHD-Dehaze.

channel prior [2], leverage statistical regularities of natural scenes under the ASM but degrade under dense or spatially non-homogeneous haze where core assumptions are violated. CNN-based methods [3]–[5] and transformer architectures [6] achieved strong performance on synthetic benchmarks, yet their dependence on paired synthetic training induces a persistent domain gap when applied to real hazy scenes. Semi-supervised and physics-constrained strategies [7]–[9] partially address this by exploiting unlabeled real images; however, spatially non-homogeneous haze remains difficult due to significant variation in local degradation strength and the scarcity of reliable real-world supervision.

As illustrated in Fig. 1, non-homogeneous haze causes spatially varying degradation that demands models that are simultaneously structure-aware and degradation-adaptive, a requirement unmet by existing uniform-haze frameworks.

To address this, we propose PhysHD-Dehaze, a semi-supervised framework that unifies hierarchical Swin Transformer encoding, SWT-IDWT feature refinement, haze density-aware attention, orthogonality-constrained content-haze disentanglement, physics-guided reconstruction, and uncertainty-aware pseudo-supervision on unlabeled real data.

The main contributions are summarized as follows:

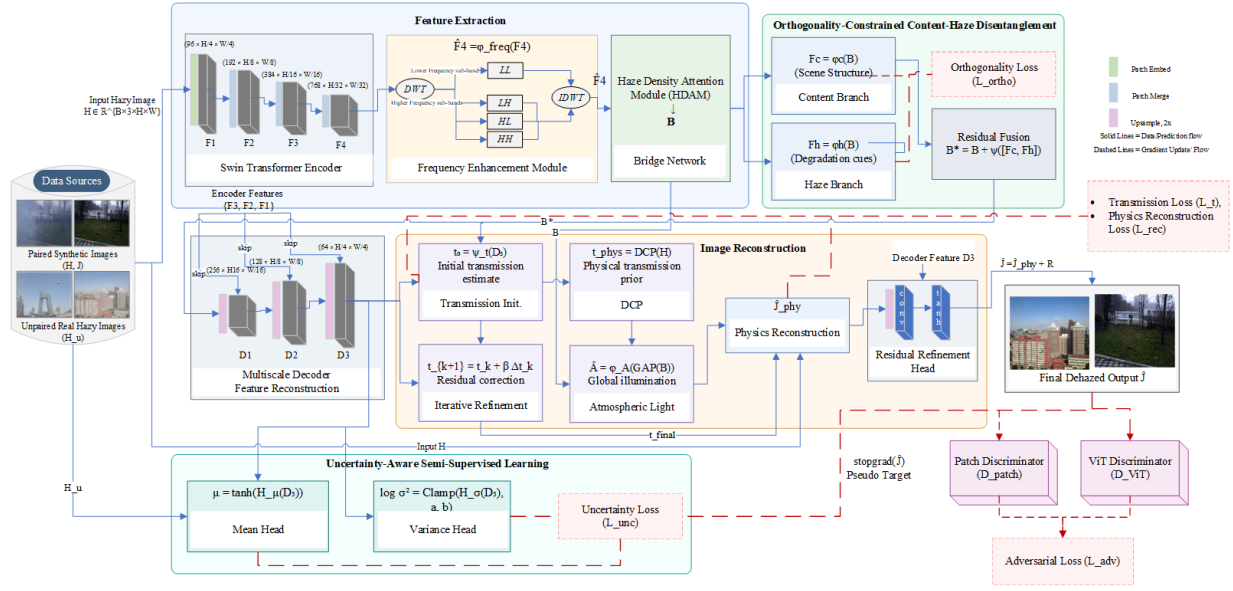


Fig. 2: Overall architecture of the proposed semi-supervised image dehazing framework.

- A semi-supervised dehazing framework for dense and non-homogeneous haze combining hierarchical transformer encoding, wavelet-based feature refinement, and haze density-aware representation learning.
- Orthogonality-constrained content-haze disentanglement with uncertainty-aware semi-supervised optimization for improved robustness on real hazy data.
- A lightweight physics-guided reconstruction branch validated through quantitative, qualitative, and task-driven evaluation, achieving 35.18 dB PSNR on RESIDE Outdoor and a best FADE of 0.807 on real-world RTTS.

II. PROPOSED METHODOLOGY

The proposed framework targets non-homogeneous dehazing where haze density varies spatially across the scene. As illustrated in Fig. 2, the network follows a hierarchical encoder-decoder design with five stages: (1) hierarchical feature extraction, (2) frequency enhancement and haze density-aware modulation, (3) orthogonality-constrained content-haze disentanglement, (4) physics-guided image reconstruction, and (5) uncertainty-aware semi-supervised optimization with adversarial supervision.

A. Hierarchical Feature Extraction

Given a hazy image $\mathbf{H}$, a Swin Transformer encoder extracts multiscale features:

$$\{F_1, F_2, F_3, F_4\} = \mathcal{E}(\mathbf{H}), \quad (2)$$

where $\mathcal{E}(\cdot)$ denotes the hierarchical encoder, F_1 and F_2 retain local texture information, and F_3, F_4 encode higher-level structural and degradation-aware representations.

B. Frequency Enhancement and Haze Density-Aware Modulation

To improve deep feature quality under spatially varying haze, the deepest feature F_4 is refined using a Frequency Enhancement Module (FEM) based on the stationary wavelet transform (SWT):

$$\tilde{F}_4 = \phi_{\text{SWT}}(F_4), \quad (3)$$

where $\phi_{\text{SWT}}(\cdot)$ decomposes F_4 into one low-frequency and three high-frequency sub-bands, enabling independent enhancement of global structure and fine-grained detail prior to reconstruction via IDWT. The refined feature is then passed through a bridge network:

$$\mathbf{B} = \phi_{\text{bridge}}(\tilde{F}_4), \quad (4)$$

where $\phi_{\text{bridge}}(\cdot)$ is a convolutional bottleneck that produces the compact latent representation forwarded to subsequent stages. A Haze Density-Aware Module (HDAM) is then applied over it $\mathbf{B}$ (Fig. 3), learning channel-wise importance weights that selectively amplify haze-sensitive responses while preserving relatively unaffected regions.

C. Orthogonality Constrained Content-Haze Disentanglement

Although $\mathbf{B}$ contains rich scene information, it still mixes clean content and haze degradation cues. To separate these factors, two parallel branches are used:

$$\mathbf{F}_c = \phi_c(\mathbf{B}), \quad (5)$$

$$\mathbf{F}_h = \phi_h(\mathbf{B}), \quad (6)$$

where $\mathbf{F}_c$ captures scene content and one $\mathbf{F}_h$ captures haze-related information. Whereas, $\phi_c(\cdot)$ and $\phi_h(\cdot)$ are dedicated convolutional projection heads for scene content and haze degradation, respectively.

To reduce redundancy between the two branches, an orthogonality constraint is imposed:

$$\mathcal{L}_{\text{ortho}} = \frac{1}{B} \sum_{i=1}^B \text{mean} \left(\left| \bar{\mathbf{F}}_c^{(i)\top} \bar{\mathbf{F}}_h^{(i)} \right| \right), \quad (7)$$

where $\bar{\mathbf{F}}_c$ and $\bar{\mathbf{F}}_h$ denote normalized features. This loss penalizes the correlation between the content and haze embeddings, encouraging cleaner feature separation.

The disentangled features are then fused back into the latent representation:

$$\mathbf{B}^* = \mathbf{B} + \psi([\mathbf{F}_c, \mathbf{F}_h]). \quad (8)$$

where $\psi(\cdot)$ is a 1×1 convolutional fusion layer is applied to the channel-wise concatenation of disentangled features.

D. Multiscale Decoder and Physics-Guided Reconstruction

The refined latent feature $\mathbf{B}^*$ is progressively decoded with skip connections from the encoder:

$$\mathbf{D}_1 = \mathcal{U}_1(\mathbf{B}^*, \mathbf{F}_3), \quad (9)$$

$$\mathbf{D}_2 = \mathcal{U}_2(\mathbf{D}_1, \mathbf{F}_2), \quad (10)$$

$$\mathbf{D}_3 = \mathcal{U}_3(\mathbf{D}_2, \mathbf{F}_1). \quad (11)$$

where $\mathcal{U}_k(\cdot)$ denotes the k -th decoderupsampling block consisting of bilinear upsampling followed by concatenation with the corresponding encoder skip feature and a convolutional refinement layer.

A key component of the proposed reconstruction stage is the integration of atmospheric priors into transmission estimation rather than relying only on direct image-to-image regression. First, a physics-based transmission prior is computed using dark channel statistics:

$$t_{\text{phys}}(x) = 1 - \min_{y \in \Omega(x)} \left(\min_{c \in \{R, G, B\}} \mathbf{H}_c(y) \right). \quad (12)$$

where $\Omega(x)$ denotes a local square patch neighborhood centered at pixel x . This prior provides a coarse estimate of haze thickness from the observed image.

The atmospheric light is estimated from the global latent representation:

$$\hat{\mathbf{A}} = \phi_A(\text{GAP}(\mathbf{B})). \quad (13)$$

This gives the scene-level illumination term required for physical reconstruction.

Using the refined transmission $\hat{t}$ and estimated atmospheric light $\hat{\mathbf{A}}$, a physics-consistent clean image is reconstructed as

$$\hat{\mathbf{J}}_{\text{phys}}(x) = \frac{\mathbf{H}(x) - \hat{\mathbf{A}}(1 - \hat{t}(x))}{\hat{t}(x) + \epsilon}. \quad (14)$$

where $\epsilon = 10^{-6}$ is a small constant introduced for numerical stability. This step introduces physical interpretability into the restoration branch and serves as a lightweight novelty in the reconstruction module.

Finally, because real non-homogeneous haze may deviate from the ideal scattering model, a residual refinement head predicts a correction term:

$$\hat{\mathbf{J}} = \hat{\mathbf{J}}_{\text{phys}} + \mathbf{R}. \quad (15)$$

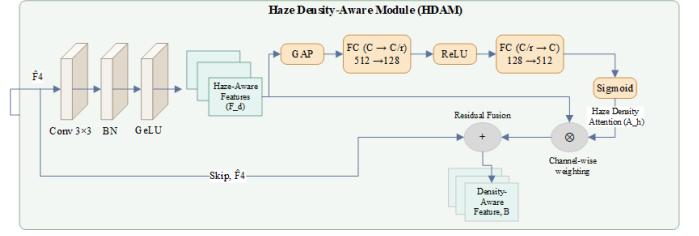


Fig. 3: Proposed feature refinement blocks: the Frequency Enhancement Module and the Haze Density-Aware Module.

Algorithm 1: Training of the proposed dehazing framework

Input: Paired data $\mathcal{D}_p = \{(\mathbf{H}, \mathbf{J})\}$, unpaired hazy data $\mathcal{D}_u = \{\mathbf{H}_u\}$
Initialize generator and discriminator parameters
for each iteration do
 Sample mini-batches from $\mathcal{D}_p$ and $\mathcal{D}_u$
 Extract hierarchical features $\{\mathbf{F}_1, \mathbf{F}_2, \mathbf{F}_3, \mathbf{F}_4\}$
 Refine $\mathbf{F}_4$ using SWT-IDWT enhancement and HDAM to obtain $\mathbf{B}$
 Disentangle $\mathbf{B}$ into content and haze features, and fuse them into $\mathbf{B}^*$
 Decode $\mathbf{B}^*$ to estimate $\hat{t}$, $\hat{\mathbf{A}}$, $\hat{\mathbf{J}}_{\text{phys}}$, and final output $\hat{\mathbf{J}}$
 For unpaired data, predict uncertainty and compute $\mathcal{L}_{\text{unc}}$
 Compute $\mathcal{L}_{\text{total}}$ and update the generator and discriminators

Here, $\mathbf{R}$ compensates for local errors and residual artifacts not captured by the physical prior alone.

E. Uncertainty-Aware Semi-Supervised Learning

To exploit unlabeled real hazy images, the network includes an uncertainty branch connected to the decoder feature $\mathbf{D}_3$. The branch predicts a mean restoration and a pixel-wise variance:

$$\boldsymbol{\mu} = \tanh(\mathcal{H}_{\boldsymbol{\mu}}(\mathbf{D}_3)), \quad (16)$$

$$\log \sigma^2 = \text{Clamp}(\mathcal{H}_{\sigma}(\mathbf{D}_3), a, b). \quad (17)$$

The mean branch estimates the restored image, while the variance branch measures confidence at each location.

For unpaired samples, the reconstructed output is used as a pseudo target with stop-gradient, and the uncertainty loss is defined as

$$\mathcal{L}_{\text{unc}} = \frac{1}{2} \left(\frac{\|\boldsymbol{\mu} - \text{stopgrad}(\hat{\mathbf{J}})\|^2}{\sigma^2} + \log \sigma^2 \right). \quad (18)$$

This formulation assigns lower weight to uncertain predictions and stabilizes learning on real hazy images without paired supervision.

F. Dual-Discriminator Adversarial Learning

To enhance perceptual realism, two complementary discriminators are employed. A patch discriminator (D_{patch}) focuses on local texture consistency, whereas a ViT-based discriminator (D_{ViT}) captures global structural and chromatic coherence. Operating in tandem, these components steer the generator toward dehazed outputs that are both structurally faithful and visually natural.

G. Training Strategy and Optimization Objective

The network is trained using paired synthetic data $\mathcal{D}_p = \{(\mathbf{H}, \mathbf{J})\}$ and unpaired real hazy images $\mathcal{D}_u = \{\mathbf{H}_u\}$. During training, paired samples use supervised, transmission, reconstruction, orthogonality, and adversarial losses, while unpaired samples are optimized with uncertainty-aware and reconstruction-related constraints. The overall objective is given by:

$$\mathcal{L}_{\text{total}} = \lambda_1 \mathcal{L}_{\text{sup}} + \lambda_2 \mathcal{L}_{\text{ortho}} + \lambda_3 \mathcal{L}_t + \lambda_4 \mathcal{L}_{\text{rec}} + \lambda_5 \mathcal{L}_{\text{unc}} + \lambda_6 \mathcal{L}_{\text{adv}}. \quad (19)$$

Here, $\mathcal{L}_{\text{sup}}$ denotes supervised image restoration, $\mathcal{L}_{\text{ortho}}$ enforces content-haze disentanglement, $\mathcal{L}_t$ constrains transmission estimation, $\mathcal{L}_{\text{rec}}$ preserves physics-guided reconstruction consistency, $\mathcal{L}_{\text{unc}}$ handles uncertain pseudo-supervision on real hazy data, and $\mathcal{L}_{\text{adv}}$ improves perceptual realism. The complete training procedure is summarized in Algorithm 1.

III. EXPERIMENTS AND RESULTS

A. Datasets and Experimental Settings

To evaluate the proposed method under diverse haze conditions, experiments are conducted on seven public benchmarks, including both synthetic and real-world datasets: RESIDE SOTS [10], Dense-Haze [11], O-HAZE [12], NH-HAZE [13], Foggy Cityscapes [14], and RTTS [15]. Foggy Cityscapes [14] provides synthetic fog rendered over real driving scenes without pixel-aligned restoration ground truth; it is therefore evaluated qualitatively and through downstream object detection performance. RTTS [15] consists of real unpaired hazy images with no clean reference and is assessed using no-reference perceptual metrics: NIQE, FADE, and BRISQUE. This per-dataset evaluation strategy reflects the nature of available supervision in each benchmark rather than a uniform protocol applied irrespective of ground-truth availability.

All methods are tested under identical evaluation protocols. The model is trained semi-supervisedly using paired synthetic images and unlabeled real hazy samples from RTTS

B. Quantitative Comparison

Table II reports PSNR and SSIM comparisons on synthetic and real paired benchmarks. PhysHD-Dehaze attains best or competitive scores across all datasets, with especially strong results on O-HAZE and NH-HAZE, reflecting its capability under dense and spatially varying conditions. Performance on Dense-HAZE remains consistently competitive, demonstrating stable restoration across diverse degradation levels.

TABLE I: No-reference perceptual evaluation on RTTS. Lower is better.

Method	NIQE↓	FADE↓	BRISQUE↓
DCP [2]	5.462	1.115	—
EPDN [16]	5.112	1.221	—
GD-Net [17]	4.987	0.984	—
Dehazer [18]	4.912	0.928	33.866
MSBDN [19]	3.154	1.363	28.743
SSLD [20]	3.489	0.867	32.428
RIDCP [21]	—	0.944	18.782
PhysHD-Dehaze (Ours)	4.859	0.807	27.94

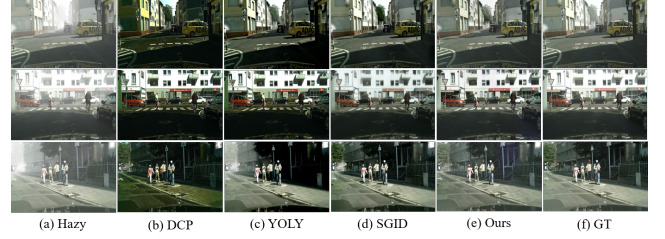


Fig. 4: Qualitative comparison on Foggy Cityscapes.

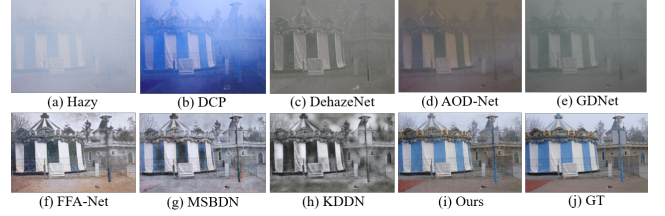


Fig. 5: Qualitative comparison on Dense Haze.

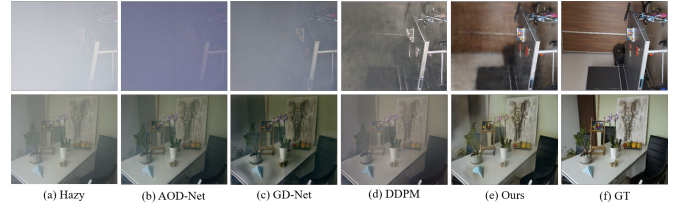


Fig. 6: Qualitative comparison on I-HAZE.

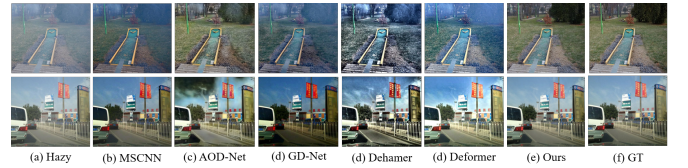


Fig. 7: Qualitative comparison on SOTS Outdoor.

Table I reports no-reference perceptual evaluation on real hazy images. PhysHD-Dehaze obtains the lowest FADE score and competitive NIQE and BRISQUE values, suggesting effective haze suppression with good perceptual quality. These results are consistent with the qualitative comparisons in challenging scenes. Fig. 10 shows PhysHD-Dehaze achieves the highest SSIM on RESIDE Indoor (0.992) and outperforms all prior methods on real-world datasets.

TABLE II: PSNR/SSIM comparison across RESIDE (Outdoor), RESIDE (Indoor), O-HAZE, NH-HAZE, and Dense-HAZE. Higher is better.

Method	RESIDE (Outdoor)		RESIDE (Indoor)		O-HAZE		NH-HAZE		Dense-HAZE	
	PSNR (dB)↑	SSIM↑	PSNR (dB)↑	SSIM↑	PSNR (dB)↑	SSIM↑	PSNR (dB)↑	SSIM↑	PSNR (dB)↑	SSIM↑
DCP [2]	19.13	0.815	16.62	0.818	16.60	0.653	14.56	0.646	—	—
DehazeNet [3]	21.14	0.847	19.82	0.821	—	—	—	—	—	—
AOD-Net [4]	20.06	0.847	20.51	0.816	19.90	0.816	—	—	—	—
GD-Net [17]	30.86	0.982	32.16	0.984	—	—	13.80	0.537	19.53	0.726
MSBDN [19]	—	—	33.79	0.984	—	—	19.23	0.706	22.55	0.758
AECD-Net [22]	33.12	0.948	33.17	0.990	16.53	0.626	15.57	0.618	—	—
FFANet [5]	31.98	0.992	33.57	0.984	—	—	12.06	0.772	22.26	0.781
EPDN [16]	22.57	0.863	25.06	0.923	15.40	0.712	16.28	0.621	—	—
Dehamer [18]	35.17	0.986	36.63	0.988	20.74	0.813	20.66	0.684	—	—
DeFormer [6]	26.44	0.962	38.93	0.988	—	—	—	—	24.01	0.815
TSMD-Net [23]	25.31	0.924	22.29	0.849	19.11	0.715	—	—	17.47	0.631
PhysHD-Dehaze (Ours)	35.18	0.988	35.64	0.992	23.68	0.827	20.70	0.780	23.07	0.782

TABLE III: Complexity comparison of representative dehazing methods. The proposed method is trained at 512×512 , but FLOPs are recomputed at 256×256 for consistency with prior works.

Method	Params (M)↓	FLOPs (G)↓
AOD-Net [4]	0.002	0.005
FFA-Net [5]	4.46	287.8
Dehamer [18]	29.44	870
DehazeFormer-L [6]	25.44	279.7
TSMD-Net [23]	16.3	97
Ours (256×256)	28.98	32.74

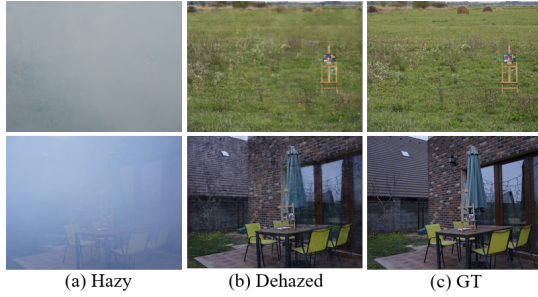


Fig. 8: Additional Dense-Haze results of PhysHD-Dehaze.

C. Qualitative Comparison

Figs. 4, 5, 6, and 7 show qualitative comparisons on Foggy Cityscapes, Dense-Haze, I-HAZE, and SOTS Outdoor, respectively. Compared with representative prior-based, CNN-based, and Transformer-based methods, PhysHD-Dehaze produces clearer scene structures, better contrast recovery, and more stable color reproduction, especially in heavily degraded regions. Competing methods often leave residual haze, introduce color bias, or over-enhance local regions, whereas the proposed method yields more visually consistent restoration across both dense and spatially varying haze conditions. Additional dense-haze examples in Fig. 8 further highlight the robustness of PhysHD-Dehaze on challenging real scenes.

Representative comparisons include DCP [2], GD-Net [17], EPDN [16], Dehamer [18], and other recent dehazing baselines.

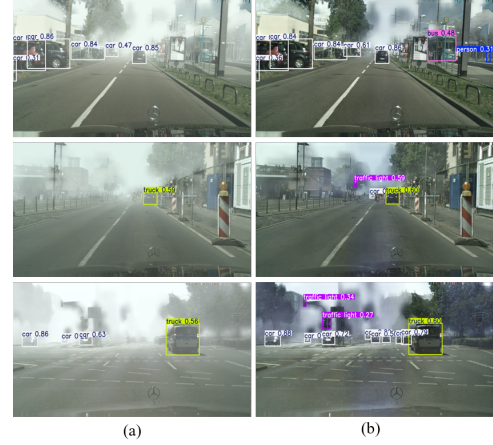


Fig. 9: YOLOv3-based task-driven evaluation. Left: hazy input. Right: PhysHD-Dehaze output.

D. Task-Driven Evaluation

A task-driven evaluation is conducted using YOLOv3 on degraded traffic scenes. As shown in Fig. 9, dehazing with PhysHD-Dehaze improves the visibility of distant and partially occluded objects, leading to more complete detections than the original hazy inputs. This indicates that the restored images are beneficial not only for visual enhancement but also for downstream scene perception.

E. Ablation Study

Table IV summarizes the contribution of each component in PhysHD-Dehaze. Starting from the baseline, progressive addition of SWT refinement, HDAM, orthogonal disentanglement, uncertainty-aware learning, and physics-guided reconstruction consistently improves PSNR and SSIM. The largest gains come from haze-aware refinement and disentanglement, highlighting their importance for dense and spatially varying haze.

F. Complexity/efficiency comparison

Table III compares parameter count and FLOPs across representative dehazing methods. The proposed method

TABLE IV: Ablation study of PhysHD-Dehaze. Higher is better for PSNR/SSIM.

Variant	PSNR (dB) $\uparrow$	SSIM $\uparrow$
Baseline (Swin encoder decoder)	17.84	0.415
+ SWT-based feature refinement	20.12	0.626
+ HDAM	21.89	0.738
+ Orthogonal disentanglement	22.23	0.809
+ Uncertainty-aware learning	23.81	0.858
+ Physics-guided reconstruction (Full)	23.98	0.867

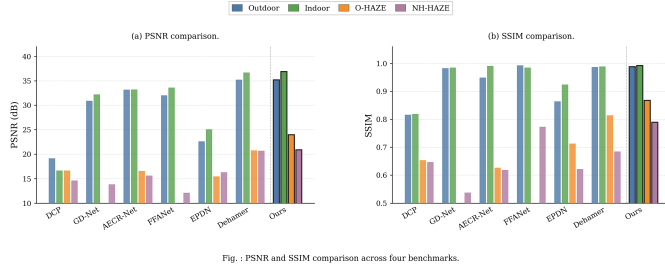


Fig. 10: PSNR and SSIM comparison across various benchmarks

achieves the lowest FLOPs (32.74 G at 256×256) among all transformer-based approaches, including DehazeFormer-L (279.7 G) and Dehazer (870 G), confirming that the proposed architecture design remains computationally efficient despite its architectural scope. The comparatively higher parameter count (28.98 M) reflects the cumulative capacity of three task-specific modules.

IV. CONCLUSION AND FUTURE WORK

This paper introduced PhysHD-Dehaze, a semi-supervised dehazing framework targeting dense and spatially non-homogeneous haze. The proposed architecture integrates hierarchical feature extraction, haze density-aware refinement, orthogonality-constrained content-haze disentanglement, uncertainty-aware pseudo-supervision, and physics-guided reconstruction into a unified pipeline. Evaluations on synthetic and real benchmarks confirm strong restoration performance, with particular gains under dense haze and improved downstream detection accuracy. Moving forward, the framework will be extended to more demanding scenarios, including nighttime haze, adverse weather degradation, and video sequences, alongside investigations into lightweight architectures suitable for resource-constrained deployment.

REFERENCES

- [1] E. J. McCartney, "Optics of the atmosphere: scattering by molecules and particles," *New york*, 1976.
- [2] K. He, J. Sun, and X. Tang, "Single image haze removal using dark channel prior," *IEEE transactions on pattern analysis and machine intelligence*, vol. 33, no. 12, pp. 2341–2353, 2010.
- [3] B. Cai, X. Xu, K. Jia, C. Qing, and D. Tao, "Dehazenet: An end-to-end system for single image haze removal," *IEEE transactions on image processing*, vol. 25, no. 11, pp. 5187–5198, 2016.
- [4] B. Li, X. Peng, Z. Wang, J. Xu, and D. Feng, "Aod-net: All-in-one dehazing network," in *Proceedings of the IEEE international conference on computer vision*, 2017, pp. 4770–4778.
- [5] X. Qin, Z. Wang, Y. Bai, X. Xie, and H. Jia, "Ffa-net: Feature fusion attention network for single image dehazing," in *Proceedings of the AAAI conference on artificial intelligence*, vol. 34, no. 07, 2020, pp. 11 908–11 915.
- [6] Y. Song, Z. He, H. Qian, and X. Du, "Vision transformers for single image dehazing," *IEEE Transactions on Image Processing*, vol. 32, pp. 1927–1941, 2023.
- [7] H. Khan and S. W. Kim, "Adaptive convolutional strategy for robust image dehazing in diverse environments," *IET Image Processing*, vol. 19, p. e70207, 2025.
- [8] X. Cong, B. Jiang, W. Liu, W. Ren, Y. Wang, and X. Cao, "A semi-supervised nighttime dehazing baseline with spatial-frequency aware and realistic brightness constraint," in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, 2024, pp. 2631–2640.
- [9] Y. Zheng, J. Zhan, S. He, J. Dong, and Y. Du, "Curricular contrastive regularization for physics-aware single image dehazing," in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, 2023, pp. 5785–5794.
- [10] B. Li, W. Ren, D. Fu, D. Tao, D. Feng, W. Zeng, and Z. Wang, "Benchmarking single-image dehazing and beyond," *IEEE transactions on image processing*, vol. 28, no. 1, pp. 492–505, 2018.
- [11] C. O. Ancuti, C. Ancuti, M. Sbert, and R. Timofte, "Dense-haze: A benchmark for image dehazing with dense-haze and haze-free images," in *2019 IEEE international conference on image processing (ICIP)*. IEEE, 2019, pp. 1014–1018.
- [12] C. O. Ancuti, C. Ancuti, R. Timofte, and C. De Vleeschouwer, "O-haze: a dehazing benchmark with real hazy and haze-free outdoor images," in *Proceedings of the IEEE conference on computer vision and pattern recognition workshops*, 2018, pp. 754–762.
- [13] C. O. Ancuti, C. Ancuti, and R. Timofte, "Nh-haze: An image dehazing benchmark with non-homogeneous hazy and haze-free images," in *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition workshops*, 2020, pp. 444–445.
- [14] M. Cordts, M. Omran, S. Ramos, T. Rehfeld, M. Enzweiler, R. Benenson, U. Franke, S. Roth, and B. Schiele, "The cityscapes dataset for semantic urban scene understanding," in *Proceedings of the IEEE conference on computer vision and pattern recognition*, 2016, pp. 3213–3223.
- [15] B. Li, W. Ren, D. Fu, D. Tao, D. Feng, W. Zeng, and Z. Wang, "Reside: A benchmark for single image dehazing," in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*, 2018, pp. 1076–1084.
- [16] Y. Qu, Y. Chen, J. Huang, and Y. Xie, "Enhanced pix2pix dehazing network," in *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*, 2019, pp. 8160–8168.
- [17] X. Liu, Y. Ma, Z. Shi, and J. Chen, "Griddehazenet: Attention-based multi-scale network for image dehazing," in *Proceedings of the IEEE/CVF international conference on computer vision*, 2019, pp. 7314–7323.
- [18] C.-L. Guo, Q. Yan, S. Anwar, R. Cong, W. Ren, and C. Li, "Image dehazing transformer with transmission-aware 3d position embedding," in *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*, 2022, pp. 5812–5820.
- [19] H. Dong, J. Pan, L. Xiang, Z. Hu, X. Zhang, F. Wang, and M.-H. Yang, "Multi-scale boosted dehazing network with dense feature fusion," in *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*, 2020, pp. 2157–2167.
- [20] Z. Chen, Y. Wang, X. Yang, D. Liu, S. Xu, L. Ma, X. Cao, and W. Zhang, "Psd: Principled synthetic-to-real dehazing guided by physical priors," in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, 2021, pp. 7180–7189.
- [21] R.-Q. Wu, Z.-P. Duan, C.-L. Guo, Z. Chai, and C. Li, "Ridep: Revitalizing real image dehazing via high-quality codebook priors," in *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*, 2023, pp. 22 282–22 291.
- [22] H. Wu, Y. Qu, S. Lin, J. Zhou, R. Qiao, Z. Zhang, Y. Xie, and L. Ma, "Contrastive learning for compact single image dehazing," in *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*, 2021, pp. 10 551–10 560.
- [23] N. Raju and K. Srinivas, "Tsmd-net: A two-stage mixed dehazing network with feature fusion and multi-window self attention on jetson board," *Digital Signal Processing*, vol. 155, p. 104710, 2024.