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ICMIC 2025

The 4th International Conference on Mobile • Military • Maritime IT Convergence

"Promoting Ultimate Convergence of Wireless, Military and Maritime Communications in the 6G Era"

Final Program

Date August 27 (Wed) ~ 30 (Sat), 2025

Venue Tambuli Seaside Resort and Spa, Cebu, the Philippines

Hosted by KICS The Korean Institute of Communications and Information Sciences

Organized by University of the Philippines Diliman

Technically Co-Sponsored by IEEE, IEEE ComSoc IEEE Communications Society

Patrons KIOST, IITP Institute of Information & Communications Technology Planning & Evaluation, Palantir Technologies, Hanwha Systems, LIG Nex1, ETRI Electronics and Telecommunications Research Institute, PIOLINK, NS LAB Networked Systems Laboratory, JY SYSTEM (주)제이와이시스템, MET-SOLUTIONS Marine Equipment & Technology Solutions, ICT Convergence Research Center CRC, CJ OLIVENETWORKS

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General Information

The International Conference on Mobile·Military ·Maritime IT Convergence (ICMIC) aims to promote convergence activities of the three pillar fields of mobile, military, and maritime, encompassing fundamental and core wireless communication technologies. With a keen understanding that advanced wireless technologies leveraging artificial intelligence must confront escalating technological hurdles in shaping our future hyper-connected societies, the conference aims to spotlight these challenges, particularly within the realms of mobile radio, military operational technologies, and maritime communications. In view of these diverse requirements and demands, the ICMIC 2025 will serve as a timely and essential academic platform wherein researchers, academics, and industrial professionals convene to exchange perspectives, unveil cutting-edge technologies, and explore tailored solutions. The focal point of this conference lies in tackling the communication challenges across the three core pillars—mobile, military, and maritime—via ICT convergence or future advancements in communications. This encompasses a broad spectrum of industrial sectors, academia, and practical engineering applications. The conference will include keynote sessions, invited special sessions, and technical paper sessions. You are warmly encouraged to contribute your research and expertise to this dynamic platform.

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Greetings

Messages from the General Co-Chairs of ICMIC 2025

It is with utmost pleasure and honor that I welcome you to the 2025 International Conference on Mobile·Military ·Maritime IT Convergence (ICMIC). As the General Chair, I am delighted to extend my warmest greetings to all participants, presenters, and distinguished guests who have joined us from around the globe.

In this conference, we have three pillars as the main focus of our discussions and presentations: Mobile Technology, Maritime IT, and Military Technology. These areas have been selected for their growing importance and impact on our field, and we are thrilled to see the enthusiasm they have generated. I am certain that these pillars will serve as an excellent platform for future AI society. Moreover, the ICMIC 2025 is now technically co-sponsored by the IEEE Communication Society. This recognition will be considered as a quantum jump in the history of the ICMIC. As such, this year we have received nearly 200 papers from researchers and practitioners worldwide, reflecting the breadth and depth of interest and expertise in these critical domains.

Additionally, we are excited to hold the conference in Cebu, the Philippines. Cebu is a beautiful and vibrant metropolis, known as "the Queen City of the South," with its rich history, diverse culture, and thriving economy. We trust that Cebu provides a unique setting in a tropical atmosphere which we hope will inspire fruitful discussions and promote new partnerships.

We have an exciting program planned, featuring keynote speeches from leading experts, insightful discussions, and opportunities for networking and knowledge exchange. We believe this year's conference will be a catalyst for innovative ideas and solutions that will shape the future of our field.

I would like to take this opportunity to express my deepest gratitude to our sponsors, Korean and Filipino organizing committees, and volunteers for their hard work and dedication in making this event possible. Their unwavering support has been instrumental in bringing this conference to fruition.

Finally, I would like to reiterate that I deeply appreciate your participation and contribution to the success of this event. We look forward to engaging with you and witnessing the innovative research and developments that will be presented over the coming days.

I wish you a very fruitful and enjoyable time here in Cebu.

Warm regards,

General Co-chair of ICMIC 2025
Prof. Yeon Ho Chung

It is my great pleasure to welcome you to the 4th International Conference on Mobile, Military, and Maritime IT Convergence (ICMIC 2025). Now in its fourth year, ICMIC has grown into a leading platform for multidisciplinary exchange and international collaboration in the fields of mission-critical technologies, defense systems, naval communications, and smart mobility.

This year, we are proud to host the conference in Cebu, Philippines. Known as the Queen City of the South, Cebu offers a dynamic environment where tradition, innovation, and development converge. It is a fitting location for a conference focused on convergence technologies, and we are delighted to welcome delegates from around the world both onsite and online.

We are especially thankful to the Korean Institute of Communications and Information Sciences (KICS) for their continued partnership and for allowing us to bring this flagship event to the Philippines. The establishment and growth of the KICS Philippine Section have made it possible to expand the reach and impact of this conference, while also strengthening research ties between Korea and the ASEAN region.

This year's conference features more than 100 peer-reviewed papers from researchers and professionals working at the intersection of mobile, military, and maritime domains. The diversity of topics, disciplines, and nationalities represented here reflects the growing relevance of ICMIC as a global venue for critical dialogue and innovation.

As General Co-Chair and Chair of the KICS Philippine Section, I extend my deepest gratitude to our organizing committee, reviewers, partners, speakers, and volunteers. Your dedication has brought ICMIC 2025 to life.

Whether you are here to present, attend sessions, or build new collaborations, I encourage you to make the most of this opportunity to learn, share, and connect.

Welcome to ICMIC 2025. Welcome to Cebu.

With sincere appreciation,

General Co-chair of ICMIC 2025
Prof. Gabriel Avelino Sampedro

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- Zulhasni Abdul Rahim (Universiti Teknologi Malaysia, Malaysia)

Program at a Glance

August 27, 2025 (Wednesday)					
12:00~17:00	Registration (Outside TIERRA & VIENTO)				
Room	Tierra	Viento	Agua	Luna	Sol
13:00~14:30	**Main Session 1A** Mobile S/W and Data Science	**Main Session 1B** Intelligent ICT Solutions I	**Workshop Session 1C** IWITC - Maritime Applications and Systems	**Workshop Session 1D** IWTBSTEC	
14:30~14:40	Break				
14:40~15:40	*Chair: Prof. Yeon Ho Chung (Pukyong National University, Republic of Korea)* **Keynote Address 1** Optical Wireless Communications for IoT Applications Prof. Zabih Ghassemlooy (Professor of Optical Communication, Emeritus Professor of Northumbria University, U.K.)			**IAC / ISC / OC Meeting**	
15:40~15:50	Coffee Break				
15:50~16:50	*Chair: Prof. Yonggang Kim (Kongju National University, Republic of Korea)* **Tutorial Session I** Accelerating AI Applications on Edge Devices Prof. Chanyoung Oh (Kongju National University, Republic of Korea)			**IAC / ISC / OC Meeting**	
16:50~17:00	Break				
17:00~18:30	**Main Session 2A** Advanced Aerial and Satellite Communications	**Main Session 2B** Intelligent ICT Solutions II	**Workshop Session 2C** IWITC - Advanced Wireless Systems	**IAC / ISC / OC Meeting**	
18:30~18:40	Break				
18:40~20:00	**Welcome Reception (Upper Pogon Deck)**				
August 28, 2025 (Thursday)					
08:00~17:00	Registration (Outside TIERRA & VIENTO)				
Room	Tierra	Viento	Agua	Luna	Sol
09:00~10:10	*Chair: Prof. Taesoo Jun (Kumoh National Institute of Technology, Republic of Korea)* **Opening Address** Prof. Yeon Ho Chung (Pukyong National University, Republic of Korea) **Congratulatory Address** Prof. Jun Heo (President of KICS, Republic of Korea) **Welcome Address** Dr. Enrico C. Paringit (Executive Director, Philippine Council for Industry, Energy, and Emerging Technology Research and Development) **Keynote Address 2** Optical Wireless Communication for Space-Air-Ground Integrated Network in 6G Prof. Telex M. N. Ngatched (McMaster University, Canada)			**IAC / ISC / OC Meeting**	
10:10~10:30	Coffee Break				
10:30~12:00	**Main Session 3A** Artificial Intelligence and Machine Learning I	**Main Session 3B** Advanced Communication Networks	**Workshop Session 3C** IWITC - AI and Machine Learning Innovations	**IAC / ISC / OC Meeting**	
12:00~13:30	Lunch				
13:30~15:00	**Main Session 4A** AI and Optimization for Maritime Systems	**Workshop Session 4B** IWC3ET I	**Workshop Session 4C** IWITC - Emerging Technologies in Military IoT and 6G	**IAC / ISC / OC Meeting**	
15:00~15:20	Coffee Break				
15:20~16:50	**Main Session 5A** IoT and AI Applications	**Workshop Session 5B** IW3CET II	**Workshop Session 5C** IWITC - Secure Frameworks for Military Operations	**IAC / ISC / OC Meeting**	
16:50~17:10	Break				

Program at a Glance

17:10~18:10	*Chair: Prof. Gabriel Avelino Sampedro (University of the Philippines Diliman, Philippines)* **Keynote Address 3** AI powered 6G-IoT Communications Towards Industrial Adaptation Prof. Arun Kumar Sangaiah (Distinguished Professor, International Graduate School of AI, National Yunlin University of Science and Technology, Taiwan (ROC))			**IAC / ISC / OC Meeting**	
18:10~18:30	Break				
18:30~20:00	**Invited Talk and Banquet (Beachfront)** Research Trends and Emerging Directions in the Philippines *Dr. Enrico C. Paringit (Executive Director, Philippine Council for Industry, Energy, and Emerging Technology Research and Development)*				
August 29, 2025 (Friday)					
08:00~17:00	Registration (Outside TIERRA & VIENTO)				
Room	Tierra	Viento	Agua	Luna	Sol
10:00~11:30	**Main Session 6A** Artificial Intelligence and Machine Learning II	**Workshop Session 6B** IWMCA & ISMOT Joint Workshop	**Workshop Session 6C** IWITC - Intelligent Security and Software Systems	**IAC / ISC / OC Meeting**	
11:30~13:00	Lunch				
13:00~14:00	*Prof. Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)* **Keynote Address 4** Quantum Machine Learning and Optimization for 6G Networks Prof. Trung Q. Duong (Canada Excellence Research Chair and Professor at Memorial University of Newfoundland, Canada)		**Poster Session 7C**	**IAC / ISC / OC Meeting**	
14:00~14:20	Coffee Break				
14:20~15:20	*Chair: Prof. Yonggang Kim (Kongju National University, Republic of Korea)* **Tutorial Session II** The AI Convergence Paradigm: Navigating Challenges, Opportunities, and Future Directions in Emerging Technologies Prof. Gabriel Avelino Sampedro (Professor at the University of the Philippines Los Baños and the Founder and CEO of the Philippine Coding Camp)		**Poster Session 8C**	**IAC / ISC / OC Meeting**	
15:20~15:40	Coffee Break				
15:40~17:10	**Main Session 9A** Advanced and Secure Communication Technologies		**Poster Session 9C**	**IAC / ISC / OC Meeting**	
August 30, 2025 (Saturday)					
Room	Tierra	Viento	Agua	Luna	Sol
09:00~10:30	Not Available			**Virtual Session 10D**	**Virtual Session 10E (IWITC)**
10:30~10:50	Break				
10:50~12:20	Not Available			**Virtual Session 11D**	**IAC / ISC / OC Meeting**

※ The Inauguration Ceremony of the Korea Institute of Communications and Information Sciences (KICS) Australia Section: Aug. 27(Wed.) 1:00 pm-2:30 pm, / Luna and Sol

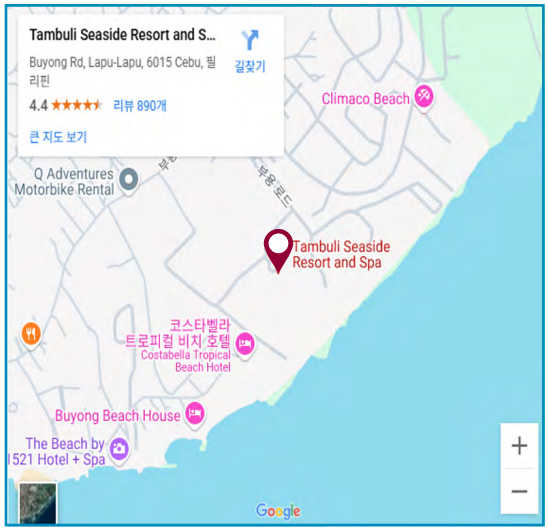
※ KICS Global Chapter Workshop: Aug 28(Thr.) 11:30 am-2:00 pm / Luna and Sol.

Venue and Conference Room Map

Venue

"Tambuli Seaside Resort and Spa has service apartments that encapsulate the modern conveniences of home in a resort. Deluxe Studios, One Bedroom Suites, One Bedroom Premier Suites, and Two Bedroom Premier Suites are among the available room types.

Each room has a balcony that provides the occupant with a view of either the Club House or the Hilutungan Channel, and it comes with a 5-foot refrigerator, an induction stove, coffee and tea amenities, a microwave, basic cooking and dining utensils, a flat iron and ironing board, a washing machine, and the standard safety deposit box. Since Wi-Fi is available in every room, you can still stay connected to the outside world while luxuriating in nature."



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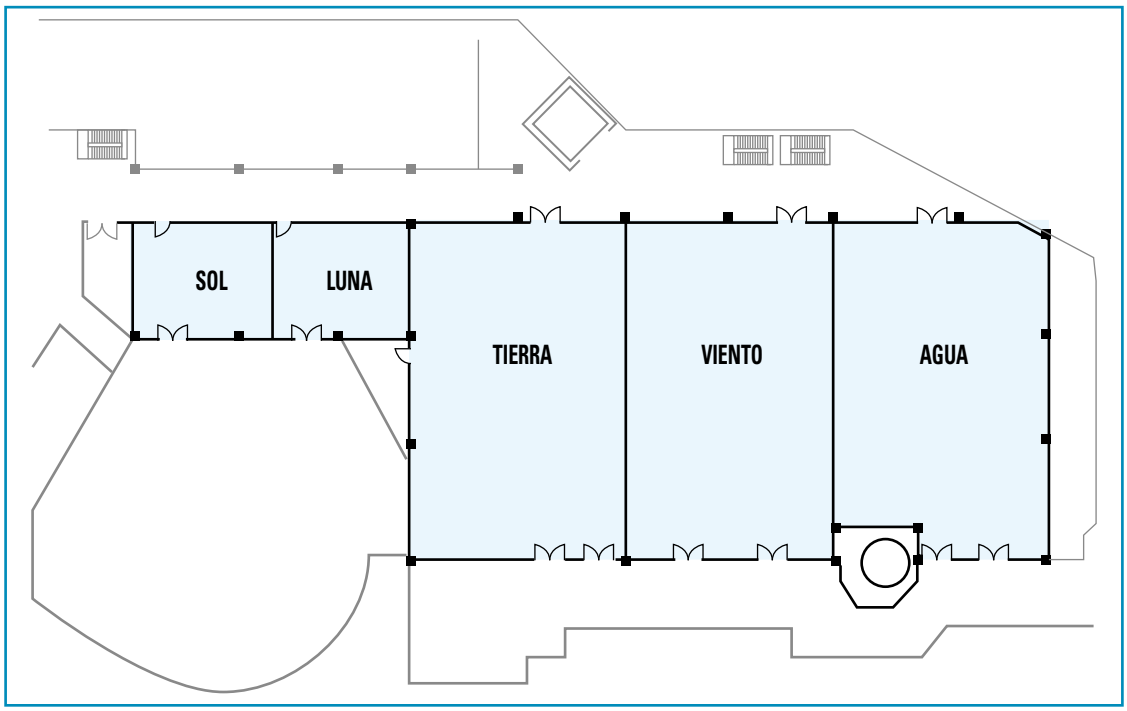
Conference Room Map



Keynote Addresses

August 27 (Wednesday)

Keynote Address 1

14:40-15:40 TIERRA, VIENTO, AGUA Chair : Prof. Yeon Ho Chung (Pukyong National University, Korea)

Optical Wireless Communications for IoT Applications

Speaker Prof. Zabih Ghassemlooy
Professor of Optical Communication, Emeritus Professor of Northumbria University, U.K.

Abstract The next generation wireless communication networks (i.e., 6G and beyond) will seamlessly connect people, devices and systems together, enabling the collection, preparation, processing, storing and decision making of vast amounts of information. It is anticipated that such wireless networks will utilise different technologies for use in smart environments, including homes/buildings/cities, manufacturing, agriculture, health care, transportation systems, etc., for improving productivity and the quality of life through the efficient and sustainable resources management and use. 6G will need the convergence of different wireless technologies, assisted by machine learning to solve flexibility and scalability issues. This talk will give an overview of the emerging integrated wireless technology focusing on optical sensing, positioning and data communication within the context of 6G wireless networks and beyond, using common spectrum, device, transmission and network infrastructure to improve both spectral and energy efficiencies.

Bio

Professor Zabih Ghassemlooy (Fellow, OPTICA; Fellow, IET; Senior Member, IEEE; CEng, BSc (Hons.) MMU (1981), MSc (1984) and PhD (1987) Manchester Univ., UK. 1987-88 Post-Doctoral Research Fellow, City Univ., UK. 1988-2004 Sheffield Hallam University and 2004- Northumbria University, UK, as Associate Dean for Research and Head of Photonics Technology Laboratory and Optical Communications Research Group and now is and Emeritus Professor at Northumbria University. He was a Research Fellow (2016-2022) and a Distinguished Professor (2015-2022) at Chinese Academy of Science, a Visiting Professor at Univ. Tun Hussein Onn Malaysia (2013-17), Huaqiao Univ., China (2017-18), Technical Univ. of Prague, Czech Rep. (2019), Technical Univ. of Graz, Austria (2018), and others. He was Vice-Chairs of EU Cost-Actions IC1101 (2011-16), CA19111, 2020-24, and CA19111, 2020-2024. He is an IEEE Distinguished Lecturer for 2024-25. Has supervised 77 PhDs, 12 Research Fellows, over 1000 publications (440 journals and 8 books), and over 100 keynote/invited talks. His research interest: optical wireless communications, free space optics, visible light communications, and hybrid RF-OWC. He was Chief Editor: British J. of Applied Science and Technology and Intern. J. of Optics and Applications, and is Vice-Cahir of OSA Technical Group (Optics in Digital Systems-2018-). He was and still is involved on the editorial board of many journals including IEEE, OPTICA and IET. He is founder and chair of several international conference including IEEE/IET CSNDSP.

August 28 (Thursday)

Keynote Address 2

09:10-10:10 TIERRA, VIENTO, AGUA Chair : Prof. Taesoo Jun (Kumoh National Institute of Technology, Korea)

Optical Wireless Communication for Space-Air-Ground Integrated Network in 6G

Speaker Prof. Telex M. N. Ngatched
McMaster University, Canada

Abstract The space-air-ground integrated network (SAGIN), which links space, air, and ground network segments using modern information network technologies, is recognized as a promising network architecture for the next generation wireless communication networks, i.e., 6G and beyond, due to its wide coverage area, high user quality service, massive connectivity, and unrestricted terrain conditions. SAGIN's integration of satellite, air, and ground segments offers seamless connectivity in remote areas, increased capacity in high-demand regions, and high-speed data access, promising significant benefits for the future evolution of 6G wireless communications. However, SAGINs, which generally operate in the radio frequency band, are limited by the high bandwidth requirements of automated driving systems, security monitoring, and the Internet of Things. To increase the speed and transmission rate of these systems, the use of optical communication links, at high frequency bands, is a promising approach. This talk will highlight the challenges related to the integration of optical wireless communication, specifically free-space optical, in SAGIN. Proposed solutions will be discussed, and prospective research avenues will be outlined.

Keynote Addresses

Bio

Dr. Telex M. N. Ngatched is an Associate Professor at McMaster University, Canada. His research interests include the next generation wireless communication networks enabling technologies, optical wireless communications, hybrid optical wireless and radio frequency communications, artificial intelligence and machine learning for communications, and underwater communications.
Dr. Ngatched serves as an Area Editor for the IEEE Open Journal of the Communications Society, an Associate Technical Editor for the IEEE Communications Magazine, and an Associate Editor of the IEEE Vehicular Technology Magazine. He was a recipient of the Best Paper Award at the IEEE Wireless Communications and Networking Conference (WCNC) in 2019. He is a Professional Engineer (P. Eng.) registered with the Professional Engineers Ontario, Toronto, ON, Canada.

Keynote Address 3

17:10 - 18:10 TIERRA, VIENTO, AGUA Chair : Prof. Gabriel Avelino Sampedro (University of the Philippines Diliman, Philippines)

AI powered 6G-IoT Communications Towards Industrial Adaptation

Speaker Prof. Arun Kumar Sangaiah
Distinguished Professor, International Graduate School of AI, National Yunlin University of Science and Technology, Taiwan (ROC)

Abstract The emergence of sixth-generation Internet of Things (6G-IoT) communication networks is poised to revolutionize industrial applications by enabling ultra-reliable, intelligent, and high-speed connectivity. These advancements will not only enhance automation but also drive innovation across various sectors, making industries more efficient and interconnected than ever before. Efficient communication plays a pivotal role in ensuring seamless data transmission, particularly in achieving full network coverage and supporting the rapid proliferation of IoT devices and sensors. However, the large-scale deployment of 6G-IoT networks brings forth significant challenges, including maintaining quality of service (QoS), ensuring robust security, and optimizing energy-efficient communication. Addressing these challenges is essential for unlocking the full potential of 6G technology and accelerating its adoption across industrial ecosystems. Unlike previous generations, the defining characteristic of 6G lies in its AI-powered communication, which shifts the paradigm from traditional connected devices to an ecosystem of connected intelligence. This transformation fosters a more adaptive and autonomous network environment, enabling real-time decision-making and intelligent resource management. To harness the full capabilities of 6G-IoT, leveraging AI-driven optimization, predictive analytics, and autonomous decision-making is crucial. These advanced technologies not only enhance network performance and reduce latency but also enable self-sustaining smart industries capable of operating with minimal human intervention. The keynote highlights the seamless integration of AI and 6G will be instrumental in supporting next-generation industrial applications, including real-time automation, digital twins, and intelligent manufacturing. By enabling these innovations, 6G-IoT is set to pave the way for Industry 4.0 and beyond, redefining the future of industrial connectivity and automation.

BIO

Prof. Arun Kumar Sangaiah received his Ph.D. from School of Computer Science and Engineering, VIT University, Vellore, India. He is currently a Full Professor with National Yunlin University of Science and Technology, Taiwan. He has published more than 200 research articles in refereed journals (IEEE TII, IEEE TITS, IEEE TNSE, IEEE TETCI, IEEE SysJ, IEEE SensJ, IEEE IOTJ, ACM TOSN), 11 edited books, as well as 1 patent (held and filed) and 3 projects, among two of them funded by National Science and Technology Council (NSTC), Taiwan, the Ministry of IT of India and few international projects (CAS, Guangdong Research fund, Australian Research Council) cost worth of USD 500,000 USD. Dr. Sangaiah has received many awards, Yushan Young Scholar, Clarivate Highly Cited Researcher (2021,2022, 2023), Top 2% Scientist (Standord Report-2020,2021,2022), PIFI-CAS fellowship, Top 10 outstanding researcher, CSI significant Contributor etc. Also, he is responsible for Editor-in-Chief, and Associate Editor of various reputed ISI journals. Dr. Sangaiah is a visiting scientist (2018-2019) with Chinese Academy of Sciences, China and visiting researcher of Université Paris-Est (UPEC), France (2019-2020). His Google Scholar Citations reached 27000+ with h-index of 93 and i10-index of 351.

Keynote Addresses

August 29 (Friday)

Keynote Address 4

13:00-14:00 TIERRA, VIENTO, AGUA Chair : Prof. Dong Seong Kim (Kumoh National Institute of Technology, Korea)

Quantum Machine Learning and Optimization for 6G Networks

Speaker Prof. Trung Q. Duong
Canada Excellence Research Chair and Professor at Memorial University of Newfoundland, Canada

Abstract Quantum computing uses the concept of quantum mechanics to offer a massive leap forward in relations to solving complex computation problems. Hybrid quantum-classical machine learning algorithms can significantly enhance the processing efficiency and exponentially computational speed-up, highly capable of guaranteeing high QoS requirements of 6G networks. This talk presents the state-of-the-art in quantum machine learning and optimization and provide a comprehensive overview of its potential, via machine learning approaches. Furthermore, this talk introduces quantum-inspired machine learning/optimization applications for 6G networks in terms of 6G channel estimation and RF fingerprinting considering their enabling technologies and potential challenges. Finally, some dominating research issues and future research directions for the quantum-inspired machine learning/optimization in 6G networks are elaborated.

BIO

Dr. Trung Q. Duong (IEEE Fellow, IET Fellow, CAE Fellow, EIC Fellow, and AAIA Fellow) is a Canada Excellence Research Chair and Full Professor at Memorial University of Newfoundland, Canada. He is also an adjunct professor at Queen's University Belfast, UK and a visiting professor under eminent scholar program at Kyung Hee University, South Korea. His current research interests include quantum optimisation and machine learning in wireless communications. He is an author/co-author of 600+ publications with 22,500+ citations and h-index 81. He has served as an Editor for many reputable IEEE journals (IEEE Trans on Wireless Communications, IEEE Trans on Communications, IEEE Trans on Vehicular Technology, IEEE Communications Surveys & Tutorials, IEEE Communications Letters, and IEEE Wireless Communications Letters) and has been awarded best paper awards in many flagship conferences including IEEE ICC 2014, IEEE GLOBECOM 2016, 2019, and 2022. He was the only UK-based researcher awarded both the Research Fellowship and Research Chair from the Royal Academy of Engineering. In 2017, he was awarded the Newton Prize from the UK government. He is currently the Editor-in-Chief of IEEE Communications Surveys & Tutorials and an IEEE ComSoc Distinguished Lecturer. He is a fellow of the Institute of Electrical and Electronics Engineers (IEEE), the Institution of Engineering and Technology (IET), the Canadian Academy of Engineering (CAE), the Engineering Institute of Canada (EIC), and the Asia-Pacific Artificial Intelligence Association (AAIA).

Tutorial Session

August 27 (Wednesday)

Tutorial Session I

15:50-16:50 TIERRA, VIENTO, AGUA — Chair : Prof. Yonggang Kim (Kongju National University, Korea)

Accelerating AI Applications on Edge Devices

Speaker Prof. Chanyoung Oh
Kongju National University, Korea

Abstract AI have become an essential tool across every domain, and mobile environments are no exception. As a result, there is growing demand to run AI workloads (e.g., object detection and tracking, natural language processing, and autonomous decision-making) directly on edge platforms such as smartphones, robots, drones, and so on. However, these devices often require real-time performance, yet their computing resources are far more limited than those of servers, making it difficult to execute intensive AI workloads quickly. Although acceleration approaches like weight pruning and quantization promise reduced model complexity, they typically rely on specialized accelerators and thus deliver little (or, sometimes no) speedup on commodity edge devices such as smartphones. This tutorial will introduce practical techniques that enable acceleration of AI applications on off-the-shelf edge devices.

Bio

Dr. Chanyoung Oh is an Assistant Professor with the department of Software at the Kongju National University, South Korea. He received his Ph.D. in Electrical and Computer Engineering from the University of Seoul in 2021. Before joining the faculty of the Kongju National University, he was a senior researcher at the Electronics and Telecommunications Research Institute (ETRI), and was a senior research engineer at KT. His research interests include on-device AI, parallel software design, real-time computer vision (e.g., object detection) on edge devices, and high-performance computing. He is a lifetime member of the Institute of Embedded Engineering of Korea (IEMEK), and a member of IEEE.

August 29 (Friday)

Tutorial Session II

09:10-10:10 TIERRA, VIENTO — Chair : Prof. Yonggang Kim (Kongju National University, Republic of Korea)

The AI Convergence Paradigm: Navigating Challenges, Opportunities, and Future Directions in Emerging Technologies

Speaker Prof. Gabriel Avelino Sampedro
Professor at the University of the Philippines Los Baños and the Founder and CEO of the Philippine Coding Camp

Abstract Artificial Intelligence (AI) is increasingly intersecting with other emerging technologies such as the Internet of Things (IoT), blockchain, extended reality, and next-generation networks. This convergence is creating new possibilities for intelligent, connected, and adaptive systems, while also introducing significant challenges in areas such as interoperability, ethics, governance, and long-term scalability. This talk will examine how AI convergence is being applied in real-world settings through case studies from projects in healthcare, smart infrastructure, manufacturing, and defense. Each example will highlight the technical approaches used, the practical issues encountered, and the broader implications for adoption. The session will close with a discussion on future directions and strategies that can help researchers, practitioners, and policymakers guide the development of responsible, inclusive, and impactful AI-driven systems.

Bio

Prof. Gabriel Avelino Sampedro, Ph.D. is an Professor at the University of the Philippines Los Baños and the Founder and CEO of the Philippine Coding Camp, where he leads initiatives in digital literacy, emerging technologies, and industry-academia collaboration. A Senior Member of the IEEE and the current Chair of the Philippine Section of the Korean Institute of Communications and Information Sciences (KICS), he holds a Ph.D. in IT Convergence Engineering from Kumoh National Institute of Technology, South Korea. He has authored over 100 publications in artificial intelligence, blockchain, and the Internet of Things, and his work spans international research collaborations, technology-driven education programs, and innovation-focused events, with a strong commitment to advancing ethical, sustainable, and inclusive technology adoption across sectors.

Oral Sessions

August 27 (Wednesday)

Oral Session 1A : Mobile S/W and Data Science

13:00-14:30 Tierra

Chair : Dr. Min Kim (KIOST, Republic of Korea)

1A-1) 3D Data Optimization for Real-Time Applications Using glTF and Texture Compression

Author Sungho Cho, Seunghyun Yoo, Jihyeon Lee, Yunhui Lee (SundoSoft Co., Ltd., Republic of Korea)

Abstract This study presents a lightweight 3D model conversion methodology by transforming CityGML 3.0 datasets into glTF format. The proposed pipeline enables a 70 – 80% reduction in file size while preserving detailed architectural information. To address the network transmission bottlenecks and rendering load caused by high-resolution textures, we adopt advanced texture compression algorithms such as Adaptive Scalable Texture Compression(ASTC), DirectX Texture Compression(DXT), and PowerVR Texture Compression(PVRTC), based on usage environments. Among them, ASTC is particularly recommended due to its flexibility in block size and high visual fidelity under low bitrates. Furthermore, we integrate Draco for geometry compression to minimize the size of 3D mesh data. Through the combined use of ASTC and Draco, this approach achieves optimal performance in mobile, AR/VR, and BIM visualization environments. Our method contributes to improving real-time rendering performance while ensuring visual integrity and efficient data delivery. However, the pipeline may require additional configuration to support dynamic streaming or advanced semantic features beyond Level of Detail3(LOD3).

1A-2) NUIFMS: Development of a Facility Management and Maintenance System in National University with Prescriptive Data Analytics

Author Prince Kenneth Mamaril, Jimuel C. Bustarde, Roben A. Juanatas, Angelo Kenneth S. Florendo, Wilfredo M. Romero, Aris Jael C. Manuel (National University, Manila, Philippines)

Abstract This paper focuses on the role of facility management in learning institutions since it plays a major role in learning and governance. In many universities such as National University Manila the management of physical facilities which include job order request has been made to take primitive techniques. This little efficiency leads to delay of affairs and outstanding requests that slow down the operation and decrease satisfaction of users. This has resulted in the establishment of the National University Integrated Facility Management System (NUIFMS) which is web and mobile to strengthen the management of job orders. The system combines the descriptive and prescriptive BI, allowing administrators to monitor job orders and performance indicators and produce reports. The NUIFMS also consists of options for submitting job requests, uploading proofs, and providing feedback, which are intended at enhancing the Business effectiveness and satisfaction of the Physical Facilities department at National University. The project meets the concept of Sustainable Development Goal no. 4 focusing on: Quality Education by Sustainable Facility Management. Based on the findings of the present study, it might be concluded that the NUIFMS could improve the management of job orders and even facilitate an effective and appreciated management of facilities in higher education institutions.

1A-3) B-Ready: Enhancing Barangay Disaster Readiness Through a Web and Mobile-Based Platform

Author Roben A. Juanatas, Thomas Galilleo R. Mailom, Christian V. Villarta, Wilfredo M. Romero, Nympha Delaila S. Munoz, Mhel Kenneth A. Sumo (National University, Manila, Philippines)

Abstract Disasters are becoming more frequent, and the number of persons affected is also increasing. This greater morbidity is attributable not only to the greater number of events, but also to population dynamics, location, and susceptibilities. While these incidents have led to an increase in general disaster awareness, the relative infrequency of major catastrophes affecting defined populations lead to a certain degree of complacency and underestimation of the impact of such an event. Disaster preparedness is an accumulation of steps undertaken in advance by governments, organizations, communities, or citizens to better respond and to cope with the immediate aftermath of a disaster, whether caused of humankind or natural hazards. This paper focuses on creating a mobile and web application called B-Ready: Barangay Preparedness System with the goal of giving online resources to benefit not only individual families but also the entire community of the Barangay, San Agustin, Sto Domingo, Nueva Ecija. By utilizing our app, you are not only preparing yourself, but also assisting the community to which you belong. Our team provides an application that can help you prepare users whenever a natural disaster occurs within any specific area in the Philippines. When going through the website, users are required to register themselves by providing basic information. Users are able to explore different locations within the area of the Philippines to determine if disaster would likely be encountered by using website's search function. The team allocated different drills, practices, and preparedness checklist to ensure how an individual can be prepare before any disaster occurs.

1A-4) Equal Perspectives: A framework for parallax website journey through gender equality on men

Author Roben A. Juanatas Veronica M. Silva, Wilfredo M. Romero (National University, Manila, Philippines)

Abstract Gender inequality has been ruining the diversity of the entire humanity, in which separating people in all gender resulting to unhealthy relationship amongst each other. But there is a lot of organizations that supports equality for woman and for the LGBTQ+ community but none of them are for men. The continuous innovation of our technology will be used in effort to promote gender equality for men that are being stereotyped into societal expectations, where they are expected to also be emotionally stable who doesn't possess weak emotions that are potentially stopping men to speak up for themselves whenever they are being violated, because the reality is men can also be emotionally fragile, which it adds up to men's health hazards. Using the technology as an opportunity to widen the knowledge of how the issue has a big negative impact amongst the nation, parallax website is a scrolling type of web design than is more visually appealing for the users and catch their interest with its graphics. The goal is to make another unique way of distributing information and educate the users enable to give them knowledge about the importance of support system for men too and give out resources than will assist men in developing their mental health issues and their skill development.

Oral Sessions

1A-5) Design Optimization of a Pico Hydroelectric Turbine using Computational Fluid Dynamics

Author Francisco C. Dime (Metals Industry Research and Development Center, Philippines), Naresh Kumar (Cardiff University, UK), Cristian Della (University of Glasgow, UK), Kiran Ramesh (Cardiff University, UK), Geoffrey L. Abulencia, Jayson P. Rogelio (Metals Industry Research and Development Center, Philippines)

Abstract The design optimization of a pico-hydroelectric turbine using computational fluid dynamics (CFD) for a marine propeller is studied in this paper. The component selected for analysis and improvement is the runner of the turbine. Parametric studies were conducted to investigate the effects of the blade angles (between 56o and 80o) and the number of blades (3-5) in a runner on the flow of the fluid running through the turbine in terms of average particle velocity. The CFD simulation results show that the highest velocity was achieved at a blade angle of 70°. While the number of blades is directly proportional to the particle velocity, a three-blade configuration was selected in the design as it is more practical and cost-effective for small-scale turbines. The optimized parameters were then incorporated into an Archimedes Windmill (AWM)-based runner and re-simulated to verify improved efficiency. The AWM-based runner produced an average particle velocity of 11.89 m/s, compared to 9.1 m/s for the original flat-blade runner design, implying a velocity improvement of roughly 30.66% in comparison to the original design.

Oral Session 1B : Intelligent ICT Solutions I

13:00-14:30 Viento — Chair : Dr. Jonathan Taylar (National University, Philippines)

1B-1) Development of an RFID-Based Information Management System with GPS Tracking for Veterinary Clinics

Author Wilfredo M. Romero, Roben A. Juanatas (National University Philippines, Philippines)

Abstract The scale of pet facilities is growing while there are fewer professional personnel available. Technology-enabled pet systems not only enhance animal care but also give researchers insight into how animal equipment is used. This viewpoint may inspire innovative engineering concepts. These methods have also produced a distinct data stream that may be utilized to generate distinct animal phenotypes. Numerous applications, such as road tracks, animal monitoring, race timing, retail inventory, and attendance tracking, employ radio frequency identification. There are several kinds of RFID systems, each with special qualities that present opportunities or difficulties depending on the circumstance. RFID technology is widely recognized for its ability to track and identify items and assets. Such identification may be carried out without requiring line of sight alignment or physical contact between the RFID tag and the RFID reader, while monitoring is naturally performed due to the short field of interrogation by RFID readers. For this reason, there is a correlation between the decline in the cost of RFID tags and the rise in interest in this technology. Nevertheless, creating secure and private RFID identification procedures is challenging since tags are resource devices that wirelessly broadcast identity data. The complexity of this scenario outweighs the necessity to address the scalability of those protocols. There are more worries about RFID technology, given the availability of scalable, safe, private, and lightweight identity protection using RFID technology. While some of it arises from technological advancements like distance testing, the remainder is due to RFID devices' capacity to collect vast volumes of monitoring data.

1B-2) Design and Formal Verification of a Critical Patient Monitoring and Alert System

Author Coleen May S. Gatus, Emilio Juaquin M. Tagudin, Henry Adorna, Alfonso Labao, Gabriel Avelino Sampedro (University of the Philippines Diliman, Philippines)

Abstract The quality of healthcare in the Philippines con- tinues to face challenges due to limited resources, underdefined monitoring standards, and a shortage of medical personnel. De- spite the introduction of the Universal Health Care (UHC) Act in 2019, the effective implementation of healthcare reforms remains hindered by the lack of reliable and automated patient monitor- ing systems. This project proposes the development of a resource- efficient patient monitoring system capable of measuring heart rate, oxygen saturation, blood pressure, and body temperature in real time. Designed for under-resourced healthcare facilities, the system emphasizes correctness and reliability through formal verification methods. Specifically, the model ensures accurate data buffering, average computation over dynamic intervals, and total classification of patient states based on medically defined thresholds. By applying formal methods to verify system logic, this project aims to contribute a safe, scalable, and dependable tool that enhances patient safety, supports medical personnel, and improves clinical outcomes, particularly in rural and resource-limited healthcare settings.

1B-3) FurCare: a Comprehensive Digital Solution for Pet Adoption, Tracking, and Community Engagement in the Philippines

Author Roben A. Juanatas, Ralph Ibn Jheio M. Bugarin, Wilfredo M. Romero (National University Manila, Philippines)

Abstract The rapid growth of the pet population has created a pressing need for comprehensive digital solutions that address the diverse requirements of pet owners. FurCare integrates a variety of features, including pet adoption services, veterinary clinic locators, real-time updates for missing pets, a pet dating platform, and a QR code editor for pet tags. This paper discusses the development, implementation, and societal impact of FurCare, emphasizing its contributions to animal welfare, community building, and the promotion of responsible pet ownership. By addressing the unique challenges faced by pet owners in the Philippines, FurCare aligns with global sustainability goals, particularly the United Nations Sustainable Development Goals (SDGs).

1B-4) ECOLoop: Enhancing Operational Readiness Through Intelligent Waste Management

Author Nina Sapitula, Danyael Dela Cruz, Gerimiah Juganas, Kyle Martinez, Kaila Ondoy, Petter Sapalo (University of the Philippines Diliman, Philippines), Aileen Vasquez (Sienna College of Taytay, Rizal, Philippines), Gabriel Avelino Sampedro (University of the Philippines Diliman, Philippines)

Oral Sessions

Abstract Inefficient waste management not only presents environmental but also operational and logistical threats in military bases and forward operating bases. Piles of wastes can cause health risks, attract rodents, and undermine readiness for mission—particularly in extended deployments or disaster relief situations. In order to overcome these issues, this research proposes ECOLoop, a smart waste management prototype that seeks to optimize plastic bottle disposal collection and verification in controlled settings like military camps or distant outposts. ECOLoop has both hardware and software aspects, with user identification, image object recognition, and weight-based deposit verification to guarantee accurate and accountable waste separa- tion. By automating disposal procedures and incorporating incen- tive mechanisms, the system instills discipline, sustainability, and environmental stewardship in military environments. Initial tests of the functional prototype exhibit modest accuracy for detecting bottles, and the paper presents actionable recommendations for improving system reliability and field applicability.

1B-5) Trusted Voting for Mission-Critical Environments: a Coq-Verified Approach

Author Arian Balicusto, Yanni Jose Ella, Chloe Althaia Santos, Henry Adorna, Alfonso Labao, Gabriel Avelino Sampedro (University of the Philippines Diliman, Philippines)

Abstract Electronic voting systems play a crucial role in modern governance, but their adoption in military and mission- critical environments has been hindered by concerns over cor- rectness, auditability, and resilience to manipulation. While prior work has introduced secure voting protocols and electronic ballot systems, few offer formal, machine-checked guarantees of correctness across the entire voting pipeline. In this paper, we present a formally verified voting system modeled and proven using the Coq proof assistant. The system captures key components including voter registration, eligibility validation, ballot verification, vote tallying, and winner determination. Each stage is encoded as a logical function and subjected to theorem-proving to establish properties such as vote uniqueness, tally accuracy, and deterministic outcomes. Our approach demonstrates that it is feasible to construct a verifiably correct voting infrastructure even for constrained or adversarial deployment scenarios, such as remote military installations. Through diagrammatic models and Coq proofs, we illustrate how formal methods can mitigate ambiguity, improve transparency, and reduce risks in sensitive electoral contexts.

Oral Session 2A : Advanced Aerial and Satellite Communications

17:00-18:30 Tierra — Chair : Prof. Yonggang Kim (Kongju National University, Republic of Korea)

2A-1) GNN-Aided Efficient Multipath Routing in Satellite Constellation Networks

Author Gwangun Yu, Minjung Kwak (Kongju National University, Republic of Korea), Siwoong Park (Electronics and Telecommunications Research Institute(ETRI), Republic of Korea), Yonggang Kim (Kongju National University, Republic of Korea)

Abstract This paper proposes a graph neural network (GNN) based framework to predict dynamic Inter Satellite Link (ISL) topology under Free Space Optical Communication (FSOC) constraints. The GNN model captures both local connectivity and global structural patterns in the satellite graph. The output of the GNN is used to construct a predicted adjacency matrix, over which routing paths are computed using Yen's k-shortest path algorithm.

2A-2) Dynamic Beam-Hopping in Multi-Beam LEO Networks Using Deep Reinforcement Learning

Author Tae-Yoon Kim, Jaeyeol Lee, Jihong Park, Taehan Moon, Jae-Hyun Kim (Ajou University, Republic of Korea)

Abstract Conventional beam-hopping (BH) methods are not well-suited for the complex nature of LEO satellite networks. In this paper, we define a channel model and signal model based on the 3GPP standard and propose an effective action selection BH deep Q-network (EABH-DQN) algorithm to optimize the BH scheduling of Earth-fixed multi-beam LEO satellites based on ground cell traffic demand. The EABH-DQN algorithm employs an effective action-selection strategy to address the challenges of executing BH across a large number of ground cells within the highly dynamic conditions of LEO satellite networks.

2A-3) A Technical Survey on Uplink Capacity Enhancement in Direct-to-Cell (D2C) Systems: Toward Cooperative LEO Satellite Architectures

Author Tae Hoon Yoon, Can Zheng, Fitsum Debebe Tilahun, Chung G. Kang (Korea University, Republic of Korea)

Abstract Direct-to-Cell (D2C) connectivity via LEO satellite networks offers a promising path to extend mobile coverage to underserved regions. However, challenges such as limited link budgets, uplink interference, and beam management must be addressed. This paper surveys key technologies for uplink capacity enhancement, including regenerative payloads, interference mitigation, beamforming, and distributed antenna systems. It aims to guide future research and support scalable D2C network development in non-terrestrial systems.

2A-4) Interference Evaluation Between HAPS and UAVs Considering Overlapped Ground Service Coverage

Author Hyunduk Kang, Ho-kyung Son (Electronics and Telecommunications Research Institute (ETRI), Republic of Korea)

Abstract We evaluate the interference between High-Altitude Platform Stations (HAPS) and Unmanned Aerial Vehicles (UAVs), considering their overlapped ground service coverage under various parameters, including the distance between HAPS and UAV, the radius of ground service coverage, the altitude, and the ground user density. Based on coexistence scenarios, we examine situations in which a neighboring UAV interferes with a HAPS, and vice versa—a neighboring HAPS interferes with a UAV. We also investigate the required keep-out distance, i.e., the separation distance between HAPS and UAV that ensures a target interference probability. Numerical results demonstrate how these parameters affect the interference probability, emphasizing the importance of careful deployment of both aerial platforms and the planning of their respective ground service coverages.

Oral Sessions

2A-5) Massive MIMO Enabled UAV Communication Model for Enhanced Battlefield Surveillance During Offensive Military Operations

Author Rajesh Kapoor (GLA University, India)

Abstract Static battlefield surveillance devices have certain limitations which restrict their usage during offensive operations. In the current paper, we review the limitations of static surveillance devices and efficacy of Unmanned Aerial Vehicles (UAVs) as prime battlefield surveillance device for offensive operations. We then explore the possibility of connecting UAVs with existing cellular base stations and with vehicle mounted cellular base stations which can be moved into enemy territory with the progress of offensive operations. Furthermore, a UAV communication model for enhanced battlefield surveillance during offensive operations is presented after carrying out performance analysis of various multiple antenna techniques that can be utilized to achieve desired data rates for UAV operations.

Oral Session 2B : Intelligent ICT Solutions II

17:00-18:30 Viento

Chair : Dr. Jinkyu Bang (KIOST, Republic of Korea)

2B-1) Feasibility Study on Rapid Tunneling Based on Fuzzy Clustering Algorithm and Numerical Simulation Analysis

Author Shuai Wei (Taiyuan Institute of China Coal Technology and Engineering Group, China & Shanxi Tiandi Coal Mining Machinery Company Limited, China), Arun Kumar Sangaiah (National Yunlin University of Science and Technology, Taiwan), Jianwei Jia (Taiyuan Institute of China Coal Technology and Engineering Group & Shanxi Tiandi Coal Mining Machinery Company Limited, China), Chao Zhang (Shanxi University, China)

Abstract Regarding the applicability of rapid excavation equipment under medium and complex surrounding rock conditions in coal mines, as well as the challenge of adopting partial bolt-cable delayed support technology, this study aims to solve the problem of high trial-and-error costs in excavation experiments and realize the transformation from qualitative analysis dominated by personnel experience to quantitative analysis based on scientific data.In terms of fuzzy clustering algorithm, seven indicators were preliminarily selected for analysis through field investigations and literature reviews. Calculations and analyses were completed based on practical cases, and preliminary conclusions were drawn. On the basis of the fuzzy clustering algorithm, a mechanical numerical model was established to further analyze the basic applicability of rapid excavation equipment and technology. Based on the fuzzy clustering algorithm, a mechanical numerical model was established to further analyze the basic applicability of rapid excavation equipment and technology. Two analysis schemes were divided according to the number of delayed support bolts and cables. Through methods such as cloud diagram slicing and data extraction, the suitable mining technology, surrounding rock movement laws, and the spatio-temporal distribution laws of delayed support were obtained based on the geological parameters of the mine, which verified the results of mathematical analysis.

2B-3) Secure AI-Enabled Wireless Gas Analyzer for Real-Time Emission Monitoring in Naval and Defense Environments

Author Raymart Belza, Marco Antonio Cenir, Gene Luis Manaligod, Lance Melvin Sajona, Reginaldo Belza, Joey Evangelista (Sienna College of Taytay, Philippines), Gabriel Avelino R Sampedro (University of the Philippines, Philippines), Aileen Vasquez (Sienna College of Taytay, Philippines)

Abstract Urban emissions monitoring in tactical and maritime environments presents unique challenges due to connectivity limitations, real-time demands, and the need for verifiable results. This paper proposes AI-GAAN, a mobile-integrated secure gas analyzer system that combines wireless sensing, embedded artificial intelligence, and cryptographic result verification. The system leverages a commercial five-gas analyzer paired with a microcontroller and a Wi-Fi module to transmit emission data to an Android application. On-device inference using a lightweight 1D-CNN model enables real-time classification of gas profiles without reliance on Internet access. The test results are hashed using SHA-256 and encoded in QR format to support tamperresistant validation. Comparative evaluation against traditional classifiers demonstrates that AI-GAAN achieves superior accuracy (95.7%), low latency (94 ms) and compact model size (1.2 MB), which makes it suitable for deployment in naval checkpoints and mobile defense operations. The system offers a scalable and secure solution for the enforcement of emission compliance in constrained and high-stakes settings.

2B-4) Proximity-Activated Smart Parking System with Secure IoT Control for Military Facilities

Author Jynon Mapa (Park King Technologies, Philippines), Shekinah Lor Huyo-a (Philippine Coding Camp, Philippines), Clarice Cabanlit (Willow AI, Philippines), Gabriel Avelino R Sampedro (University of the Philippines, Philippines)

Abstract Secure and efficient vehicular access control is critical in high-security environments such as military compounds and defense installations. This paper presents a proximityactivated smart parking system that combines mobile app-based authentication, Bluetooth Low Energy (BLE) or Ultra-Wideband (UWB) proximity sensing, and secure Internet of Things (IoT) communication protocols. The system enables automated gate control based on verified proximity and user credentials, supported by fallback mechanisms using NFC for offline access. Using a modular architecture built on ESP32 microcontrollers, MQTT over TLS, and Firebase cloud backend, the system was deployed and tested under simulated military conditions. Results show a 98% access success rate and an average gate response time of 2.3 seconds using BLE, outperforming manual override and NFC fallback methods. The proposed solution demonstrates potential for enhancing security, reducing gate congestion, and supporting scalable access control in smart military base deployments.

2B-5) Optimal Image Resolution for Crop Growth Stage Classification Using Drone Imagery

Author Jonggeol Park, Souichiro Toyota, Jiuyun Zhang (Tokyo University of Information Sciences, Japan)

Abstract This study explores the optimal image resolution for detecting crop growth stages using drone imagery and AI. Drone flights were conducted over a 2,727 m2 field in Chiba Prefecture, capturing images at various altitudes. YOLOv8 was used to classify the growth stages of cabbage, broccoli, and peanuts. Results showed that early-stage crops required higher image resolution for accurate detection, especially for cabbage and peanuts. Broccoli was detectable at lower resolutions in early stages but became difficult to distinguish as it matured. The findings suggest that the ideal resolution varies by crop type and growth stage, and adjusting drone altitude accordingly can improve detection accuracy. Future work will address labeling quality and detection challenges for later growth stages.

Oral Sessions

August 28 (Thursday)

Oral Session 3A : Artificial Intelligence and Machine Learning I

10:30-12:00 Tierra

Chair : Prof. Yonggang Kim (Kongju National University, Republic of Korea)

3A-1) Dual-Stream Landmark-Based Sequence Network for Face Presentation Attack Detection

Author Sun-hong Min, Moonseung Choi, Yonggang Kim (Kongju National University, Republic of Korea)

Abstract As the use of face recognition technology expands, the security of face presentation attack detection has become critically important, and existing methods that rely solely on a single type of feature have proven insufficient. This study proposes a dual-stream network that utilizes landmark point information extracted via OpenCV to capture frame-by-frame variations in color and brightness between genuine faces and attack faces, stabilizing these variations with a Kalman filter. The network employs both frame-based and sequence-based approaches in its learning process, combining the outputs from the two streams to classify genuine faces and attacks. The proposed method demonstrates its effectiveness by achieving an F1-score of 0.9207 on the test dataset.

3A-2) Privacy-Preserving Fault Detection in Additive Manufacturing Using Federated YOLOv11

Author Gabriel Avelino R Sampedro (University of the Philippines, Philippines), Made Adi Paramartha Putra (Primakara University, Indonesia)

Abstract Additive manufacturing is revolutionizing the manufacturing industry by allowing for the creation of complex geometries and reducing waste. This technology has the potential to greatly impact various sectors, from aerospace to healthcare, by offering faster production times and cost-effective solutions. However, there are still challenges to overcome, such as ensuring the quality and consistency of printed parts and addressing issues related to material properties and structural integrity. Research and development efforts are ongoing to improve these aspects and unlock the full potential of additive manufacturing in different industries. In this research, an enhanced deep learning approach for fault detection in Fused Deposition Modeling (FDM) 3D printers is developed by combining an improved YOLOv11 architecture with federated learning for scalable, privacy-preserving edge deployment. To further improve accuracy, grid search hyperparameter optimization is applied. The results show that the proposed decentralized YOLOv11 model achieves satisfactory performance, with an accuracy of 97% in detecting faults in FDM 3D printers. Additionally, experiments on various YOLOv11 model variants under federated learning settings indicate that larger models provide better performance.

3A-3) Wireless Body Sensor Based Cardiotocography for Fetal Assessment Using Hybrid 1D-CNN-LSTM Deep Learning Approach

Author Blessie Joy Dela Paz Dellosa, Jocelyn Villaverde (Mapua University, Philippines)

Abstract This study proposes a wireless bodysensor CTG system that embeds a lightweight onedimensional convolutional neural network–long short-term memory (1D-CNN-LSTM) model for automatic binary classification of fetal heart rate (FHR) traces. A total of 1,571 twenty-minute FHR segments, extracted and rigorously cleaned from the public CTU-UHB repository, were split into 1,201 training and 158 hold-out test samples. The prototype streams results in a single pre-configured e-mail account, demonstrating a feasible Internetof-Things pathway that supports Sustainable Development Goals 3 and 10 by extending highquality fetal monitoring beyond hospital settings. Study limitations include the exclusion of uterinecontraction data, pre-term gestation, and broader multimodal inputs. Overall, the integration of wireless sensing with deep learning furnishes an objective and deployable tool that can enhance realtime obstetric decision support and reduce unnecessary interventions.

3A-4) Self-Collected and Synthesized Data for SELD in Data-Constrained Environments

Author Yeongseo Shin (LIG Nex1, Republic of Korea)

Abstract This paper presents a dataset construction and training methodology for Sound Event Localization and Detection (SELD) in data-constrained environments. To capture the acoustic characteristics of the target space, Room Impulse Responses (RIRs) were measured and convolved with various sound events to generate a highquality synthetic dataset simulating realistic conditions. SELD models were trained using Convolutional Recurrent Neural Networks (CRNN) and Residual Convolutional Block (RCB)-based Transformer (Conformer) architectures. The proposed models achieved stable and consistent performance across diverse test scenarios. Experimental results demonstrate the practical applicability of SELD techniques even in environments with limited real acoustic data.

3A-5) FOAM-AI: an AI-Enabled Flood Monitoring and Alert Platform for Tactical Urban Disaster Response

Author Raymart Belza, Marco Antonio Cenir, Gene Luis Manaligod, Lance Melvin Sajona, Reginaldo Belza, Joey Evangelista (Sienna College of Taytay, Philippines), Gabriel Avelino R Sampedro (University of the Philippines, Philippines), Aileen Vasquez (Sienna College of Taytay, Philippines)

Abstract Flooding remains a persistent threat to low-lying, densely populated municipalities in the Philippines, such as Taytay, Rizal—posing both humanitarian and operational challenges during disaster response missions. Existing early warning systems lack the responsiveness and localization needed for tactical deployment and civilian protection. To address these limitations, we present FOAM-AI, an intelligent flood monitoring and alert platform designed to support command-level situational awareness through the integration of IoT sensors, crowdsourced intelligence, and machine learning. The system deploys ultrasonic water-level sensors with GSM/Wi-Fi-enabled microcontrollers in critical zones, while a mobile application aggregates field reports from civilians and operatives. Three classification algorithms—Random Forest, Support Vector Machine (SVM), and K-Nearest Neighbors (KNN)—were trained on multi-source data including sensor telemetry, rainfall intensity, and labeled user submissions. Simulation results indicate that Random Forest outperformed the others with 93.2% accuracy in classifying flood severity. The system demonstrated low-latency alert dissemination (1.8s average) and operational resilience under unstable network conditions using GSM fallback. FOAM-AI illustrates how AI-enabled, hybrid sensing architectures can serve as a force multiplier for early warning, mobility planning, and disaster mitigation in civilian-military response operations.

Oral Sessions

Oral Session 3B : Advanced Communication Networks

10:30-12:00 Viento Chair : Dr. Jayson Rogelino (Metals Industry Research and Development Center, Philippines)

3B-1) Federated Reinforcement Learning Based Handover for V2X-Communications in Imperfect-CSI and Doppler Shift

Author Sanjay Bhardwaj, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract This paper presents a Federated Reinforcement Learning (FRL)-based handover (HO) approach for Vehicle-toEverything (V2X) communications operating under the challenges of imperfect Channel State Information and Doppler Shift. The proposed method enables distributed and adaptive HO (HO) decision-making by training local models collaboratively across network nodes, thereby reducing signaling overhead and enhancing responsiveness to fast-changing environments. A branching deep reinforcement learning framework is utilized to simultaneously optimize multiple performance objectives, including HO cost, number of HOs, and outage probability. The simulation results demonstrate that the proposed solution consistently outperforms contemporary HO approaches

3B-2) Coexistence of Military and Commercial 5G Mobile Network

Author Sangchul Oh,Nak Woon Sung, Heesang Chung, Kiwon Kim, Woocheol Kim, HeaSook Park (Electronics and Telecommunications Research Institute (ETRI), Republic of Korea)

Abstract The convergence of commercial 5G mobile networks and military mobile infrastructures presents both an opportunity and a challenge for national defense communication systems. The paper proposes architectural models that enable secure and efficient coexistence between these two domains. Three coexistence strategies are introduced: (1) dual-PLMN integration via multi-operator core network (MOCN), (2) RAN slicing under a shared PLMN using distinct single network slice selection assistance information (S-NSSAI) values, and (3) inter-PLMN federation employing security edge protection proxy (SEPP) interfaces. Each architecture for military network incorporates zero trust principles and software defined perimeter (SDP) to ensure data plane isolation and session-based access control. Performance evaluation confirms that although SDP introduces throughput degradation, it is essential for enforcing military-grade security policies. The proposed models support flexible deployment scenarios such as dualuse base stations and joint operations paving the way for secure 5G adaptation in defense environments.

3B-3) Lendr: a Military-Adapted Library-of-Things System for Secure Tool Sharing and Resource Optimization

Author Juan Antonio L Bonuan, Jemimah Mae C Isaig, Pe Arian Rey (University of the Philippines Diliman, Philippines), Aileen Vasquez (Sienna College of Taytay, Philippines), Gabriel Avelino R Sampedro (University of the Philippines, Philippines)

Abstract Secure and efficient access to shared equipment is a growing need in both civilian communities and military operations, particularly in scenarios where resource optimization and accountability are critical. Existing Library-of-Things (LoT) systems have demonstrated the value of shared-use models in reducing costs and promoting sustainability. However, most implementations rely on manual oversight or limited automation, lacking the robustness and security required in defense and hightrust environments. This paper introduces Lendr, a smart locker system designed to automate access control, item verification, and usage monitoring in LoT deployments. The system combines RFID-based user authentication via an ESP8266 microcontroller with AI-powered visual verification using an ESP32-CAM and the OpenAI Vision API. A SvelteKit-based Progressive Web Application (PWA), integrated with Firebase, manages reservations, real-time status updates, and transaction logs. Upon locker closure, an interior image is captured and verified against the expected contents, with status indicated via a tri-color LED. Initial testing of a single-locker prototype demonstrates effective access management, autonomous item validation, and responsive user feedback. Future work will extend the system to multilocker arrays, incorporate tamper detection and multi-factor authentication, and evaluate performance in field conditions relevant to military and disaster-response applications.

3B-4) An SDN-Based Tactical Network Architecture for JADC2

Author Jaekyu Cho (Changwon National University, Republic of Korea)

Abstract Modern warfare requires agile and resilient tactical networks to support Multi-Domain Operations (MDO) and Alenabled systems under the Joint All-Domain Command and Control (JADC2) framework. Current networks struggle with connectivity, bandwidth, QoS, interoperability, and security in dynamic battlefield conditions. This study proposes an SDNbased tactical network architecture with a hierarchical control plane—distributed local controllers manage Tactical Areas of Responsibility (TAORs), while a centralized controller handles global orchestration. Unmanned aerial vehicles (UAVs) serve as airborne relays to reduce disconnections and increase capacity. Simulation results demonstrate significant improvements in throughput, latency, and link utilization, confirming the potential of the architecture as a foundation for AI-driven network management and future JADC2 integration.

3B-5) IoT and Long-Range Antennas: Challenges, Solutions and Comparison in the Next Generation

Author Jayson P. Rogelio, Don Lorenzo F Cruz, Juan Paolo C. Escasura, Marci Angelo Q. Lara, Kate Zyrll M Plantilla (De La Salle University, Philippines), Von Jansen G Comedia Metals Industry Research and Development Center, Philippines)

Oral Sessions

Abstract Central to the success of IoT systems are longrange antennas, which enable communication over vast distances, even in challenging environments. These antennas are essential for applications requiring reliable connectivity, low energy consumption, and accurate data transmission. However, as IoT technologies advance, challenges such as signal interference, energy efficiency, and deployment in remote areas must be addressed to realize their full potential. This study evaluates the performance of long-range antennas in three distinct IoT systems: remote environmental monitoring, smart metering for water, gas, and electricity, and smart building and facility management. These systems utilize different long-range communication technologies, including Sigfox, LoRaWAN, and NB-IoT, optimized for specific use cases. By analyzing these technologies, the research compares their effectiveness in terms of location coverage, energy efficiency, and signal transmission accuracy. This comparative analysis offers insights into the strengths and limitations of each technology, providing guidance for improving IoT deployments. Additionally, the study examines the challenges faced by IoT systems using long-range antennas and suggests potential solutions to enhance their performance. The findings contribute to the development of next-generation IoT technologies, emphasizing the importance of long-range antennas in fostering innovation, ensuring sustainable energy use, and maintaining reliable communication in diverse, demanding environments.

Oral Session 4A : AI and Optimization for Maritime Systems

13:30 - 15:00 Tierra — Chair : Prof. Alfonso Labao (University of the Philippines, Philippines)

4A-1) Construction of a Structured Maritime Dataset Using Acoustic and AIS Data

Author Sungjin Shin, Youngshin Kim (LIG Nex1, Republic of Korea), Donhyug Kang, Sungho Cho (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea)

Abstract With the advancement of maritime monitoring technologies, vast amounts of underwater acoustic and AIS (Automatic Identification System) data are now collected in real-time. However, these datasets are often unstructured and non-standardized, hindering their direct application in AI-based tasks such as ship classification and maritime situational awareness. This paper proposes a method for constructing a structured, security-compliant maritime dataset by synchronizing acoustic and AIS data. Unlike previous studies focused on limited geographical regions or specific hardware, our approach utilizes diverse environments in Korean waters, aiming for broader applicability. The resulting dataset enhances ship identification and contributes to Underwater Domain Awareness (UDA), laying a foundation for future AI-driven maritime monitoring systems.

4A-2) Deep Learning-Based 3D Reconstruction for Coastal Digital Twins: a Review and Preliminary Evaluation

Author Soorim Yang (LIG NEX1, Republic of Korea), Donghoon Lee (Sejong University, Republic of Korea)

Abstract Coastal digital twins offer a practical step toward full-scale marine systems by leveraging aerial and satellite imagery for environmental monitoring. However, coastal environments introduce unique challenges for 3D reconstruction. These include dynamic shoreline topography, water-induced distortion, and temporal variability—factors that remain underexplored in existing research, which primarily focuses on urban or underwater scenes. This paper reviews recent deep learning-based 3D reconstruction methods for coastal digital twins and presents a preliminary experiment using 3D Gaussian Splatting (3DGS) on UAV coastal imagery. Results show both potential and limitations of real-time reconstruction in shoreline scenarios. We highlight future directions in multimodal data integration and temporally consistent modeling to meet the demands of adaptive coastal digital twins.

4A-3) PSO-Based Optimal Deployment Strategy for Multistatic Sonobuoy Systems

Author Jiseop Kim, Youngshin Kim (LIG NEX1, Republic of Korea), Donhyug Kang, Sungho Cho (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea)

Abstract The detection performance of sonobuoys is highly influenced by environmental conditions, sensor positions (latitude and longitude), and deployment depths. To address this, optimal deployment strategies are required to maximize detection performance under varying marine environments. This paper proposes an optimal placement algorithm for multistatic sonobuoys considering both position and depth in the continental slope region of the East Sea. A particle swarm optimization (PSO) algorithm is applied to determine the transmitter and receiver configurations that maximize the detectable area within the search region. Simulation results demonstrate that the proposed algorithm increases the detection coverage as the number of iterations progresses, and the sonobuoy positions and depths converge toward optimal configuration.

4A-4) Adaptive Parallelization of Time-Varying Dispersive Channels Using the Power Waveforming Framework

Author Charleston Dale M Ambatali (University of the Philippines, Philippines)

Abstract The power waveforming (PW) technique is conceptualized to maximize energy transfer from a transmitter to an intended receiver communicating over a scatteringrich or dispersive wireless channel. To achieve this, the PW technique measures the channel impulse response, converts it into a Toeplitz matrix, and solves the eigenvector that corresponds to the maximum eigenvalue. Using the same framework, it can be shown that a dispersive channel, wireless or wired, can be parallelized to increase the information transfer throughput, but sacrificing robustness against noise. This is done by exploiting the vector space formed from the CIR's Toeplitz matrix. Its basis can be exploited as parallel waveforms that can be transmitted simultaneously, effectively turning a dispersive channel into multiple single channels. In this paper, we establish this expanded framework and analyze the resulting bit error rate when it is performed.

Oral Sessions

4A-5) Power Waveforming Using a Bidirectional Time Reversal Mirroring Implementation

Author Charleston Dale M Ambatali (University of the Philippines, Philippines)

Abstract To increase the performance of communication, the signal-to-noise ratio at the receiver must be increased. In a severe multipath environment, this can be achieved by matched filtering assuming complete knowledge of the channel's impulse response. Time reversal (TR) is a technique that performs this, and is shown to improve communication performance of underwater communication systems where severe multipath is expected. However, TRdoes not maximize the power delivered to the intended receiver. The power waveforming (PW) technique achieves this maximum, but it requires complete knowledge of the channel to be computed. Thus, it must be performed in conjunction with channel estimation techniques. In this paper, we unify the TR and PW techniques by showing that the PW pulse predicted the channel impulse response can be formed from repeated TR operation between two communicating nodes. We also compared the performance of the resulting pulse with the performance of TR and PW pulses in a severe multipath environment through a simulation. Results show that if the proposed system is given enough time, it can provide a good estimate of the optimum PW pulse and outperform the TR pulse.

4A-6) Advanced Materials for Energy-Efficient and Resilient Communication Devices in Harsh Environments

Author Paula Marielle Ababao, Ian B Benitez (FEU Institute of Technology, Philippines), Gabriel Avelino R Sampedro (University of the Philippines, Philippines)

Abstract This study assesses the potential of advanced materials, specifically graphene, perovskites, and nanostructured ceramics to enhance the energy efficiency, durability, and environmental resilience of 5G and 6G communication systems deployed in harsh environments. A comparative evaluation was conducted based on electrical conductivity, thermal stability, mechanical strength, optical performance, and corrosion resistance, drawing on recent experimental data and life-cycle analyses. Graphene demonstrates electrical conductivity near 10^8 S/m and thermal conductivity up to 5000 W/m·K, enabling transistors with 200 times higher speeds and coatings reducing corrosion by over 90%. Perovskite-based devices achieve solar cell efficiencies up to 34% and optical modulators operating at 170 Gbps. Nanostructured ceramics offer low dielectric loss and stability above 1000 °C, supporting high-frequency operation in challenging conditions. Integrating these materials is projected to extend device lifespans by up to 40% and reduce energy and cooling demands by 30%. These findings indicate that adopting advanced materials can significantly improve the performance and sustainability infrastructure. of next-generation communication

Oral Session 5A : IoT and AI Applications

15:20-16:50 Tierra — Chair : Prof. Sumin Jeong (Kumoh National Institute of Technology, Republic of Korea)

5A-1) Climate-Smart Maritime Surveillance: Integrating AI and Low-Power Communications for Blue Carbon Ecosystem Monitoring

Author Paula Marielle Ababao, Ian B Benitez (FEU Institute of Technology, Philippines), Gabriel Avelino R Sampedro (University of the Philippines, Philippines)

Abstract Blue carbon ecosystems (mangroves, saltmarshes, seagrasses) are globally significant carbon sinks, absorbing an estimated 50% of oceanic carbon despite covering only 2% of the ocean surface. However, these important habitats face rapid degradation, with 25% to 50% loss over the past 50-70 years, transforming them into carbon sources. This paper presents a climate-smart communication and sensing framework for realtime monitoring of these critical marine ecosystems. It integrates Artificial Intelligence (AI) with advanced sensing technologies, including satellite, Uncrewed Aerial Vehicles (UAVs), LiDAR, and in-situ sensors, for comprehensive data acquisition and analysis. The framework evaluates energyefficient and secure underwater (acoustic, optical) and overwater (satellite, cellular, LoRaWAN) communication strategies to ensure continuous data flow. AI algorithms enhance data processing, pattern recognition, predictive modeling, and autonomous operations of platforms like Autonomous Underwater Vehicles (AUVs). This integrated approach not only supports accurate carbon accounting but also yields substantial co-benefits for climate change mitigation and adaptation, biodiversity conservation, and maritime security by deterring illegal activities and pollution. The framework provides a transformative pathway for sustainable blue economy and resilient coastal communities.

5A-2) CoLLAID: Collaborative Lightweight Language Model for Adaptive Intrusion Detection in Maritime IoT

Author Md Tayeb Adnan, Sium Bin Noor, Subroto Kumar Ghosh, Jae Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract Maritime IoT environments face growing cybersecurity threats, yet traditional intrusion detection systems remain illsuited for dynamic, decentralized, and resource-limited settings. We propose CoLLAID, a Collaborative Lightweight Language Model framework for adaptive intrusion detection across distributed maritime nodes. CoLLAID converts structured network traffic into natural language sentences using a feature-templated encoding scheme and processes them with a compact TinyBERT model for efficient classification. To address unknown attacks, the system applies a confidence-aware rejection mechanism followed by Gaussian Mixture Model (GMM) clustering for dynamic threat discovery. Federated learning enables decentralized model refinement without raw data exchange, while PureChain, a permissioned blockchain, ensures verifiable synchronization and tamper-resistant update tracking. Evaluations on NSL-KDD and CICIDS2017 demonstrate that CoLLAID outperforms classical baselines, achieving high accuracy (up to 94.72%), strong generalization, and low-latency performance suitable for real-time edge deployment in maritime environments.

Oral Sessions

5A-3) The Loom of Oceanic Vigilance: Orchestrating Pure-Chain and Language Agent for MIoT Security

Author Mohtasin Golam, Esmot Ara Tuli, Jae Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract The rapid growth of the Marine Internet of Things (MIoT) has introduced significant cybersecurity challenges, including vulnerabilities in data integrity, unauthorized access, and cyber threats to maritime infrastructure. This paper presents a framework that integrates blockchain architecture with a language agent model to establish a decentralized, intelligent threat prevention system for MIoT networks. By weaving blockchain's immutable ledger capabilities with a small language model (SLM)-driven threat analysis, the framework addresses critical gaps in maritime cybersecurity, including real-time attack surface management, contextual anomaly detection, and secure crossdomain data sharing. The proposed architecture leverages Smart Auto Mining Plus (SAM+) and Proof of Authority and Association (PoA2) consensus mechanisms to ensure energy-efficient, tamper-proof transaction validation across distributed MIoT nodes. Language agents process unstructured data from maritime sensors, AIS broadcasts, and operational logs, translating natural language threat descriptions into executable smart contracts for autonomous mitigation and response. The framework employs a hybrid on-chain/off-chain processing model to optimize performance for latency-sensitive maritime operations. Experimental validation using a simulated MIoT network demonstrates a 4.1% reduction in false positives compared to existing systems, with blockchain-verified threat intelligence achieving 97.8% detection accuracy for novel attack vectors, including GPS spoofing and false distress calls. The system's distributed consensus approach ensures reliable sharing of threat intelligence across maritime stakeholders while preserving operational privacy.

5A-4) A Global Review of Modern Underwater Surveillance Systems for Maritime Security

Author DaEun Jung (LIG Nex1, Republic of Korea)

Abstract Underwater surveillance systems play an essential role in maritime security, particularly in addressing threats such as submarines, unmanned underwater vehicles (UUVs), and illicit activities. Traditional fixed surveillance infrastructures are increasingly being supplemented or replaced by mobile, autonomous, and sensor-networked systems. This paper provides a comparative analysis of the latest underwater surveillance initiatives led by the United States, Europe, Australia, China, and South Korea. Each case study is examined in terms of technological innovation, strategic objectives, and operational deployment. The findings highlight a global shift toward modular, autonomous, and multi-domain surveillance networks, underscoring the importance of acoustic communication, AIbased detection, and integrated surface-subsurface platforms in future maritime defense strategies.

5A-5) Satellite-Based Early Warning Systems for Climate-Induced Maritime Security Risks

Author Ian B Benitez, Paula Marielle Ababao (FEU Institute of Technology, Philippines), Gabriel Avelino R Sampedro (University of the Philippines, Philippines)

Abstract Climate change is intensifying maritime risks, including sea level rise, stronger storms, and disrupted ocean currents—posing threats to coastal infrastructure, navigation, and security. Traditional monitoring systems lack the predictive capabilities and coverage to address these evolving challenges. This paper explores the integration of Artificial Intelligence (AI) and satellite-based Earth observation as a next-generation early warning system (EWS) for maritime security. We assess observed and projected hazard trends, propose an AI-enhanced system architecture, and evaluate readiness in climate-vulnerable geographies. The findings highlight actionable strategies to improve forecasting, risk detection, and climate resilience in coastal and maritime domains.

5A-6) Enhancing Medical Readiness with LLMs: a Low-Resource OTC Support Bot for Deployed Units

Author James Paul L Tan (Samar State University, Philippines & Philippine Coding Camp, Philippines), Margrette B Yebes, Michael Ralph A Estrada (De La Salle University, Philippines & Philippine Coding Camp, Philippines), Paula Marielle Ababao (FEU Institute of Technology, Philippines), Gabriel Avelino R Sampedro (University of the Philippines, Philippines)

Abstract In military and expeditionary (maritime) health care environments where isolation, safety, limited personnel, and resource constraints can threaten the delivery of frontline health care, access to timely and knowledgeable medical assistance can be extremely valuable. The purpose of this paper is to investigate the use of large language models (LLMs) in military and maritime health care environments by creating an AIpowered, Over-the-Counter (OTC) Medication Assistance Bot using the Mistral-7B model. The bot is intended to be deployed within tactical, or even shipboard systems, and it would empower autonomous, in-the-moment recommendations of medications for specific symptoms, while mitigating the risks associated with deploying personnel self-medicating through potential nonfundamental use errors. For this work, we employed LowRank Adaptation (LoRA) to fine-tune the system, and the bot was trained on a specific dataset derived from material on pharmacological sources, contextualized for medical practices in the Philippines. Based on evaluation the model achieved an average F1-score of 0.7296, which is above the 0.60-0.70 expected levels of performance for medical dialogue systems. The research shows promise for the model as it enhances combat and maritime healthcare readiness by providing consistent, low-bandwidth, and local medical assistance when connected medical supervision may not be immediately available.

Oral Sessions

August 29 (Friday)

Oral Session 6A : Artificial Intelligence and Machine Learning II

10:00-11:30 Tierra — Chair : Prof. Dong Myung Lee (Tongmyong University, Republic of Korea)

6A-1) Feedback-Guided Summarization Refinement for Small Language Models Using ModernBERT

Author Geonwoo Hong, GilHan Choi, Gwangun Yu, Yonggang Kim (Kongju National University, Republic of Korea)

Abstract Small language models (SLMs) are gaining traction due to their efficiency and deployability on low-resource devices. Despite these advantages, SLMs often underperform compared to large language models (LLMs) in summarization tasks. In particular, they struggle to maintain coherence and ensure factual accuracy. In this paper, we introduce a feedback-guided framework for summarization. This framework improves summary quality without any fine-tuning of SLMs. To implement our method, we use ModernBERT, a bidirectional encoder designed for long-context inputs, which is fine-tuned to classify each article–summary pair into one of eight predefined feedback types. Next, the SLM uses the predicted feedback to perform a single, post-hoc refinement step. We evaluate this approach on the CNN/DailyMail news dataset and observe consistent improvements in both Recall-Oriented Understudy for Gisting Evaluation (ROUGE) and Bidirectional Encoder Representations from Transformers Score (BERTScore). In several cases, our method outperforms LLMs, despite requiring only minimal computing resources. Our results show that the modular, feedback-guided approach can deliver high-quality summaries on lightweight systems with minimal resource consumption.

6A-2) Scaled Entropy Guided FedAvg: Improving Federated Learning on Imbalanced Data

Author Nayeon Kim, Harun Ur Rashid, Seong Ho Jeong (Hankuk University of Foreign Studies, Republic of Korea)

Abstract With the development of 5G and the proliferation of distributed data, federated learning (FL) has emerged as a crucial approach for decentralized model training. However, a critical impediment to FL's effectiveness is the prevalent imbalanced data distribution among participating clients, leading to suboptimal global model performance. This paper proposes an improved FL algorithm, scaled entropy-guided FedAvg, which addresses label imbalance by incorporating client-specific entropy during parameter aggregation. Specifically, each client's model update is weighted by its scaled entropy, ensuring that the scaled weight remains close to 1 so that they do not deviate significantly from the original parameters. The evaluation reveals that Scaled Entropy FedAvg significantly reduces both average loss increase and average accuracy decrease, exhibiting superior stability and performance across communication rounds compared to conventional FedAvg and a baseline unscaled entropy method.

6A-3) Enhancing Machine Learning Performance Through Quantile Binning for Resource Forecasting

Author Jim Gregorie Ilejay (Philippine Coding Camp, Philippines), Paula Marielle Ababao (FEU Institute of Technology, Philippines), Gabriel Avelino R Sampedro (University of the Philippines, Philippines)

Abstract Accurate resource yield prediction is critical for military logistics, planning, and operational readiness, yet remains challenging due to numerous influencing factors such as environmental conditions, resource quality, and logistical constraints. This study examines the effectiveness of quantilebased data binning on classical machine learning algorithms in predicting resource yields pertinent to military applications. Furthermore, the effectiveness of Backpropagation Artificial Neural Networks (BP-ANN) and Naive Bayes classifiers with regression models such as K-Nearest Neighbors (KNN), Linear Regression, and Multi-Layer Perceptron Regressors (MLPRegressor) are compared using a robust dataset representative of global resource metrics. The results indicate that binning continuous data into quartiles substantially enhances model accuracy, precision, recall, and computational efficiency. In particular, the binned data enables the BP-ANN to achieve an accuracy of approximately 90.4%, with regression models such as KNN and MLPRegressor outperforming this benchmark by attaining accuracies exceeding 93%. Additionally, binning drastically reduced hyperparameter tuning duration from around 149 minutes to less than 10 minutes, underscoring its computational efficiency advantage. Overall, this research demonstrates that quantile-based data binning is a valuable preprocessing technique that improves predictive accuracy, reduces computational cost, and enhances the reliability of classical machine learning models for military resource forecasting.

6A-4) Reconstructing Hyperspectral Images from RGB Using a Spectral-Informed Neural Network

Author Ryuna Kang (Kumoh National Institute of Technology, Republic of Korea), Zahyun Ku (Apex Microdevice, USA), Yunsang Kwak (Kumoh National Institute of Technology, Republic of Korea)

Abstract Hyperspectral imaging is a technology that captures rich spectral information across a wide range of wavelengths. However, its application in extreme environments is limited due to bulky hardware and a complex acquisition process. To address these limitations, this study proposes a network based on a spectral-informed neural network (SINN) that reconstructs high-dimensional hyperspectral images from standard RGB inputs. The proposed model predicts over 250 spectral bands within the visible range by applying spectral basis embedding and a neural network-based mapping structure. It also demonstrates strong generalization performance through training on real hyperspectral datasets. Experimental results show that the proposed SINN outperforms a baseline model in both quantitative metrics and spectral reconstruction accuracy. These findings validate the potential of SINN as a lightweight and interpretable solution for hyperspectral image recovery.

Oral Sessions

6A-5) Gradient Flow Bounds of Kullback-Leibler (KL)- Divergence in the Self-Attention Mechanism of Transformers

Author Woo Yong Lee, Keunyoung Kim (Electronics and Telecommunications Research Institute (ETRI), Republic of Korea)

Abstract The core of the Transformer technique lies in the structure called self-attention. This self-attention technique is a new mechanism that differentiates the Transformer from conventional neural network structures, and it has played a good role in the excellent practical performance. Existing studies interpret the operating principle of the transformer as a nonlinear transport equation that reflects the structure of the interacting particle system. Meanwhile, since the KullbackLeibler (KL) divergence is defined with the entropy, it plays a important role in the information transmission fields. In existing studies, it has been elucidated that the optimal transportation problem (OTP) can be related to the variational problem of finding the optimal channel for the optimal rate distortion and information transmission. This paper applies these existing research results to the self-attention mechanism, and analyzes the upper and lower bounds of the gradient flow of the KL divergence, which is closely related to it. In addition, we examine the difference between the lower and upper gradient flow bounds of the change in Weighted mean Softmax according to the inverse temperature in self-attention through a simple toy example. The difference between the boundaries values of Weighted mean Softmax is relatively small, so this will be sufficient to examine only the upper bound. This result is expected to be of good help in understanding and interpreting the self-attention mechanism, which is the core scheme of Transformers.

6A-6) DeepDGA Adversarial Machine Learning Model Tuned Domain Generation and Detection for Cyber Defence

Author Stanley Adiele Okolie, Donatus Onyedikachi Njoku, Janefrances Eberechukwu Jibiri, Rosemary Chinyere Okolie, Juliet Nnenna Odii, Emmanuel Somkelechi Ubalatu (Federal University of Technology, Nigeria)

Abstract The evolution of malware techniques has significantly challenged conventional cybersecurity defenses, with Domain Generation Algorithms (DGAs) emerging as a powerful tool for evading detection and ensuring persistence in malicious infrastructures. DGAs allow malware to algorithmically generate a large number of pseudo-random domain names, which are used to establish communication with command-and-control (C2) servers. Among the advancements of DeepDGA, is a Machine Learning (ML) framework which adopts Generative Adversarial Networks (GANs) to both generate realistic-looking domain names and improve detection mechanisms through adversarial training. This research focuses on the design, implementation, and evaluation of DeepDGA as a dual-purpose tool: first, as a generator of adversarial domains that mimic legitimate domain patterns to bypass detection systems, and second, to enhance the training of classifiers to better recognize and distinguish between benign and malicious domains. By leveraging GANs, DeepDGA consists of a generator network that creates domain names indistinguishable from legitimate ones, a discriminator, that attempts to classify them accurately. From the adversarial process, the components improve iteratively, resulting in a more resilient detection model. The paper employs a comprehensive methodology that includes dataset preprocessing, model training, evaluation using standard classification metrics, and comparative analysis with traditional DGA detection approaches. Real-world datasets such as Alexa's top domains and known DGA-generated domains are used to train and validate the model. The experimental results demonstrate that adversarial-trained models like DeepDGA not only generate highly realistic domain names but also significantly improve detection performance across multiple benchmarks.

Oral Session 9A : Advanced and Secure Communication Technologies

15:40-17:10 Tierra, Viento — Chair : Prof. In Soo Sohn (Dongguk University, Republic of Korea)

9A-1) Quantum Code-Assisted Entanglement Distillation Under Bit-Flip Noise

Author Huidan Zheng, Gunsik Min, Yujin Kang, Youshin Chung, Hyelin Kwak, Jun Heo (Korea University, Republic of Korea)

Abstract This paper investigates entanglement distillation protocols assisted by quantum codes under bit-flip noise. Three protocols are compared: repetition code in correction and detection modes, and the [[4,2,2]] code in detection mode. We derive output fidelity and success probability for each, showing that the detection-based repetition code achieves the highest fidelity, while the [[4,2,2]] code provides better success rates. These results illustrate trade-offs between fidelity and yield, and highlight the potential of quantum codes in realistic noisy channels.

9A-2) An Experimental Analysis of Several Variants of CASCADE Protocol for QKD

Author Heejeung Won, Jieun Ryu, Ju-Sung Kang, Yongjin Yeom (Kookmin University, Republic of Korea)

Abstract In a quantum key distribution (QKD) system, the shared secret, called sifted key between the participants may not match due to the inherent properties of the noisy quantum channel. Thus, error correction protocols are indispensable. CASCADE is one of the most popular (currently the standard) error correction protocol in QKD based on parity exchange followed by binary search. In this study, we compare four Trace-Back algorithms in CASCADE and experimentally analyze their efficiency. Up to QBER 5%, we recommend the variant, TraceBack2First, as the most optimized approach, and comparatively analyze its efficiency in terms of communication with CASCADE. Through experiments, we examine that TraceBack2First is effective in reducing communication passes and memory usage, and expect it to be applicable to commercial QKD systems.

9A-3) Pure Chain Enabled Access Control System for Fire Detection in Military Communications

Author Sium Bin Noor, Md Tayeb Adnan, Subroto Kumar Ghosh, Mohtasin Golam, Jae-Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Oral Sessions

Abstract Military fire detection requires both rapid identification of hazards and strict protection of sensitive images. This paper presents an integrated Pure Chain Enabled framework that unites real-time YOLOv11n fire detection, Advanced Encryption Standard with Galois Counter Mode (AES-GCM) encryption, decentralized off-chain storage, and blockChain Enabled access control. Upon detection, annotated frames are encrypted using AES-GCM . The ciphertext is stored in Interplanetary File System (IPFS), while only the resulting Content Identifier (CID) and base64 encoded symmetric key are recorded on a Pure Chain. Authorized personnel must be preregistered in the contract and a client-side barrier verifies contract deployment and prompts user confirmation before allowing decryption. Using Pure Chain's Proof of Authority and Association (PoA2) consensus, the system delivers confidential, tamper-proof alerts with subsecond consensus and minimal encryption overhead. Performance tests on a Pure Chain test network confirm realtime viability demonstrating low latency and robust auditability. This framework offers a scalable and secure solution for critical military alerting scenarios where data integrity, confidentiality, and rapid response are paramount.

9A-4) Blockchain-Integrated Circular Economy Framework for Maritime ICT Energy Materials

Author Paula Marielle Ababao, Ian B Benitez (FEU Institute of Technology, Philippines), Gabriel Avelino R Sampedro (University of the Philippines, Philippines)

Abstract This study proposes a Blockchain-Integrated Circular Economy Framework to improve lifecycle tracking and emissions reporting for maritime ICT and energy materials. The system combines Digital Product Passports, IoT telemetry, and smart contracts on a permissioned blockchain to record operational data and end-of-life events for batteries, photovoltaic modules, and navigation equipment. A parametric algorithm calculates emissions by combining production impacts, usage profiles, and recycling credits, while automated incentives promote material recovery. Synthetic data simulations illustrate the framework's ability to monitor degradation, quantify emissions, and enforce circularity incentives. Results indicate that production emissions dominate lifecycle impacts, highlighting the value of integrated tracking and verified recovery to support low-carbon maritime operations.

9A-5) Machine Learning Algorithms for Early Detection of Cybersecurity Threats

Author Donatus Onyedikachi Njoku, Stanley Adiele Okolie, Janefrances Eberechukwu Jibiri, Rosemary Chinyere Okolie, Vitalis Chibuike Iwuchukwu, Juliet Nnenna Odii (Federal University of Technology, Nigeria)

Abstract Intrusion detection in sensor networks presents significant challenges due to the constrained computational resources, high variability in data distribution, and ever-evolving nature of cyber threats. This paper presents a hybrid framework that combines Spectral Clustering's unsupervised power with a Deep Neural Network Ensemble's classification strength to improve intrusion detection performance in sensor-based infrastructures. Spectral clustering uncovers latent network traffic data, which are refined into an set of deep neural networks. The paper is evaluated using benchmark datasets, NSL-KDD and UNSWNB15, to validate its accuracy, precision, recall, F1-score, and AUC performance. The hybrid model outperforms traditional machine learning algorithms and deep learning models, achieving detection accuracy of 98.71% on the NSL-KDD dataset and 97.48% on the UNSW-NB15 dataset. It distinguishes between normal and malicious traffic with minimal false positives. The framework is scalable and adaptable, suitable for real-time and resource-constrained environments like industrial IoT systems and wireless sensor networks.

Poster Sessions

August 29 (Friday)

Poster Session 7C

13:00-14:00 Agua — Chair : Prof. Yonggang Kim (Kongju National University, Republic of Korea)

7C-1) A Study on Anticipatory Failure Determination (AFD) for Military Defense Systems

Author: Jung Hyeon Kim, Ik-Hyun Kwon, Da-Jung Lee (Kumoh National Institute of Technology, Republic of Korea)

Abstract: Recently, various local wars and full-scale wars have occurred all over the world, and each country is making various attempts to improve its military defense system. In particular, autonomous unmanned combat systems are emerging as key forces in the manned-unmanned military defense system. However, these systems face various possibilities of failure in a complex battlefield environment, and especially in the uncertain security environment of the future. To overcome these situations, traditional risk analysis is not sufficient. Therefore, this study proposes TRIZ's AFD (Anticipatory Failure Determination) as a practical and creative methodology that can actively explore and derive potential failure factors in advance and prevent them. In this paper, we have shown the applicability of the AFD methodology in military defense systems by using the cases of AFD-1 and AFD-2. In addition, a future study to maximize its effectiveness by actively combining scenario planning onto AFD-2 is proposed. It goes beyond simple risk analysis and provides a practical analysis framework.

7C-2) Military Microgrid Integration with Civilian Macrogrid Framework

Author: Eun Jeong Son, Jae Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract: Military installations are increasingly adopting microgrids with solar PV, ESS, and diesel generators to enhance resilience. This paper proposes a framework for integrating these systems with civilian macrogrids while preserving islanded operation. It addresses interoperability and cybersecurity challenges, leveraging standards like IEEE 1547, IEC 61850, IEEE 2030.5, and OpenADR. The framework includes automatic islanding and reconnection protocols, enabling secure and flexible grid interaction. Expected outcomes include improved military energy reliability, support for civilian grids, and policy insights for dualuse microgrid deployment.

7C-3) Design of an AI-Based Automated MOSA Compliance Evaluation Software

Author: Jae Woo Kim, Dong Seong Kim, Jae Min Lee (Kumoh National Institute of Technology, Republic of Korea)

Abstract: This paper proposes an AI-driven system that automates modular open system approach (MOSA) compliance evaluation in defence design documents. The proposed tool collects interface control documents, interface specifications, and drawings, applies natural language processing to extract standards, supplier references, and modular cues, performs diagram analysis to recover module topology, and runs a rule engine filled with MOSA-PART criteria and open architecture standards. Finally, the evaluation engine outputs MOSA compliance as a score along with traceable evidence.

7C-4) A Study on MOSA Assessment Criteria for Defense Weapon Systems

Author: Neulsom Lee, Jae Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract: As the defense weapon system developed into an integrated system, development requirements and system complexity increased, but new development and maintenance were carried out without a unified standard, resulting in a decrease in development and operation efficiency. The Modular Open Systems Approach (MOSA), a policy promoted by the U.S. Office of Defense, attempted to improve these problems and secure interoperability, scalability, and reusability of weapon systems through modular development. However, it is analyzed that the assessment criteria recommended by the policy are highly ambiguous, abstract and qualitative guidelines, and are difficult to use quantitatively. To prepare practical assessment criteria for the application of MOSA, this paper sought to integrate and quantify criteria by analyzing the U.S. MOSA Assessment Criteria Document and Assessment Tool (PART, Program Assessment and Review/Rating Tool).

7C-5) Optimizing Hub Location and Routing in a Physical Internet-Based Smart Military Logistics System

Author: Seungmin Lee, Jae Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract: The military is currently confronted with rising maintenance costs and workforce shortages due to population decline, which in turn delay logistical flows. In this context, the Physical Internet (PI) has been identified as a potential driver of future innovation in military logistics. This paper proposes a PIbased military logistics system in which multiple units can share warehouses and transportation assets efficiently, thereby achieving operational effectiveness and reducing overall operating costs. Key PI components—namely π-containers, πnodes, π-movers, and π-protocols—are incorporated, and an approach employing clustering techniques alongside an ant colony optimization (ACO) algorithm is presented to solve the dynamic location-routing problem.

7C-6) Challenges and Technologies for Physical Internet in Defense Logistics

Author: Youngjune Kwon, Jae Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract: Modern defense logistics faces complex challenges such as dispersed operational environments, intricate supply chain structures, cyber threats, and low efficiency, all of which demand fundamental innovation. In particular, delays or disruptions in logistics during wartime or crisis situations can lead directly to operational failure, highlighting the need for a logistics system that ensures both reliability and flexibility. As a potential solution to these limitations, the concept of the Physical Internet (PI), which applies digital internet principles to physical logistics, is gaining increasing attention. This paper explores the applicability of PI to defense logistics, focusing on key enabling technologies such as Artificial intelligence (AI)-based dynamic routing and demand forecasting, blockchain, and digital twin, and examines their potential to enhance traceability, security, and real-time responsiveness. Furthermore, it discusses Challenges and identifies critical challenges that must be addressed for the successful implementation of PI in defense logistics.

Poster Sessions

7C-7) Consortium Blockchain for Access Control on Military Logistics

Author Hee-Jae Shin, Jae-Min Lee, Dong-Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract This paper proposes a dynamic and secure access control framework that integrates a consortium blockchain and the InterPlanetary File System (IPFS), specifically designed for military logistics applications. While most prior research has focused on internal file-level security, this paper's approach dynamically governs network-level access by coordinating IPFS Swarm Key updates through blockchain consensus. Using permissioned smart contracts, the proposed system ensures that only authorized nodes can participate in the network, and former members are securely excluded. A prototype implementation validated the feasibility of this architecture in enforcing access restrictions. Future work will focus on deploying this framework on Hyperledger Fabric to enhance operational robustness and enterprise scalability.

7C-8) The Development of BIM-CIM System with Physics Engine for Simulation in Extreme Environments

Author Osoon Kwon, Hyoun Kang, Changjoo Shin (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea)

Abstract With the rapid digital transformation across industries, port construction is also embracing advanced technologies that integrate virtual simulations with real-world operations. This study presents the development of a virtual construction system for the installation of armor blocks, specifically tetrapod (TTP), one of the most critical and hazardous processes in port construction. By combining Building Information Modeling (BIM) and Construction Information Modeling (CIM) with physics simulation and 3D visualization, the system allows for pre-construction validation and post-construction safety evaluation. The simulation system is built using the BulletSharp physics engine and HelixToolkit for 3D rendering within a C# .NET framework. Eighteen standardized TTP models, ranging from 1 to 80 tons, are preloaded as resources, enabling interactive placement and dynamic behavior under realistic physical conditions. The system supports design input, construction simulation, object manipulation, and real-time feedback through an intuitive graphical interface. Moreover, a CIM module integrates GPS and video feed to assist in the accurate placement of TTPs during actual construction. The proposed system enhances the efficiency, accuracy, and safety of port construction processes and will be further refined through field application and parameter optimization.

Poster Session 8C

14:20-15:20 Agua — Chair : Engr. Wilfredo Romero (National University, Philippines)

8C-1) Adaptive 3D Underwater Acoustic Communication System Based on Multi-Modal Sensing

Author Hyeonggeol Kim, Yongtaek Woo, Yujae Song, Wongeol Ko (Yeungnam University, Republic of Korea)

Abstract We propose a cost-efficient underwater acoustic communication system combining a low-cost IMU and an acoustic modem with distance, Doppler, and channel-check capabilities. A hybrid EKF–PF algorithm improves AUV localization by mitigating IMU drift, while a pan–tilt unit enables adaptive beam alignment. Simulations and water-tank experiments confirm enhanced localization accuracy and communication reliability, demonstrating the system's scalability for underwater IoT applications.

8C-2) Sonar Micro-Doppler Signature Analysis for Diver Classification in Maritime Environments

Author Min Kim, Seungjae Baek, Hyoun Kang, Sungmin Koo, Doyoung Kim, Juhyun Kim, Jungmin Seo, Jaeho Choi (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea), Inoh Choi (Pukyong National University, Republic of Korea)

Abstract This work presents a micro-Doppler signature (MDS) analysis framework for classifying scuba divers using active sonar in maritime environments. By modeling the diver as a set of periodic scattering centers, the proposed system captures fin-kick-induced Doppler variations. Real-world data are collected using a custom-built Doppler sonar system. Signals undergo I/Q demodulation, notch filtering, and short-time Fourier transform (STFT) analysis. Cadence-velocity diagrams (CVDs) are used to highlight periodic motion. Six features—including Doppler bandwidth, stroke rate, and cadence entropy—are extracted and fed into a logistic regression classifier. Results confirm the feasibility of skill-level classification using underwater MDS.

8C-3) A Risk-Aware PI-Based Routing Model for Military Logistics

Author Heui kyeong Yang, Jae Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract This paper proposes a risk-averse Physical Internet (PI)-based military logistics routing model that dynamically searches for safe forwarding routes by calculating the allowable risk level according to asset importance and mission urgency. Existing systems mainly focus on shortest distance or cost minimization, but fail to reflect the operational risk or strategic value of assets. The proposed system calculates the allowable risk level for each asset based on the Asset Priority Score (APS) and Mission Urgency Score (MUS), and compares it with the Hub Risk Score to avoid high-risk sections and provide safe routes in real time. An adjustment cost matrix reflecting distance, risk, and priority is constructed and applied to the Stepping-Stone algorithm to simultaneously optimize the route and forwarding volume. This approach enhances both stability and flexibility of repatriation operations, establishing a tactical routing framework for military logistics.

8C-4) Intelligent Cooperative System for Clustered USV Environments Based on DDS

Author Junhye Baek, Jae Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Kore)

Poster Sessions

Abstract In recent maritime operations, centralized intrusion detection systems for clustered Unmanned Surface Vehicles (USVs) suffer from communication delays, scalability issues, and lack of cooperative detection. To overcome these limitations, this paper proposes a distributed intrusion detection system that integrates Graph Neural Network (GNN)-based anomaly detection with Data Distribution Service (DDS)-based real-time communication. Each USV independently analyzes its surroundings, computes anomaly scores through GNNs, and shares the results via DDS topics. This structure enables mutual verification and collaborative response among USVs, enhancing the reliability and responsiveness of the overall system.

8C-5) Development of a Tripod with Vertical-Stabilizing Anchors and One-Touch Wire Locking Devices for Deployment in Extreme Environments

Author Hyoun Kang, Sungmin Koo, Min Kim, Huicheol Shin, Seungjae Baek, Osoon Kwon (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea)

Abstract This study proposes a novel tripod system suitable for installation and operation in extreme environments. The proposed system includes a replaceable anchor capable of vertical stabilization and load distribution, as well as a one-touch wire locking and release device for adjusting the leg angles. The anchor can be selected and replaced according to varying ground conditions, enhancing adaptability in diverse terrains. The onetouch wire mechanism significantly improves ease of operation during both setup and disassembly. This system enables stable and rapid tripod deployment in a wide range of outdoor applications, including meteorological monitoring, environmental sensing, and military operations.

8C-6) Time-Synchronized WSN Routing Using Quick UDP Internet Connections for Defense IoT Systems

Author Shanley Valenzuela, Maria Sarah Althea Mata, Arianne Ranada, Jasmine Louise Uy, Marnel Peradilla (De La Salle University, Philippines), Gabriel Avelino R Sampedro (University of the Philippines, Philippines)

Abstract Wireless Sensor Networks (WSNs) are vital in modern defense operations. They enable ongoing surveillance, awareness of situations, and the exchange of crucial data in challenging or resource-limited environments. This work-inprogress introduces a time-synchronized routing protocol based on the Quick UDP Internet Connections (QUIC) protocol. This protocol provides a lightweight, secure alternative to TCP/UDP for tactical sensor networks. By incorporating synchronization logic directly into the routing process and using QUIC's lowlatency handshakes, stream multiplexing, and built-in encryption, the proposed system improves timing accuracy and delivery reliability while lowering energy use. Preliminary results obtained using ESP32 sensor nodes and a Raspberry Pi sink demonstrate reduced latency, synchronization offset, and packet delivery ratio. This demonstrates QUIC's effectiveness as a transport layer for resilient and efficient WSNs in defense applications.

8C-7) A Review of Advances in Rechargeable Seawater Batteries

Author Haeyoug Park, Sang Ki Jeong, Sungmin Koo (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea)

Abstract Lithium-ion batteries are widely used in energy storage systems due to their high reversible capacity and efficiency. However, when used in submersibles, lithium batteries pose a significant risk of explosion, and the absence of evacuation space can lead to serious casualties. Therefore, there is a need for alternative rechargeable battery systems that ensure greater safety in such environments. In this study, we investigate recent trends in seawater battery systems, which utilize abundantly available seawater as a resource and enable charge–discharge cycles through redox reactions.

8C-8) Dual-Band Shared Aperture Reflectarray Antenna for LEO Swarm Communication Systems

Author Salwa Salsabila, Bagas Satriyotomo (Hanbat National University, Republic of Korea), Dongho Lee (Mokpo National University, Republic of Korea), Seongmin Pyo (Hanbat National University, Republic of Korea)

Abstract This paper presents a reflectarray antenna featuring a reflection-type horn feed, designed to deliver enhanced radiation performance in both the Ku and Ka bands. The antenna employs a precisely engineered phase distribution across the reflectarray elements, enabling accurate control of beam direction and radiation pattern. Simulation results demonstrate realized gains of 16.88 dBi at Ku and 28.5 dBi at Ka band. The antenna exhibits excellent impedance matching, with a scattering parameter (S11) of -21.99 dB at 11.77 GHz and a bandwidth of 970 MHz (centered at 12 GHz). At 28 GHz, the antenna maintains low S11 values, indicating good impedance matching across a broad frequency range.

Poster Session 9C

15:40 - 17:10 Agua Chair : Prof. Taesoo Jun (Kumoh National Institute of Technology, Republic of Korea)

9C-1) A Digital Transceiver for 384/3072-FFT/IFFT OFDM of HomePlug Green Phy

Author Sunhee Kim (Sangmyung University, Republic of Korea), Yong-Seong Kim (Korea Electronics Technology Institute (KETI), Republic of Korea), Yongseok Lim (Bionever, Republic of Korea)

Abstract Although HomePlug Green Phy for smart grid applications was been adopted as a communication between plug-in electric vehicle and electric vehicle supply equipment by major auto manufactures, research on it is still insignificant. This paper proposes a digital transceiver for HPGP 384/3072point FFT/IFFT OFDM. Since it is a baseband transmission without frequency conversion, it produces real-valued OFDM symbols. Auto-correlator is used to detect a preamble and the boundary between the preamble and frame control. Time sync finds phase shift due to OFDM symbol timing mismatch and performs a reverse phase shift. This is modeled using python and verified to operate in a three-channel environment.

Poster Sessions

9C-2) Conditional Normalizing Flow for Acoustic Scene Generation

Author Eojin Kim, Yujeong Pak, Hyeonwoo Park, Chanjun Chun (Chosun University, Republic of Korea)

Abstract This paper addresses the task of acoustic scene generation conditioned on scene labels, by proposing a conditional normalizing flow (CNF) model. Built on a Glow-based architecture, the model injects one-hot condition vectors into every affine coupling layer to enable consistent, scene-aware generation of mel-spectrograms. We train the model on the TUT Acoustic Scenes 2017 dataset using five distinct scene classes, and evaluate the generated samples using a pre-trained scene classifier. The model achieves classification accuracy of up to 98%, confirming that it effectively reflects the target conditions. These results demonstrate the potential of flow-based conditional generation for acoustic scenes and other audio domains.

9C-3) Deep Learning-Based Cuffless Ambulatory Blood Pressure Monitoring from Multimodal Biosignals

Author Ari Kurniawan Saputra, Rae Hyun Jung, Ki Moo Lim (Kumoh National Institute of Technology, Republic of Korea)

Abstract Hypertension remains a significant global health burden, necessitating continuous and non-intrusive blood pressure monitoring. This study presents a wearable, cuffless ambulatory blood pressure monitoring (ABPM) system that estimates systolic and diastolic blood pressure in real-time using ECG, PPG, and PCG biosignals processed through a deep learning model. The system integrates a compact multi-sensor module and performs signal preprocessing, feature extraction, and regression-based prediction using a convolutional neural network. Preliminary experimental results demonstrated high predictive accuracy, meeting the British Hypertension Society (BHS) evaluation criteria, Association for the Advancement of Medical Instrumentation (AAMI), and IEEE. This approach offers a promising alternative to traditional cuff-based methods, enabling continuous, non-invasive blood pressure monitoring in everyday settings.

9C-4) Implementation of a Remote Noise Frequency DAQ System for Wide-Area Noise Analysis

Author Hyuntae Cho (Tongmyong University, Republic of Korea)

Abstract Modern individuals are increasingly exposed to excessive noise in their daily environments, resulting in issues such as stress, conflicts, aggression, and even violence. To address these problems effectively, platforms and services capable of fundamentally measuring and monitoring noise are essential. In this paper, we design and implement a Data Acquisition (DAQ) system to collect noise data across diverse areas and environments. The proposed system captures acoustic data via a microphone, calculates the sound pressure level, and analyzes the frequency characteristics of the collected noise. This processed data is then transmitted wirelessly to a cloud-based platform, where it is further managed and analyzed.

9C-5) Dynamic Relay Reassignment for Reliable V2V Content Precaching in Vehicular Ad-Hoc Networks

Author Jongpil Youn, Irina Em, Euisin Lee (Chungbuk National University, Republic of Korea)

Abstract The increasing data demands of autonomous driving and infotainment services have imposed significant challenges on traditional RSU-based delivery architectures. To address limited cache storage and coverage gaps in Roadside Unit (RSU) network, Vehicle-to-Vehicle (V2V) precaching has emerged as a promising solution. However, existing schemes assume static roles for relaying vehicles, often failing when a relay initiates its own content request. This leads to wasted cached content and delivery disruptions. In this study, we propose a dynamic relayto-requester reselection scheme that promptly detects role transitions and designates two new relays: one to complete the original delivery and another for the new requester. The RSU selects these vehicles by evaluating dwell time, connectivity duration, and precaching capacity. Simulation results under various content demand scenarios show that the proposed scheme significantly reduces content delivery latency and improves service continuity.

9C-6) Physics-Informed Deep Learning for Speckle Noise Reduction in OCT

Author Jaehan Joo, Suk Chan Kim (Pusan National University, Republic of Korea)

Abstract Optical Coherence Tomography (OCT) is a widely adopted imaging modality in ophthalmology, enabling highresolution visualization of retinal layers. However, OCT images are heavily affected by speckle noise, which deteriorates both image quality and interpretability. Conventional denoising techniques often blur anatomical boundaries or depend on handcrafted filters that fail to generalize. This work presents a deep learning-based denoising approach tailored for speckle noise in OCT, combining pixel-level supervision and physics-informed priors derived from the Rayleigh distribution. We train our model using only 10 B-scan images from the Duke dataset and evaluate it on 20 separate scans. Experimental results show that our approach achieves effective noise suppression while preserving structural integrity, with a model size of 31M parameters and inference latency of 27 ms per image.

9C-7) PAVES: a Vision System for Analyzing Public Emotional Responses to Mobile Virtual Reality in Public Environments

Author Ahyun Lee (Soonchunhyang University, Republic of Korea), SooYoung Jang (Hanbat National University, Republic of Korea)

Abstract As the use of Virtual Reality (VR) systems expands into public spaces, understanding bystander perception is critical for ensuring social acceptance. Traditional survey methods have clear limitations in capturing in-situ, instantaneous reactions. This paper proposes PAVES (Public Affect and Vision Evaluation System), a novel automated pipeline for the offline analysis of public emotional responses to individuals using VR devices in real-world environments. To maximize accuracy, PAVES integrates state-of-the-art deep learning models, adopting YOLOv12 for high-precision person detection, ByteTrack for robust multiobject tracking, and a DeepFace module with a RetinaFace backend for fine-grained facial attribute analysis. This research presents a system architecture for quantitatively analyzing public reactions to pervasive VR, offering a new methodological approach in Human-Computer Interaction (HCI).

Workshop Sessions

August 27 (Wednesday)

Workshop Session 1C : IWITC - Maritime Applications and Systems

13:00-14:30 Agua — Chair : Dr. Seungjae Baek (KIOST, Republic of Korea)

1C-1) Joint Optimization of Beam Control and Power Adaptation for Underwater Optical Wireless Communication

Author: Huicheol Shin, Seungjae Baek (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea)

Abstract: This paper proposes a deep reinforcement learning (DRL)-based adaptive control framework for underwater optical wireless communication (UOWC) systems operating under dynamic environmental conditions. The system is designed to support reliable and energy- efficient point-to-point communication between a seabed sensor and a mobile unmanned surface vehicle (USV). The proposed algorithm, termed two-phase three-agent DRL (TPTA-DRL), jointly optimizes beam orientation angle, beam divergence angle, and transmission power level using three dedicated DRL agents. Simulation results using real- world USV trajectory data demonstrate that the proposed TPTA-DRL approach significantly improves signal-to- noise ratio, link alignment probability, and energy efficiency compared to baseline methods. These findings suggest that TPTA-DRL algorithm is a scalable and practical solution for reliable UOWC deployment in complex marine environments.

1C-2) Investigation of Polarization Effects in Wireless Communication Systems Considering Snow-Laden Surfaces in Extreme Environments

Author: Jinkyu Bang, Seungjae Baek (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea), Jae Hee Kim (KOREATECH, Republic of Korea)

Abstract: This study analyzes the effects of multilayer ground reflections on wireless communication between an Autonomous Mobile Robot (AMR) and a base station in extreme environments. Snow-covered ground is modeled as a three-layer medium, and the reflection behavior is examined under vertical and horizontal polarization conditions. Using the Friis equation at 2.4 GHz, the impact of reflection-induced interference on received power is evaluated. Results show that horizontal polarization experiences greater interference due to phase reversal, while vertical polariza- tion provides more stable performance. The findings underscore the importance of selecting appropriate polarization for reliable LOS communication in snow-laden environments.

1C-3) Analysis Resources Utilization for AI

Author: Juhyun Kim, Sungmin Koo, Seungjae Baek (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea)

Abstract: With the growing adoption of artificial intelligence (AI) technologies in various maritime platforms including autonomous surface vessels, autonomous underwater vehicles (AUVs), and marine IoT buoys the importance of efficient hardware resource management is becoming increasingly critical, especially in constrained resource environments. This study aims to analyze how the structural characteristics of AI models affect the utilization of system resources in such constrained settings, particularly within maritime environments. We quantitatively measured the utilization of CPU, GPU, memory, and storage for four AI models CNN, GPT, AlexNet, and Diffusion. Experimental results reveal that the CNN model exhibited evenly distributed and relatively low resource usage, whereas the GPT model demonstrated strong dependence on GPU computational performance. AlexNet exhibited simultaneous bottlenecks in both storage and GPU, while the Diffusion model experienced complex resource bottlenecks across GPU, memory, and storage due to its repetitive computation and intermediate data saving. These findings highlight the limitations of conventional model selection practices that focus primarily on accuracy or efficiency, and emphasize the necessity of analyzing resource interactions and bottlenecks in advance for each model. Ultimately, the study underscores the importance of selecting and deploying models suited to resource conditions model selection and deployment strategies to ensure stable and reliable AI operations in environments with physical constraints, such as maritime environments.

1C-4) Internet of Extreme Things Platform for Remote Antarctic Climate Monitoring

Author: Sungmin Koo, Huicheol Shin, Seungjae Baek (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea)

Abstract: In this work, we introduce the implementation of a long-range wireless communication for remote Antarctic climate monitoring. Because each piece of equipment is installed in locations with limited access, our platform consists of an IoET device and a gateway for data collection, storage, and power control, and a large-capacity battery suitable for extreme environments. Each device can be powered on/off according to user requirements, enabling prolonged operation. The developed equipment is deployed at three control points: Jangbogo station, Mt. Melbourne, and Browning Pass. Each control point acts as a relay, transmitting data collected from nearby observation stations to the server at Jangbogo station. The communication distances between Browning Pass and Mt. Melbourne, and between Mt. Melbourne and Jangbogo station, are 50km and 35km, respectively. By establishing a reliable long-range communication network covering these distances, we demonstrate the feasibility of utilizing long-range wireless networks for IoET applications in Antarctica, thereby enhancing environmental monitoring and scientific research in challenging environments.

Workshop Sessions

1C-5) Anomaly Detection and Cooperative Control of USVs

Author Sang Ki Jeong, Jung Min Seo, Jea Ho Choi (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea)

Abstract This paper presents a study on anomaly detection and swarm control of unmanned surface vessels (USVs) for marine IoT platform applications. We propose an LSTM Autoencoder-based anomaly detection algorithm for fault diagnosis of propulsion systems and a rule-based swarm control algorithm that enables cooperative operation of multiple USVs. The anomaly detection algorithm learns normal vibration data to identify abnormal propeller conditions. The control algorithm redistributes thrust among functional propellers to maintain mission continuity. Field experiments and simulations demonstrate the system's effectiveness in harsh marine environments, improving reliability and safety.

1C-6) Preliminary Investigation of a Grey-Box Modeling Approach for Unmanned Surface Vehicle Dynamics

Author Hyunjoon Cho, Dae-hyeong Ji, Sunghyub Ko, Jong-Wu Hyeon (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea)

Abstract This study develops a grey-box system identification framework for unmanned surface vehicles (USVs), based on first-principle dynamic equations derived via the Newton–Euler approach. Given the characteristics of the USV selected as the identification target in this study, the dynamic equations are derived from first principles for a flat-bottom, low-speed vessel, with external disturbances modeled as input forces to enhance model fidelity. Under a series of reasonable assumptions, translational accelerations in the surge and sway directions, along with yaw angular acceleration, are decoupled and expressed as combinations of measurable variables and corresponding parameters. To support experimental implementation, a real-time variable measurement system is developed, along with a denoising technique to handle inherently noisy acceleration data. The feasibility of the proposed framework is verified through field experiments.

Workshop Session 1D : IWTBSTEC

13:00-14:30 Luna, Sol — Chair : Prof. Artem Lenskiy (UNSW at ADFA, Australia)

1D-1) Resilient Multi-Task Deep Learning for EV Infrastructure Anomaly Detection and Mitigation

Author Oluleke Babayomi, Dong-Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract Electric Vehicle (EV) charging infrastructure faces increasing cybersecurity threats that can compromise operational efficiency and stability. Existing techniques are limited by poor efficiency and limited mitigation solutions. Therefore, this paper addresses these challenges by a novel resilient multi-task deep learning framework that simultaneously predicts charging demand, detects cyber-attacks, and mitigates the impact of the attack to ensure trustworthy demand prediction. The proposed framework has three key components: LSTM autoencoder for anomaly detection, interpolation-based anomalous data mitigation to preserve temporal continuity, and multi-task learning via Long Short-Term Memory (LSTM) networks. The framework is validated on a real charging station dataset augmented with realistic anomalies including distributed denial of service and spoofing attacks cyber-anomalies. Experimental results show that our multi-task learning approach achieves superior performance compared to single-task models, with 20% improvement in volume prediction accuracy and 28.3% faster training time. Also, the integrated cyber-attack mitigation method produced trustworthy datasets that enhance prediction reliability with 8.3%, 4.8% and 4.4% improvements in MSE, MAE and R^2 metrics. The proposed architecture enables enhanced EV infrastructure planning, management, cybersecurity, response and recovery from malicious threats.

1D-2) A Structure-Based Data Migration Method for Heterogeneous DBMS in Defense Systems

Author Yejee Lee (LIG Nex1, Republic of Korea)

Abstract This paper proposes a mapping method based on structure to address consistency issues that may arise during data migration between heterogeneous databases operating in the defense sector. The table structure in the Oracle DB is referred to as Structure A, and the destination table in Microsoft SQL Server as Structure B. Data migration is performed through explicit field-to-field mapping. The proposed method ensures high-reliability migration by incorporating data type consistency checks between structures, field name mismatch detection, duplicate key insertion detection, string length overflow handling, and Open DataBase Connectivity-based query execution with error logging. The proposed method contributes to enhancing the stability and maintainability of the migration process through structural abstraction, and can be effectively applied in defense data environments where high data integrity and security are critical.

1D-3) Integration of Modular Open Systems Approach (MOSA) to Blockchain Systems

Author Ikechi Saviour Igboanusi. Dong-Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract This paper explores the integration of the Modular Open Systems Approach (MOSA) with blockchain technology. We delve into the core principles of MOSA and blockchain, highlighting their potential synergies. A system model for a MOSA-based blockchain is presented, detailing its key components and variations in network setup. Furthermore, the potential benefits of adopting a MOSA-based blockchain network are discussed, particularly in terms of network flexibility, broader adoption, and applications within military environments. The paper concludes with a summary of findings and outlines future research directions.

Workshop Sessions

Workshop Session 2C : IWITC - Advanced Wireless Systems

17:00-18:30 Agua — Chair : Dr. Sang Ki Jeong (KIOST, Republic of Korea)

2C-1) Metaheuristic Optimization for Joint Service Placement and Routing in 6G Networks

Author Doyoung Lee, Taeheum Na, Tae-Yeon Kim (Electronics and Telecommunications Research Institute (ETRI), Republic of Korea)

Abstract With the evolution of communication technologies toward the 6G network era, use cases that consider extremely dynamic environments and stringent performance requirements for supporting services are being envisioned. Additionally, the advancement of AI/ML technologies has accelerated the emergence of user-customized services, thereby renewing the need for jointly considering service placement and routing. To address this issue, AI/ML-based optimization methods have been widely studied. However, these approaches still face challenges such as acquiring training data, high operational costs, and data privacy concerns for model training. In this paper, a metaheuristic approach is proposed to tackle these problems, deriving optimal decisions for service placement and routing while reducing carbon emissions.

2C-2) RL-Based Adaptive Scheduling for Full-Duplex Multi-Hop FSOC in Smart Semiconductor Manufacturing

Author Siwoong Park (Electronics and Telecommunications Research Institute (ETRI), Republic of Korea), Ji-Soo Shin (Electronics and Telecommunications Research Institute (ETRI), Republic of Korea & Chonnam National University, Republic of Korea), Chan IL Yeo (Electronics and Telecommunications Research Institute (ETRI), Republic of Korea)

Abstract We present a novel reinforcement learning (RL)driven adaptive scheduling framework for full-duplex multihop free-space optical communication (FSOC) networks tailored to the operational complexities of smart semiconductor manufacturing. By directly integrating overhead hoist transport (OHT) mobility, burst traffic, and dynamic link constraints into a unified, parameterized model, our approach enables proactive, context-aware network optimization beyond conventional rule-based schemes. While large-scale simulations and experimental validation are left as future work, the proposed framework lays the groundwork for robust, largecapacity wireless connectivity under real-world industrial constraints, offering a strategic blueprint for practical deployment and further research. This work opens new directions for intelligent optical networking in advanced manufacturing, bridging the gap between theoretical design and practical implementation.

2C-3) Estimation of Elevation Angle for Low Altitude Maneuvering Target over the Sea Surface

Author Inoh Choi (Pukyong National University, Republic of Korea), Min Kim, Seungjae Baek (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea)

Abstract When an unknown target is maneuvering at low altitude over the sea surface, the radar echoes by direct path between passive array radar and the target are contaminated due to multi path signals reflected from the sea surface, leading to inaccurate estimation for the elevation angle of the target. To solve this problem, we propose a monopulse-based algorithm for the elevation angle estimation of a low altitude maneuvering target over the sea surface. Especially, the proposed method deterministically estimates the elevation angle despite use of a few array antennas, compared to the existing methods using multi-band or a lot of passive antennas. In simulations, our proposed method could perform accurate and efficient estimation for the elevation angle of a low altitude target over the sea surface.

2C-4) OTFS-Based OAM Communication for Multiuser Environments

Author Aye Yadanar Win, Merhawit Berhane Teklu, Yeon Ho Chung (Pukyong National University, Republic of Korea)

Abstract Orbital Angular Momentum (OAM) has emerged as a promising solution for increasing the system performance of optical wireless communication systems due to its ability to multiplex multiple orthogonal beams. However, modulation techniques combined with OAM, such as OFDM, suffer from inter-mode interference (IMI) and performance degradation in dynamic and dispersive channels. Recently, Orthogonal Time Frequency Space (OTFS) modulation has demonstrated robust performance against delay and Doppler spreads by operating in the delay-Doppler domain. In this paper, we propose the first framework that utilizes OAM multiplexing with OTFS modulation and multiuser interference suppression using Regularized zero-forcing detection for multiuser communication systems. We mathematically model the OAM-OTFS channel, analyze the system performance, and validate the advantages of the proposed scheme through numerical simulations. The results show significant improvements in bit error rate performance compared to the OAM-OFDM system.

2C-5) Indoor Positioning Algorithm Based on Distance Compensation Using k-NN in UWB Environment

Author Mookyung Jung (Goodmorning IT Company, Republic of Korea), Dong Myung Lee (Tongmyong University, Republic of Korea)

Abstract Indoor positioning accuracy significantly varies depending on whether the radio environment is line of sight (LOS) or non-line of sight (NLOS). Therefore, early detection of the wireless environment can improve positioning performance. Against this backdrop, this paper designs an indoor positioning algorithm based on distance compensation using k-nearest neighbors (k-NN) in an ultra-wideband (UWB) environment and analyzes the performance of the compensated coordinates. After training the proposed algorithm with a given dataset, we conducted performance experiments in an office and a building corridor, where NLOS and multipath propagation are likely to occur. This paper demonstrates that the proposed algorithm can sufficiently reduce positioning errors caused by NLOS and multipath propagation in indoor environments.

Workshop Sessions

August 28 (Thursday)

Workshop Session 3C : IWITC - AI and Machine Learning Innovations

10:30-12:00 Agua Chair : Prof. Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

3C-1) Hybrid Quantum-Classical Scheduling for Dynamic Resource Allocation in Physical Internet Hubs

Author Tran Hoa, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract This paper presents a hybrid quantum-classical scheduling framework for dynamic resource allocation in Physical Internet hubs. By integrating deep reinforcement learning with parameterized quantum circuits, the system optimizes task offloading across edge, classical fog, and quantum fog nodes. Simulation results on logistics tasks—AGV routing, bin packing, picking, and vehicle docking—demonstrate reduced energy consumption and latency. The proposed approach achieves efficient and scalable decision-making, highlighting the potential of quantum-enhanced computing for real-time logistics optimization in distributed fog environments

3C-2) PureEdge AI-Driven Scheduling for Failover Management in Edge Computing Systems

Author Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea), Syamsul Rizal (Telkom University, Indonesia)

Abstract This paper presents a comparative analysis of three scheduling methods— round-robin, energy-aware, and pure AIbased —focusing on failover time, switch time, request handling efficiency, energy efficiency, and load balancing in edge computing environments. The PureEdge AI-based method leverages machine learning to dynamically optimize scheduling decisions based on energy availability and system states. The simulation results demonstrate the effectiveness of the proposed AI-based method in reducing failure over time, balancing load distribution, and improving energy efficiency.

3C-3) Lightweight Hybrid Deep Learning Model with Digital Twin for Industrial Energy Optimization

Author Md Raihan Subhan, Md Mahinur Alam, Kanita Jerin Tanha, Taesoo Jun (Kumoh National Institute of Technology, Republic of Korea)

Abstract This paper introduces Energy-Twin, an integrated system that combines Digital Twin (DT) technology with Explainable Artificial Intelligence (XAI) to support energy prediction and optimization in industrial manufacturing environments. Using real-time data from the Gumi Industrial Complex, the system establishes a dynamic link between physical operations and their digital counterparts, enabling continuous monitoring and intelligent decision-making. At its core, the framework employs a hybrid deep learning architecture that integrates Convolutional Neural Networks (CNN), Gated Recurrent Units (GRU), and Bidirectional Long Short-Term Memory (BiLSTM) layers. This architecture is specifically designed to capture both spatial and temporal dependencies in energy consumption data, improving the accuracy of predictive modeling. The DT component simulates alternative operational scenarios in real time, identifying configurations that reduce energy usage without compromising production efficiency. XAI techniques are embedded to make the system's recommendations transparent and interpretable, fostering trust and usability for operators. Evaluation results show that Energy-Twin achieves a high prediction accuracy of 99.55% with low computational overhead, making it well-suited for deployment in resource-constrained industrial environments. The proposed approach offers a practical pathway to energyefficient and intelligent manufacturing under the Industry 5.0 framework.

3C-4) Generative Agents for Realistic Mobile Computing and User Behavior Case

Author George Chidera Akor, Love Allen Chijioke Ahakonye, Jae-Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract Realistic mobile user behaviour is essential for evaluating mobile systems, but traditional methods often lack context and adaptability. We explore using Large Language Models (LLMs) to simulate human-like mobile interactions by developing generative agents with defined personas and goals. These agents query Google's Gemini model within a discrete-time simulation environment to determine actions based on dynamic context. We compared LLM-powered agents against a random-action baseline across key metrics like location, activity, application usage, and charging patterns, using simulated 24-hour histories for student and office worker personas. Results show that LLMagents exhibit more plausible, goal-oriented behaviour that better aligns with persona expectations and real-world benchmarks. Despite some limitations, such as overestimated application usage, this work demonstrates the potential of LLM-powered agents for creating rich, context-aware mobile behaviour scenarios.

3C-5) RealAIGI: an Innovative Dataset for Enhanced Detection of Real and AI-Generated Images

Author Md Mahinur Alam, Kanita Jerin Tanha, Md Raihan Subhan, Taesoo Jun (Kumoh National Institute of Technology, Republic of Korea)

Abstract The rapid advancement of generative neural networks has facilitated the creation of photorealistic images, raising concerns about the proliferation of misinformation. Detecting AIgenerated fakes has become crucial, given their potential impact on public opinion and various sectors. This paper introduces RealAIGI, a novel dataset for real and AI-generated images, created using the advanced diffusion transformer model Sora. We demonstrate the applicability of this dataset through comprehensive evaluations, showing its effectiveness in AI-generated image detection. The dataset was tested using CNN and ViT models, achieving remarkable performance against benchmark datasets IEEE VIP Cup and DE-FAKE. Our results show that the dataset enhances detection accuracy and robustness, offering significant improvements over existing datasets.

Workshop Sessions

Workshop Session 4B : IWC3ET I

13:30-15:00 Viento — Chair : Prof. Paula Marielle Ababao (FEU Institute of Technology Philippines)

4B-1) Volatile Compound Identification of Traditional Filipino Alcoholic Beverages Through Electronic Nose with KNN Algorithm

Author: Chris B. Domingo, Ealiezerr Andrei E. Ladia, John Paul T Cruz (Mapua University, Philippines)

Abstract: This study presents the development of an electronic nose (E-Nose) system for the identification and classification of volatile compounds in traditional Filipino alcoholic beverages—Basi, Bignay, Lambanog, and Tapuy. The system employs a gas sensor array (MQ3, MQ6, MQ8, MQ135, and MQ136) and utilizes the K-Nearest Neighbors (KNN) algorithm with Principal Component Analysis (PCA) for classification and dimensionality reduction. The experimental process consists of three phases: absorption, data acquisition, and desorption. A total of 1,125 training samples and 125 testing samples were used, evenly distributed across all classes. The model achieved an accuracy of 94%, demonstrating its effectiveness in distinguishing between the beverages. This work supports efforts in quality control, standardization, and cultural preservation of cultural Filipino-made wine through a low-cost, sensor-based solution.

4B-2) Crystal Classification Using CNN with Microscopy and Fluorescence UV Light Test

Author: Clark M Felix, Marc E Endaya, Meo Vincent Caya (Mapua University, Philippines)

Abstract: Over the years, quartz has been sought for its beauty and versatility, yet people often mischaracterize it from other types of crystals. This study classifies three types of quartz: Rose, Clear, and Citrine, implementing Mask R-CNN (Mask Region-based Convolutional Neural Network) to detect inclusions using a digital microscope with up to 1000x magnification. A Raspberry Pi 4 is used to process and analyze the captured images. Fluorescence UV light are utilized to highlight inclusions, while Microscopy will be used along with VGG-19 architecture serves as the second test to classify quartz based on extracted features. The system aims to enhance quartz classification accuracy, benefiting gemology, mineralogy, and the jewelry industry, while also laying a foundation for future machine learning-driven mineral identification studies.

4B-3) Identification of Indigenous Vegetables in the Philippines Using Convolutional Neural Network and Transfer Learning

Author: Vinz G. Bequilla, Altaire Faith C. Española, Jocelyn Villaverde (Mapua University, Philippines)

Abstract: Classification procedures for Philippine indigenous vegetables are crucial for nutritional diversity and local sustainability. However, recognition of such vegetables is still insufficient in modern agricultural and technological systems. This study presents the implementation of a machine learning classification system utilizing transfer learning and Convolutional Neural Network (CNN), specifically the MobileNetV2 architecture, deployed on a Raspberry Pi 4 Model B. The device captures and identifies five indigenous vegetables, namely the Alukon, Bagbagkong, Kamangeg, Lagikway, and Tapilan, using the Raspberry Pi Camera Module 3. The device displays the vegetable's name, description, and suggested recipes on the mounted 7-inch touchscreen display. The dataset consists of 2,500 preprocessed and data-augmented images, divided into training, validation, and testing sets using an 80:10:10 split. The model achieved an overall accuracy of 98% as indicated on the confusion matrix.

4B-4) IoT-Integrated Machine Learning Model for Analyzing Temperature, pH, and Turbidity Effects on Catfish Growth in Bandung Techno Park Pond

Author: Divany Maulidyna Putri, Rr Meidita Thifal Lelyta, Devan Ramadhana, Nyoman Karna, Danu Dwi Sanjoyo (Telkom University, Indonesia), Dewa Rahyuni (Universitas Padjajaran, Indonesia)

Abstract: The decline in catfish production in Bandung Regency is influenced by fluctuations in water quality, particularly in temperature, turbidity, and pH levels. This study presents an IoT- and machine learning-based system designed to analyze these impacts. Data was collected over 30 days using IoT devices equipped with temperature, turbidity, and pH sensors, integrated with an ESP32 microcontroller for real-time data transmission to Firebase. After preprocessing, K-Means clustering was used to categorize water conditions into three groups: most optimized, optimized, and moderately optimized. K-Means outperformed Agglomerative Clustering, achieving a Silhouette Score of 0.670 and a Davies-Bouldin Score of 0.407. The most optimized cluster, observed in Pond 1, demonstrated ideal conditions for catfish growth. These findings underscore the potential of IoT and machine learning for real-time water quality monitoring and support sustainable aquaculture practices.

Workshop Session 4C : IWITC - Emerging Technologies in Military IoT and 6G

13:30-15:00 Agua — Chair : Prof. Jae Min Lee (Kumoh National Institute of Technology, Republic of Korea)

4C-1) SoldierCare: Blockchain-Enabled IoMT Framework for Real-Time Health Monitoring and Cyberattack Detection in Tactical Environments

Author: Chigozie Athanasius Nnadiekwe, Collins Izuchukwu Okafor, Ikechi Saviour Igboanusi, Jae-Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract SoldierCare is a real-time, blockchain-enabled Internet of Medical Things (IoMT) framework designed to enhance military personnel safety through integrated health monitoring and cyberattack detection. The system employs a hybrid Convolutional Neural Network–Long Short-Term Memory (CNNLSTM) model trained on the WUSTL-EHMS-2020 dataset, combining physiological sensor data and network traffic to identify both health anomalies and malicious activities with high accuracy. A smart contract-enabled Ethereum blockchain ensures the integrity and traceability of alerts by immutably logging metadata, while detailed data is stored off-chain in IPFS to reduce on-chain overhead. The architecture supports edge deployment, enabling low-latency inference and autonomous operation in mission-critical environments. Experimental results demonstrate a detection accuracy of 98.6%, with efficient scaling and minimal false detections. Optimizations such as transaction batching enhance blockchain performance under increasing load. SoldierCare represents a secure, scalable solution that fuses AI, fog computing, and blockchain to provide resilient operational support in dynamic battlefield scenarios.

4C-2) Hybrid Quantum Machine Learning for Detecting GPS Spoofing Attacks in Military Mission

Author Esmot Ara Tuli, Mohtasin Golam, Mehedi Hasan, Raneem Khafagy, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract The integration of the internet of things (IoT) into military applications, including sensors embedded in soldier uniforms, drones, and weapons, has brought about significant advancements in operational efficiency and battlefield intelligence. However, this increased network connectivity has also introduced new vulnerabilities, making military networks susceptible to cyber-attacks. These threats pose substantial risks to the conf identiality, integrity, and availability of critical military systems. In response to these challenges, this paper proposes a novel hybrid quantum machine learning-based framework to detect GPS spoofing for the military internet of things (MIoT). Our model leverages the strengths of both quantum computing and classical machine learning to enhance the security and efficiency of spoofing detection in a noisy intermediate-scale quantum computer (NISQ). To reduce complexity and enhance model performance, this work employs ANOVA F-test-based feature reduction technique to select relevant features. Proposed model effectly detect GPS spoofing attacks with a minimal number of features. The results of our proposed model demonstrate exceptional performance, achieving an accuracy of 88%. Therefore, our model offers a robust and effective security solution, capable of safeguarding critical military networks like MIoT from evolving cyber threats, making it a valuable tool for enhancing the resilience of military infrastructures against attacks.

4C-3) RIS Phase Error Estimation Method for RIS-Aided Wireless Systems

Author Sumin Jeong (Kumoh National Institute of Technology, Repubilc of Korea)

Abstract Reconfigurable Intelligent Surfaces (RIS) have recently attracted significant attention for their ability to enhance wireless communication systems through low-cost, passive signal reflection. However, practical deployment faces critical challenges, particularly in the presence of RIS phase errors caused by hardware limitations, environmental factors, and coarse quantization. In this work, we investigate the impact of RIS phase errors on the performance of channel estimation and propose a novel joint estimation algorithm that simultaneously estimates both RIS-induced phase distortions and the wireless channel. The proposed algorithm leverages impulsive pilot signaling and RIS reflection pattern diversity to isolate and correct per-element phase errors, thereby improving the accuracy of channel estimation. Simulation results demonstrate that the proposed approach significantly enhances estimation performance, particularly under high signal-to-noise ratio (SNR) conditions and with a large number of RIS elements. Furthermore, the results reveal that compensating RIS phase errors mitigates their negative impact on channel estimation quality. While the current method is developed under a single-input single-output (SISO) framework, it can be extended to multiple-input multiple-output (MIMO) systems in future work, with additional focus on pilot efficiency and scalability.

4C-4) Performance Analysis of Post-Quantum Cryptography for Military Communications

Author Mehedi Hasan, Esmot Ara Tuli, Jae Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract As quantum computing poses a growing threat to traditional encryption methods, securing military communications requires quantum-safe solutions. This paper presents a comparative analysis of CRYSTALS-Dilithium, a post-quantum signature technique, specifically for military use. Here, we used f ive sample messages to analyse the performance of classical and post-quantum cryptographic algorithms for data security. While AES-256 is efficient for data encryption in classical systems, Dilithium provides superior protection against quantum threats with lower latency, making it the preferred choice for military communications that require both long-term resilience and immediate security.

4C-5) Transformer-Based Node Selection for Enhanced Military Communication Capacity in CoMP Networks Under Rayleigh Fading Channels

Author Won Jae Ryu, Jae Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract Coordinated Multipoint (CoMP) transmission has become critically important for enhancing military communication systems by improving network capacity, reliability, and operational coverage through collaboration among multiple base stations (BSs). In complex battlefield scenarios characterized by severe channel uncertainties such as Rayleigh fading, identifying the optimal nodes for communication remains challenging. This paper proposes a novel node selection strategy using Transformer-encoder models specifically tailored for military communication environments, facilitating effective decisionmaking regarding the optimal transmission nodes among overlapping users served by four cooperating BSs. Through rigorous simulations under realistic Rayleigh fading conditions, the proposed Transformer-based solution demonstrates significantly higher sum capacity and improved performance compared to conventional Multi-Layer Perceptron (MLP)-based approaches. Our results illustrate that Transformer architectures can substantially enhance the sum capacity and adaptability of military communication networks by accurately modeling complex dependencies and dynamic battlefield conditions, highlighting their strong potential for future tactical communication systems.

Workshop Sessions

Workshop Session 5B : IW3CET II

15:20-16:50 Viento — Chair : Dr. Roben Juantias (National University, Philippines)

5B-1) Steel Pipes Classification and Size Detection in Bundles with Rejection System Using YOLOv8

Author: Janna Mae Manjares, Genesis Gabriel B. Tongson, Analyn Yumang (Mapua University, Philippines)

Abstract: This study introduces an AI-based system for automating steel pipe classification and size detection using YOLOv8 and OpenCV on a Raspberry Pi 4. It identifies pipe types, measures diameters, and flags mismatched bundles to streamline inventory checks. Trained on 1,050 images of three pipe types in six sizes, the system uses Canny Edge Detection for precise measurements and features a user-friendly display. Confusion matrix results show strong performance, with minor misclassifications. The prototype highlights the potential of realtime deep learning to enhance industrial accuracy and efficiency.

5B-2) Tilapia Fish Freshness Identification Using Bioelectrical Impedance Spectroscopy and Support Vector Machine

Author: James Mikolai N Salazar, Willie Kyle A Saragcon, Carlos Hortinela IV, Janette C. Fausto (Mapua University, Philippines)

Abstract: Preserving the freshness of fish is essential for food safety and quality assurance. Traditional freshness evaluation methods rely on subjective human assessment, which is prone to errors and inconsistencies. This study shows a way to check the freshness of Nile tilapia (Oreochromis niloticus) by using bioelectrical impedance spectroscopy (BIS) and support vector machine (SVM). Two hundred fish samples were examined, with impedance data collected over 12 hours using an AD5933EBZ, Raspberry Pi 4, and Arduino Nano. The moisture level of the fish served as a standard for assessing freshness. Experiments showed that the proposed system could tell the difference between fresh and non-fresh samples with 85% accuracy and 81.82% precision. The study shows that BIS and SVM are good for quickly and objectively fish freshness.

5B-3) Classification of Root Crops: Tuber and Tuberous Root Identification Using YOLOv9

Author: Giancarlo B. Clavo de Comer, Abdurahman M Moxsir, Jocelyn Villaverde (Mapua University, Philippines)

Abstract: In recent years, deep learning algorithms have seen significant development and application in agriculture as a means to optimize classification processes. This study aims to utilize the YOLOv9 object detection model to classify four types of root crops consisting of Igorota (potato), Ube (yam), Kamoteng Kahoy (cassava), and Taro (gabi) into two categories: tubers and tuberous roots. The system was implemented on a Raspberry Pi 4 microcontroller integrated with a camera module and display, forming a handheld classification device. A dataset of approximately 1,200 images, sourced from local markets and online references, was used for training and evaluation. The YOLOv9 algorithm was applied to detect and classify the visual characteristics of the crops in real time. After evaluating the system using a confusion matrix, the model achieved a classification accuracy of 85.63% from 174 test samples. The system's precision-recall curve analysis demonstrated reliable detection performance, further validating the model's classification capability. These findings highlight the potential of the system to accurately identify different types of root crops, which may be applied in agricultural quality control, crop sorting, and smart agriculture solutions.

5B-4) Development of a Road Defect Detection and Classification System via Object Recognition Using YOLOv8

Author: Analyn Yumang, Jizelle Sophia Y Del Barrio, Aaron Joseph R Yu (Mapua University, Philippines)

Abstract: In the Philippines, manual road surveys are still time-consuming and labor-intensive, which makes automated road condition monitoring necessary. This study introduces a road defect detection and classification system that utilizes a Raspberry Pi 5, a Global Positioning System (GPS) module, and a camera module, employing You Only Look Once, version 8 (YOLOv8) for edge-based analysis of road environments. The system addresses three problems outlined by the Department of Public Works and Highways (DPWH), these are shoving and corrugation, faded road markings, and open manholes. The model was trained and evaluated using a dataset of 900 annotated photos, 300 for each class. The model achieved a precision of 0.815, recall of 0.798, Mean Average Precision (mAP50) of 0.854, and mAP50–95 of 0.587. The system's performance is measured by its accuracy, resulting in 73.68% after the system's predictions during testing.

Workshop Session 5C : IWITC - Secure Frameworks for Military Operations

15:20-16:50 Agua — Chair : Prof. Taesoo Jun (Kumoh National Institute of Technology, Republic of Korea)

5C-1) LLM4AV: Hybrid LSTM-RAG Framework for Fault-Tolerant Decision-Making in Simulated AV Corner Cases

Author: Raneem Khafagy, Esmot Ara Tuli, Jae Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract: Autonomous vehicles (AVs) require robust faulttolerant systems for safe mission-critical operation. This paper presents a Long Short-Term Memory (LSTM)-based fault detector integrated with a Retrieval-Augmented Generation (RAG)based Large Language Model (LLM) agent for AV decisionmaking. The LSTM model detects anomalies in LiDAR data, while the RAG–LLM agent proposes safe actions using contextual retrieval of traffic rules. Evaluated in the CARLA simulator, the system demonstrated effective fault detection and decisionmaking under simulated sensor faults and corner cases. Results show a fault detection precision of 0.92, recall of 0.87, and F1 score of 0.89. The RAG–LLM agent achieved a rule compliance rate of 94.7%, with the system maintaining an average safety margin of 3.95 meters. The results validate the framework's potential applicability in more complex, real-world AV environments.

Workshop Sessions

5C-2) MilChain-UAV: a Blockchain-Based UAV Network Traffic Control Framework for Military Operations

Author Hope Leticia Nakayiza, Love Allen Chijioke Ahakonye, Dong Seong Kim, Jae Min Lee (Kumoh National Institute of Technology, Republic of Korea)

Abstract The growing deployment of unmanned aerial vehicles (UAVs) in military operations necessitates a secure, scalable, and decentralized approach to airspace management. This paper introduces MilChain-UAV, a blockchain-based traffic control framework tailored for military UAV networks. Built on PureChain, a custom permissioned blockchain network, MilChain-UAV supports autonomous mission governance, realtime path validation, and decentralized collision avoidance. To optimize blockchain efficiency while ensuring auditability, telemetry data is stored off-chain using IPFS, with only the cryptographic hashes anchored on-chain. By replacing centralized controllers with a distributed ledger, the framework enhances resilience against jamming and spoofing while enabling dynamic routing and verifiable behavior logging. Experimentation results demonstrate MilChain-UAV's effectiveness in improving efficiency and scalability in critical military operations, providing a robust solution for autonomous and secure management of military UAV traffic.

5C-3) Pure Chain Integrated AI Framework for Health Risk Monitoring of Military Personnel

Author Subroto Kumar Ghosh, Mohtasin Golam, Md Tayeb Adnan, Sium Bin Noor, Muhammad Sannan Khaliq, Jae-Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract Military personnel must remain in strong physical and mental health to carry out their duties. However, many chronic diseases like diabetes can develop silently over time. If detected early, the risk can often be managed with changes in routine, diet, or medication. Yet early detection relies on access to health data, and for military applications, that data is often sensitive and highly confidential. Most AI systems that predict health risks do not include strong privacy safeguards or consent control. This paper presents a secure health monitoring system designed specifically for military environments. The system combines AI with blockchain to ensure privacy, transparency, and individual control. It uses Pure Chain to manage access permissions through smart contracts. Military personnel must explicitly grant consent before their data is used for analysis. The health data, stored securely through IPFS, is only shared with the AI model after consent is confirmed. The AI model predicts health risks. Once a prediction is made, the result is sent securely to the respective personnel through a Flask-based backend. This way, the system maintains privacy while enabling timely health warnings. The model achieved 90.13% accuracy in cross-validation, 82.89% test accuracy, and an AUC of 0.90, showing strong potential for realworld deployment.

5C-4) The Purechain Blockchain Network: an Overview

Author Dong Seong Kim, Ikechi Saviour Igboanusi, George Chidera Akor (Kumoh National Institute of Technology, Republic of Korea)

Abstract This paper presents a comprehensive overview of the Purechain blockchain network, a novel architecture specifically engineered for enhanced efficiency, robust security, and optimized resource utilization within permissioned blockchain environments. We delve into its core design principles, detailing the synergistic combination of its primary architectural features that contribute to overall network stability and performance. The paper further analyzes key network performance characteristics, supported by evaluation insights, and contextualizes Purechain's applicability for demanding enterprise and Industrial Internet of Things (IIoT) sectors. The aim is to provide an in-depth understanding of the Purechain network's architecture, its operational advantages, and its potential impact on practical blockchain deployments.

August 29 (Friday)

Workshop Session 6B : IWMCA & ISMOT Joint Workshop

10:00-11:30 Viento — Chair : Sungtek Kahng (Incheon National University, Republic of Korea)

6B-1) Millimeter-Wave High-Gain Metamaterial Lens Antennas Mountable on the Aircraft

Author Woogon Kim, Sanghyun Yun, Bae Jinwoo, Jaewon Koh, Seongbu Seo, Sungtek Kahng (Incheon National University, Republic of Korea)

Abstract For aircraft-to-satellite communication, a new antenna is designed. This gives high directivity required for the link with satellites and size-reduction for the airborne platforms, which is enabled by a metamaterial lens converging the EM wave from the source antenna. The source antenna and its metamaterial lens are realized for a frequency band aimed at satellite communication. The antenna shows the gain of around 20 dBi as a flat and small structure.

6B-2) Deep Learning Programs Applied to Check the Anomaly in the Geometry of the 6G Antenna

Author Bae Jinwoo, Sanghyun Yun, Woogon Kim, Jaewon Koh, Hongsik Park, Sungtek Kahng (Incheon National University, Republic of Korea)

Abstract This paper talks about a measure to hinder people from wasting resources of developing the wireless communication system by applying deep learning approaches. As the array antenna is essential but costly to the 6G mobile communication device, no single flaw is not allowed in its manufacturing as well as design, which leads them to checking a flaw or some in its geometry. A measure is taken to comb through the pixels of the array antenna and will tell you attributes of the physical error interpreted by the deep learning algorithms. The electromagnetic characteristics will entail the information of the classes of the defects. An 8-by-8 array working for 28 GHz is taken an instance of and the corresponding far-field patterns will be presented with technical comments.

Workshop Sessions

Workshop Session 6C : IWITC - Intelligent Security and Software Systems

10:00-11:30 Agua — Chair : Dr. Irish C. Juantas (FEU Diliman, Philippines)

6C-1) Image Rearrangement for Fast on-Drone Tiny Object Detection

Author: Hyeonji Hong, Chanyoung Oh (Kongju National University, Republic of Korea)

Abstract: Although commercial networks such as LTE and 5G have seen significant improvements, they sometimes face challenges in providing reliable, low-latency links between high-altitude platforms, such as autonomous drones, and remote servers as they are primarily designed for terrestrial use. As a result, on-drone object detection becomes necessary, but the limited computational capacity of typical mission computers makes real-time inference infeasible. Moreover, the inference latency of state-ofthe-art deep-learning detectors is determined solely by the input resolution, irrespective of scene content; this produces severe inefficiencies when targets occupy only a small portion of each drone-captured image frame. To address these challenges, this paper presents imagerearrangement techniques that automatically extract RoIs from each frame and re-tiles them into a compact, highdensity layout so as to reduce overall computation. With our evaluation on a drone-captured image dataset, we achieve substantial speedups up to 4.86× while maintaining detection accuracy.

6C-2) Mitigating DDoS Attacks in the Internet of Military Things with Explainable Machine Learning-Based Intrusion Detection System

Author: Odinachi Udemezuo Nwankwo, Simeon Okechukwu Ajakwe, Dong Seong Kim, Jae Min Lee (Kumoh National Institute of Technology, Republic of Korea)

Abstract: The growing use of Internet of Military Things (IoMT) devices has improved battlefield intelligence, especially in Joint All Domain Command and Control (JADC2), but also introduced vulnerabilities to cyber threats like Distributed Denial of Service (DDoS), malware, and enumeration attacks, which disrupt mission-critical communications. This paper presents an explainable artificial intelligence (AI)-based network intrusion detection system (NIDS) to detect and mitigate DDoS and malware attacks in IoMT environments. The system uses a machine learning model, specifically a Random Forest classifier trained on the Edge-IIoTset Cyber Security dataset, improved with class imbalance correction, and incorporates SHapley Additive exPlanations (SHAP) and Local Interpretable Modelagnostic Explanations (LIME) for transparent and local model explainability. Experimental results show the model distinguishes between normal, DDoS traffic, and malware attacks, making the solution suitable for deployment in tactical networks.

6C-3) Internal Threats to Deepfake Detectors: a Weight Tampering Scenario on MesoNet

Author: Seo-Ah Myeong, Yonggang Kim (Kongju National University, Republic of Korea)

Abstract: With the advancement of deepfake technologies, Albased detection systems have emerged as essential tools for verifying content authenticity across various domains, including journalism, social media, and digital forensics. However, existing research has primarily focused on adversarial attacks that manipulate input data or model architectures, while threats involving direct manipulation of a model's internal parameters have received comparatively little attention. This study presents a weight tampering attack scenario that targets MesoNet [1], a lightweight convolutional neural network (CNN) designed for deepfake detection, by covertly modifying the weights of its internal Dense (fully connected) layers. Our experimental results demonstrate that, under conditions where the inputs remain visually indistinguishable (LPIPS = 0.0), the detection performance can degrade by up to 0.507, thereby disrupting the model's decision-making without altering the input image. In particular, dense layers adjacent to the final classification stage play a crucial role in interpreting high-level visual features such as texture, structure, and edges. Even minimal changes to the parameters in these layers can significantly distort the detection output, allowing visually normal images to evade detection or induce misclassification. Although demonstrated on Meso4, the proposed approach may be applicable to other CNNbased detectors with similar architectural traits. By empirically verifying the feasibility of silently undermining a detector's internal trust mechanism, this research highlights a structural vulnerability inherent in current deepfake detection systems. It further suggests that, to ensure the long-term robustness of Albased detection systems, security design should move toward protecting and verifying internal parameters within tamperresistant, isolated environments.

6C-4) Quantum-Resistant Cryptography for Underwater Acoustic Channels Using CRYSTALS-Kyber and SPHINCS+

Author: Collins Izuchukwu Okafor, Love Allen Chijioke Ahakonye, Dong Seong Kim, Jae Min Lee (Kumoh National Institute of Technology, Republic of Korea)

Abstract: Secure underwater communication is vital for maritime operations; however, acoustic channels pose significant challenges, including limited bandwidth, high latency, and complex propagation effects. With quantum computing threatening classical methods, there is a need for cryptographic schemes that can withstand quantum attacks. This study presents a quantum-resistant underwater communication system that integrates CRYSTALS-Kyber for key encapsulation, SPHINCS+ for digital signature authentication, and AES for efficient payload encryption. The proposed system is evaluated under realistic underwater channel simulations that account for propagation delay, multipath fading, and Doppler effects. Experimental benchmarks reveal that while post-quantum operations, such as CRYSTALS-Kyber key encapsulation (2.41–4.91ms) and SPHINCS+ signing (96.10ms) exhibit higher latencies compared to classical ECC/ECDSA methods, these latencies remain within acceptable limits given the substantial security advantages they offer. This approach bridges the gap between rigorous quantumresistant security and practical underwater deployment, establishing a robust foundation for future enhancements in error correction and adaptive network strategies.

Workshop Sessions

6C-5) Code Smell of a Blockchain App with Static Analysis: a PureWallet Case Study

Author Ebuka Chinaechetam Nkoro, George Chidera Akor, Collins Izuchukwu Okafor, Jae-Min Lee, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract Within blockchain innovation and software engineering, a single line of code can determine the security fate of a digital wallet. This paper presents a comprehensive static analysis of Pure Wallet's offline token service server, a proprietary blockchain wallet designed to secure digital assets. Integrating automated scanning via SonarQube with meticulous manual reviews, our study examines over 3,000 lines of Go code to reveal subtle design inefficiencies and code smells that may compromise long-term maintainability. Although our analysis found no critical bugs or security vulnerabilities, full coverage and further scanning by the static analyzer is expedient. Our experimental findings present a balanced approach to code quality and security, combining rigorous static analysis to secure blockchain applications like Pure Wallet against future threats.

6C-6) ConnectivePro: Development of Events and Membership Management System for Professional Organizations

Author Roben Antalan Juanatas, Wilfredo M Romero, Charity Mary Arevalo (National University, Philippines)

Abstract In any organizations, managing events and memberships are complex and time-consuming especially when the organization is dealing with many chapters or regions. Traditional methods of manual record keeping, spreadsheets, and paper-based systems often lead to inefficiencies, errors, and difficulties in maintaining accurate and up-to-date information. Most of the organizations are still using traditional methods or utilize two different applications to do separate tasks which heightens the financial liability of the organizations. This study aims to focus on creating a web application called ConnectivePro with the goal of easing organizational tasks by combining membership and event management system into one application to lessen the hassle. The study used systematic approach and adheres to the organized and systematic steps of the Agile Model. Organizations, especially professional organizations, will benefit from this application as it will manage all the processes and ease their work by using one application to do all the work that is required in managing an organization.

Virtual Sessions

August 30 (Saturday)

Virtual Session 10D

09:00-10:30 Luna — Chair : Dr. Hea Sook Park (ETRI, Republic of Korea)

10D-1) Fixed-Point Based IMU Pre-Integration for Accelerating ORB-SLAM 3

Author Michael C Akor, Heoncheol Lee (Kumoh National Institute of Technology, Republic of Korea)

Abstract While most SLAM acceleration research targets feature extraction and backend optimization, the IMU preintegration module in ORB-SLAM3 remains an overlooked performance bottleneck for real-time visual-inertial SLAM on embedded platforms. We present the first hardware-ready, fixedpoint C++ kernel for this module, achieving strict algorithmic equivalence and seamless high-level synthesis integration. Experiments on EuRoC MAV and TUM VI datasets demonstrate up to 8.2× speedup on desktop and 5.5× on ARM, with accuracy preserved within MEMS IMU noise. Our results reveal a promising and previously neglected avenue for practical SLAM acceleration on constrained hardware.

10D-2) Efficient Offloading for Edge Computing in UAV-Assisted Maritime Networks

Author Thanh Phung Truong, Tung Son Do, Juyoung Kim, Junsuk Oh, Sungrae Cho (Chung-Ang University, Republic of Korea)

Abstract This paper investigates the problem of delay-efficient task execution in UAV-assisted maritime networks. In the proposed system, unmanned aerial vehicles (UAVs) are deployed to collect and process computational tasks, either locally or by offloading them to ocean beacon stations (OBSs) equipped with edge computing resources. To minimize the total task execution time while satisfying energy and resource constraints, we formulate a joint optimization problem over offloading ratios, transmit power, and UAV–OBS association. Due to the nonconvexity and mixed-variable nature of the problem, a deep reinforcement learning (DRL) framework based on the Deep Deterministic Policy Gradient (DDPG) algorithm is proposed to learn optimal decision policies. Simulation results demonstrate that the proposed approach significantly reduces execution delay compared to baseline methods, highlighting its effectiveness in dynamic and resource-limited maritime environments.

10D-3) Chase-OSD Hybrid Decoding of Block Turbo Codes for Mobile Communications

Author Jaeyong Son (SK Hynix, Republic of Korea), Borami Kim (KRPIA, Republic of Korea)

Abstract In this paper, we propose two hybrid decoding strategies that dynamically switch between Chase and ordered-statistic decoding (OSD) decoders during block turbo code (BTC) decoding. The proposed schemes switch between two decoders based on criteria such as the number of distinct codewords or the Hamming distance between hard-decision inputs and decoded outputs at the Chase decoding stage. Numerical results demonstrate that our methods achieve BER performance close to pure OSDbased BTCs with 40% lower complexity through an adaptive switching mechanism that balances performance and computational efficiency.

10D-4) Application of IOT in Aquaponics System for Automatic Monitoring and Maintenance of Fish Ponds and Hydroponics

Author Wineu Putri Setiana, Nazwa Nurazizah Zain, Firscha Aulia Ghassani Fikri, Rr. Nurrizka Puspa Wiranti, Nyoman Karna and Yulinda Eliskar (Telkom University, Indonesia)

Abstract Indonesia faces challenges in aquaculture and agriculture due to land limitations, water scarcity, and declining interest among the younger generation. Aquaponics offers an alternative by combining fish and plant cultivation in a closed, resource-efficient ecosystem. This study presents an IoT-based aquaponics system that monitors and controls pH, water level, temperature, and light intensity, and includes real-time plant monitoring and automated fish feeding via a mobile app. Experimental results show reliable sensor performance with 6.75%–13.60% error margins. The system effectively supported Brassica rapa var. chinensis growth, especially under semioutdoor conditions. These findings highlight the system's potential for scalable smart farming in educational and commercial settings.

10D-5) A Study on Acquisition Procedures for Unmanned Systems Based on K-MOSA

Author Min-Gyu Kim, Chibuzo Nwabufo Okwuosa, Jang-Wook Hur (Kumoh National Institute of Technology, Republic of Korea)

Abstract As unmanned platforms gain traction in the defense sector, open architecture-based acquisition strategies are becoming essential for efficient development and operation. South Korea's K-MOSA (Korea Modular Open System Architecture) aims to enhance flexibility and reduce lifecycle costs through modular design and standardized interfaces, supporting interoperability and future upgrades. However, K-MOSA's practical application has revealed shortcomings, particularly in linking early design stages with quality assurance and testing. The U.S. Navy's DDG-1000 program illustrates this issue, where adopting MOSA without sufficient technology maturity led to design risks, maintenance complexity, and cost overruns—emphasizing the need for early interface definition and QA integration. To improve K-MOSA's effectiveness, integrating QA processes from the outset, adopting phased development based on technology readiness, and establishing a unified testing system are critical.

Virtual Sessions

Virtual Session 10E

09:00-10:30 Sol Chair : Prof. Sumin Jeong (Kumoh National Institute of Technology, Republic of Korea)

10E-1) Optimizing Federated Learning on Non-IID Data with Cosine Similarity-Driven Client Selection and Retraining

Author Tesfahunegn Minwuyelet Mengistu, Taewoon Kim (Pusan National University, Republic of Korea)

Abstract In federated learning, addressing the challenges stemming from non-IID data distributions, such as model bias and slow convergence, is prioritized over those in traditional machine learning. This study introduces an approach that combines cosine similarity-based client selection with retraining epochs to optimize the learning process in non-IID data distribution scenarios. Through evaluation, the proposed model has demonstrated a 93.00% improvement in accuracy in the CIFAR-10 data set. Empirical findings reveal that the proposed method reaches an accuracy of 66.20%, significantly exceeding the accuracy of 34.30% achieved by random selection. In addition, it improves communication efficiency, robustness, and convergence smoothness compared to conventional random selection.

10E-2) Hybrid Multi-Objective UAV Deployment for Energy-Efficient Routing of Military FANETs Through Monarch Butterfly Optimization

Author Simeon Okechukwu Ajakwe, Dong Seong Kim (Kumoh National Institute of Technology, Republic of Korea)

Abstract In this paper, we present an energy-aware strategy for Unmanned Aerial Vehicle (UAV) deployment in military Flying Ad Hoc Networks (FANETs), aimed at enhancing network longevity and reducing communication energy costs in missioncritical operations. We propose a novel hybrid framework that combines the Monarch Butterfly Optimization (MBO) algorithm with an enhanced Low-Energy Adaptive Clustering Hierarchy (LEACH) protocol to optimize UAV positioning and routing efficiency. Unlike existing methods that rely on static or heuristicbased placement, our MBO-driven approach dynamically determines UAV hover points to minimize overall transmission energy while ensuring robust ground-to-air connectivity. Through extensive simulations in a realistic battlefield model, our method achieves up to 45% energy savings over traditional schemes and maintains higher residual energy with fewer node failures. These results highlight the potential of biologically inspired optimization for strategic UAV deployments in military communication scenarios.

10E-3) Polarization-Selective Multiplexing Metasurface Using OAM Interleaving

Author Kattupalayam Chandiran Karthick, Merhawit Berhane Teklu, Yeon Ho Ho Chung (Pukyong National University, Republic of Korea)

Abstract We propose a passive complex-amplitude metasurface for high-capacity vectorial holography, which enables secure and scalable optical communication by independently modulating Ex and Ey through interleaved orbital angular momentum (OAM) modes and polarization states. Utilizing a geometry-based lookup table, the metasurface encodes distinct holograms for each polarization. Preliminary results demonstrate an improved bit error rate with higher signal-to-noise ratio, conf irming the robustness of this approach. This work represents a novel integration of OAM and polarization multiplexing through passive complex-amplitude modulation, offering a high-capacity and noise-tolerant solution for scalable optical communication systems.

10E-4) IoT-Based Disaster Management System in Response Stage: Application of the Port Alert System for Seismic Events

Author Jihye Seo (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea), Deokhee Won (Halla University, Republic of Korea), Woo-sun Park (Korea Institute of Ocean Science and Technology (KIOST), Republic of Korea)

Abstract The Ministry of Oceans and Fisheries (MOF) in Korea established the Port Alert System for Seismic Response (PASS) in 2018 to enhance the nation's capacity to respond to earthquakes and tsunamis affecting major trade ports. PASS serves as a core platform for intelligent situational management during seismic events by enabling the rapid dissemination of critical information for situational assessment and decisionmaking. Through this system, quick and effective responses to earthquake emergencies in port environments are made possible. This paper provides an overview of the smart disaster management system for Korean ports and presents the main developments in response-stage management based on PASS.

Virtual Sessions

Virtual Session 11D

10:50 - 12:20 Luna Chair : Prof. Yonggang Kim (Kongju National University, Republic of Korea)

11D-1) A DDPG-Based Secure OAM-Multiplexed Underwater Optical Wireless Communication

Author Fayshal Ahmed, Yeon Ho Ho Chung (Pukyong National University, Republic of Korea)

Abstract We propose a secure, high-capacity, and adaptive underwater optical wireless communication (UOWC) framework that integrates Orbital Angular Momentum (OAM) multiplexing, E91 Quantum Key Distribution (QKD), and Deep Deterministic Policy Gradient (DDPG). This unified DDPG-UOQNet system addresses key underwater challenges, including dynamic channel distortion, bandwidth limitations, and physical-layer security by combining spatial OAM multiplexing, quantum entanglement, and continuous control. The architecture incorporates quantum dot-based (QDs) OAM photon sources, Micro-ElectricalMechanical-System (MEMS) beam steering, and SPAD detectors. Simulations demonstrate that our method outperforms traditional and learning-based baselines in QBER reduction, throughput, and energy efficiency.

11D-2) Data Redistribution Algorithm Using Reconfigurable Metasurfaces Under Occlusion Situations

Author Young Jae Moon, Yeon Ho Ho Chung (Pukyong National University, Republic of Korea)

Abstract Communication using vortex-structured beams with orbital angular momentum (OAM) has influenced increasing attention, benefitting from the unique property of OAM modes being orthogonal. This feature offers high potential compared to traditional optical systems, theoretically covering an infinite user base. Moreover, when OAM is combined with holography, the system significantly improves transmission capacity by precisely manipulating vortex beam intensity, phase, and polarization with metasurfaces. Still, OAM-based holographic systems that operate in the visible light spectrum are vulnerable to occlusion, distorting visual integrity and transmission efficiency when exposed. To address this challenge, adaptive grid reconstruction using a preloaded intensity lookup table (ILUT) was previously considered. Still, addressing the data redistribution to unblocked metasurface areas has not yet been presented. This paper demonstrates our resilient data redistribution algorithm tailored for occlusion scenarios with a fallback lookup table (DRLUT).

11D-3) Autoencoder Assisted Channel Adaptation for CSK-OFDM

Author Jae Yeong Ryu, Young Jin Cho, Yeon Ho Ho Chung (Pukyong National University, Republic of Korea)

Abstract Color Shift Keying (CSK), a modulation technique designed to improve the efficiency of visible light communication (VLC), is typically based on linear mapping and reconstruction. This paper proposes a nonlinear approach using an autoencoder to better cope with light interference and channel fluctuations, which VLC systems are particularly vulnerable to. Additionally, a CSK-OFDM based MIMO transmission technique is studied to construct a VLC system capable of achieving data rates in the Mbps range.

Travel Information

We are pleased to welcome all participants to the upcoming international conference held in Cebu, Philippines — one of the country's most vibrant cultural and travel destinations.
Cebu is renowned for its rich historical heritage, stunning tropical beaches, and dynamic urban attractions. As the oldest city in the Philippines, it offers a unique blend of colonial architecture, modern infrastructure, and natural wonders. Delegates are encouraged to take this opportunity to explore some of Cebu's notable sites, including Magellan's Cross, Basilica Minore del Santo Niño, Kawasan Falls, Temple of Leah, and the surrounding Mactan Island resorts.

Magellan's Cross

Magellan's Cross is one of the most famous historical landmarks in Cebu City. Housed in an octagonal pavilion made up of adobe and red tiles, many tourists have regularly visited the cross. It is located in front of the Cebu City Hall, near the Basilica Minore Del Sto. Nino at Magallanes Street is named after Magellan. It was erected on April 21, 1521, shortly after Magellan's expedition landed in Cebu. It commemorates the first baptism in the Philippines, including that of Rajah Humabon, Queen Juana, and around 800 of their subjects. The cross back then was believed to have miraculous healing power, so the people started to take pieces of it until it began to fall apart. The government, who was aware of the incident, built another wooden cross made from tindalo to enclose the original cross and protect it. However, it was rumored that the cross encased inside the tindalo wood is nothing, but a replica planted there by the Spaniards who came after Magellan's death. The original cross was said to have been stolen or destroyed after Magellan passed away.

Fort San Pedro

Fort San Pedro situated at A. Pigafetta Street, Cebu City, is the oldest and smallest fort in the Philippines and is one of the city's pride. Lying in Plaza Independencia in the pier area of Cebu, the fort holds a rich history of the island and the historical events during the Spanish rule. Built by Spanish conqueror Miguel Lopez de Legaspi, it served as an army base in the early 17th century. The Filipinos then took over the fort and turned it into their own stronghold during the Philippine revolution. Fuerza de San Pedro is a triangular bastion fort. Its two sides are fronting the sea, and the other edge is facing the land where the entrance to the fort is located. You can see cannons installed on the sides facing the sea, while a sturdy fence made of wood is placed in front.

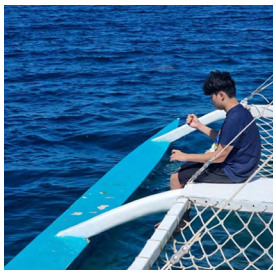
Santo Niño Cathedral

The Basílica Minore del Santo Niño de Cebú, alternatively known as the The Minor Basilica of the The Holy Child or simply The Santo Niño Basilica, is a minor basilica in Cebu City in the Philippines that was founded in 1565 by Fray Andrés de Urdaneta and Fray Diego de Herrera. It is the oldest Roman Catholic church in the country, allegedly built on the spot where the image of the Santo Niño de Cebú was found during the expedition of Miguel López de Legazpi. In 1565, Miguel Lopez de Legazpi called Basilica Minore Del Sto. Niño as San Agustin Church. The exact location of the church is the same spot where Legazpi's Spaniard troupe discovered the image of Sto. Niño. It was thought to be the gift of Ferdinand Magellan to Queen Juana, the wife of Rajah Humabon, as a sign of their allegiance and over forty years of their baptism to Christianity.

Travel Information

Hopping Tour

A must-see course for your Cebu trip
Take a traditional Philippine wooden boat, 'Bangka Boat', and enjoy the beautiful sea of Cebu while traversing the sea. Snorkeling in a marine protected area with beautiful corals and colorful tropical fish. For lunch, enjoy a delicious special barbecue meal made with a local secret recipe.




Sunset Tour

End your trip to Cebu, the beautiful island nation of the Philippines, with a romantic sunset romantic tour.
The emerald sea far away on the horizon turning red in the sunset is like a painting.
Enjoy this beautiful and wonderful moment while listening to music flowing gently in the middle of the sea.
We hope you create romantic memories by sharing stories you haven't told your loved one at this moment.

Simple Schedule
[15:30~16:00] Depart from the pier and move to San Vicente while listening to music
[16:00~17:30] Stop at San Vicente and watch the sunset
[17:30~18:00] Move to the pier and arrive

Contact point for details of Cebu City Tour

Contact point for details of Cebu City Tour

Unit 403B PDI Condominium, Archbishop Reyes Ave., Corner J. Panis St., Banilad, Cebu City TEL 63 32 253 2824

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