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ICMIC 2024

The 3rd International Conference on Mobile, Military, and Maritime IT Convergence

"Supporting the Harmonious Convergence of Mobile, Military, and Maritime"

Final Program

Date August 7 (Wed) ~ 9 (Fri), 2024

Venue Concorde Hotel Kuala Lumpur, Malaysia

Organized by KICS The Korean Institute of Communications and Information Sciences; UTM Universiti Teknologi Malaysia

Technically Co-Sponsored by IEICE Communications Society

Patrons KIOST; IITP Institute of Information & Communications Technology Planning & Evaluation; Palantir Technologies; Hanwha Systems; LIG Nex1; PIOLINK; NS LAB Networked Systems Laboratory; JY System (주)제이와이시스템; MET-SOLUTIONS

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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 2024 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.

Greetings

Messages from the General Co-Chairs of ICMIC 2024

It is with great pleasure and honor that I welcome you to the 2024 International Conference on M3 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.

This year marks a significant milestone in the history of our conference. As can be noted in the conference title (M3), we have introduced three new 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 this expansion will serve as an excellent platform for even stronger growth. As such, we have received more than 130 papers from researchers and practitioners worldwide, reflecting the breadth and depth of interest and expertise in these critical domains.

Additionally, we are excited to announce that, for the first time, we are hosting the conference here in Malaysia, outside of Korea. This move represents our commitment to fostering a truly international dialogue and collaboration. Our chosen venue provides a unique setting that we hope will inspire fruitful discussions and 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 Malaysian 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 Kuala Lumpur.

Warm regards,

General Co-chair of ICMIC 2024
Prof. Yeon Ho Chung

First and foremost, I extend my sincere gratitude to all of you for participating in ICMIC 2024. This is the 3rd international conference held this year, following the successful events in previous years. It holds great significance as it focuses on mobile, military, and maritime IT convergence and aims to introduce and share the latest technologies in the related IT field.

We extend our heartfelt gratitude to the Korean Institute of Communications and Information Sciences (KICS). We are truly honored to host this prestigious event and are immensely grateful for the opportunity to collaborate with KICS, its esteemed committee, and dedicated members.

We are delighted to announce that this marks the 1st ICMIC conference outside Korea.

During the conference, a total of about 100 papers will be presented, accompanied by keynote speeches delivered by three distinguished foreign experts in both on-site and virtual sessions.

ICMIC 2024 is a dynamic international conference organized collaboratively by the The Korean Institute of Communications and Information Sciences (KICS), the largest academic institute in the field of ICT in Korea.

Furthermore, we are committed to elevating ICMIC to an even higher level, and we hope that all participants in this event will continue to collaborate and contribute to its development.

Over the course of three days, from 7-9 August, we gather in Concorde Hotel KL, the beautiful city of Malaysia. I wish you all fruitful discussions, achievements, and opportunities to rejuvenate.

Warm regards,

General Co-chair of ICMIC 2024
Prof. Sevia M. Idrus

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- Norliza Mohammad (Universiti Teknologi Malaysia, Malaysia)
- Aduwati Sali (Universiti Putra Malaysia)

Program at a Glance

August 7, 2024 (Wednesday)			
08:00-17:00	Preparation, Registration, and Networking | 1F		
Room	Concorde Ballroom	Gallery I	Gallery II
08:30-10:00	**Oral Session 1A** • Maritime/Underwater Communication Technology	**Oral Session 1B** • 5G/6G, LTE, LTE-Advanced Communications I	**IAC/SC/OC Meeting**
10:00-10:20	Coffee Break		
10:20-10:40	*Chair: Prof. Taesoo Jun (Kumoh National Institute of Technology, Korea)* **Opening Address** | Concorde Ballroom Prof. Yeon Ho Chung General Co-Chair | Pukyong National University, Korea **Congratulatory address** | Concorde Ballroom Prof. Seong-Ho Jeong President of KICS | Hankuk University of Foreign Studies, Korea		
10:40-11:10	*Chair: Prof. Dong Seong Kim (Kumoh National Institute of Technology, Korea)* **Keynote Address 1** | Concorde Ballroom Data platform for Military ICT Convergence: Trend and Opportunities Executive Director, Joseph Lee Palantir Technologies		
11:10-11:40	*Chair: Prof. Yeon Ho Chung (Pukyong National University, Korea)* **Keynote Address 2** | Concorde Ballroom Open RAN: Pathway from 5G to 6G Prof. Tony Q.S. Quek Singapore University of Technology and Design (SUTD)		
12:00-13:20	Lunch Break		
13:20-14:50	**Oral Session 2A** • Artificial Intelligence, Machine Learning, and Pattern Awareness I	**Oral Session 2B** • 5G/6G, LTE, LTE-Advanced Communications II	**IAC/SC/OC Meeting**
14:50-15:10	Coffee Break		
15:10-16:40	**Oral Session 3A** • Artificial Intelligence, Machine Learning, and Pattern Awareness II	**Oral Session 3B** • 5G/6G, LTE, LTE-Advanced Communications III	**IAC/SC/OC Meeting**
16:40-16:50	Break		
16:50-18:20	**Oral Session 4A** • Artificial Intelligence, Machine Learning, and Pattern Awareness III	**Oral Session 4B** • Maritime Applications and Transportation Systems	**IAC/SC/OC Meeting**
August 8, 2024 (Thursday)			
08:00-17:00	Preparation, Registration, and Networking | 1F		
Room	Concorde Ballroom	Gallery I	Gallery II
08:30-10:00	**Oral Session 5A** • Maritime Internet of Things	**Oral Session 5B** • Advanced Communication Systems and Networks I	**IAC/SC/OC Meeting**
10:00-10:20	Coffee Break		
10:20-10:40	*Chair: Prof. Dong Seong Kim (Kumoh National Institute of Technology, Korea)* **Invited Talk** | Concorde Ballroom Introduction of IITP and ICT R&D plans in the defense sector Dr. Lee Jin Seok Director of Defense ICT Planning Team, IITP		
10:40-11:10	*Chair: Prof. Sevia M Idrus (Universiti Teknologi Malaysia, Malaysia)* **Keynote Address 3** | Concorde Ballroom Connecting the unconnected: MY Journey Dr. Ahmad Nasruddin 'Atiqullah Malaysian Communications and Multimedia Commission		

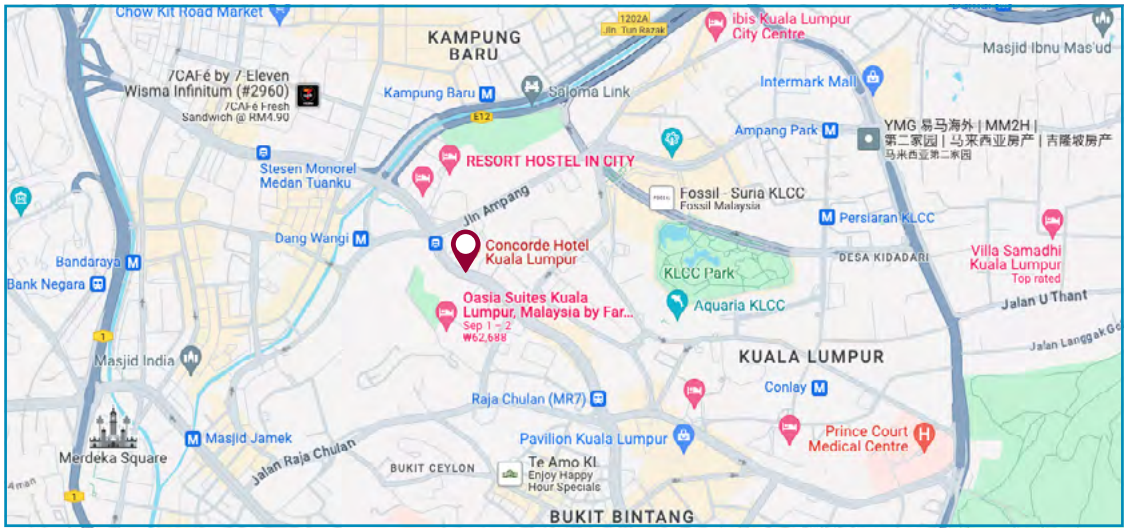
Program at a Glance

11:10-11:40	*Chair: Prof. Trio Adiono (Bandung Institute of Technology, Indonesia)* **Keynote Address 4** | Concorde Ballroom Malaysia's First Oil and Gas Enterprise 5G Deployment : A Success Story Dr. M Zurix Mohamed Custodian Instrument & Control Group Technical Solution PETRONAS		
12:00-13:20	Lunch Break		
13:20-14:50	**Oral Session 6A** • Civil-Military ICT Convergence & System I	**Oral Session 6B** • Advanced Communication Systems and Networks II	**IAC/SC/OC Meeting**
14:50-15:10	Coffee Break		
15:10-16:40	**Oral Session 7A** • Civil-Military ICT Convergence & System II	**Oral Session 7B** • Optical Communication Technology I	**IAC/SC/OC Meeting**
16:40-16:50	Break		
16:50-18:20	**Oral Session 8A** • Civil-Military ICT Convergence & System III	**Oral Session 8B** • Optical Communication Technology II	**Poster Session | Lobby**
18:20-18:30	Break		
18:30-20:30	*Chair: Dr. Wan Hafiza Wan Hassan (Universiti Malaysia Terengganu, Malaysia)* *Dr. Muhammad Yusof Mohd Noor (Universiti Teknologi Malaysia, Malaysia)* • Banquet | Concorde Ballroom V		
August 9, 2024 (Friday)			
08:00-11:00	Preparation, Registration, and Networking | 1F		
Room	Concorde Ballroom	Gallery I	Gallery II
08:30-10:00			**Oral Session 9C** • Blockchain and security for ICT convergence
10:00-10:20	Coffee Break		
10:20-11:50			**Oral Session 10C** • Big data and its applications

Venue and Conference Room Map

Venue

The Concorde Hotel Kuala Lumpur is an internationally renowned business-class hotel in Kuala Lumpur, Malaysia. The Concorde Hotel Kuala Lumpur is located in in the heart of Kuala Lumpur's Golden Triangle, and offers convenience to the city's commercial, shopping, and entertainment hub.



Concorde Hotel Kuala Lumpur
Address: 2 Jalan Sultan Ismail, 50250 Kuala Lumpur, Malaysia
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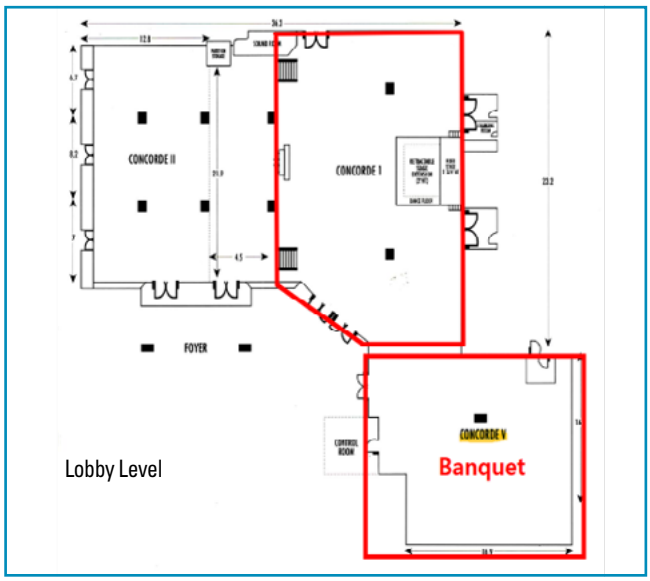
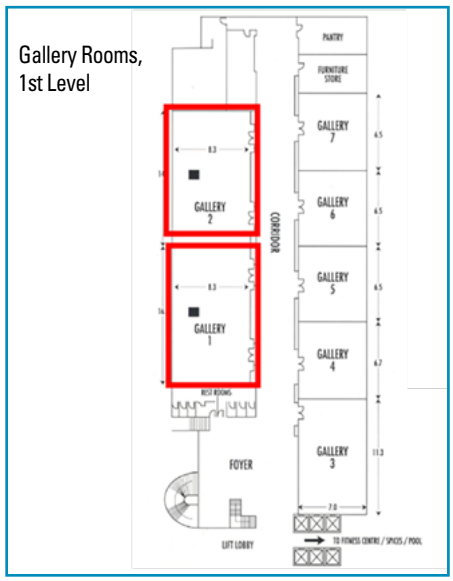
Web : https://kualalumpur.concordehotelsresorts.com/

Conference Room Map



Lobby Level



Gallery Rooms, 1st Level

Keynote Addresses

August 07 (Wednesday)

Keynote Address 1

10:50-11:30 Concorde Ballroom Chair : Prof. Dong Seong Kim (Kumoh National Institute of Technology, Korea)

Data platform for Military ICT Convergence: Trend and Opportunities

Speaker Executive Director, Joseph Lee
Palantir Technologies

Abstract The Asia-Pacific Director of Palantir is set to deliver a keynote speech at a conference on the application of AI technology in defense. He will emphasize how AI can significantly enhance military operations through intelligent systems and autonomous decision-making. Furthermore, AI enables enhanced strategic decision-making through data analysis and predictive modeling, as well as real-time communication and response capabilities in complex combat situations. This is expected to not only strengthen defense capabilities but also contribute to international stability and security.

Bio

- Executive Director, International Operations Division, Palantir Technologies
- Manager in charge of KF-X Project Contracts, Korea Aerospace Industries
- Lieutenant at the Ministry of National Defense, Department of Defense Policy, International Peace Cooperation Division, and UN Exchange Division
- Master of Business Administration, HEC Paris
- Master of Public Policy, Sciences Po Paris
- Bachelor of Law and Bachelor of Business Administration, Korea University

Keynote Address 2

11:30-12:10 Concorde Ballroom Chair : Prof. Yeon Ho Chung (Pukyong National University, Korea)

Open RAN: Pathway from 5G to 6G

Speaker Prof. Tony Q.S. Quek
Singapore University of Technology and Design (SUTD)

Abstract Today, mobile network operators source their entire radio access network (RAN) from one supplier or use multiple suppliers in different geographic areas. One of the key characteristics of Open RAN is to allow RAN components from different suppliers to be interoperable through open interfaces. Furthermore, Open RAN also allows the splitting/disaggregating of different network functions and the cloudification and virtualisation of network functions. While Open RAN is still at the early stage of development and deployment for 5G networks, there is nevertheless potential that it can be a fundamental part of 6G. In this talk, we will provide an overview of Open RAN and the pathway towards 6G. In addition, we will share Singapore's first national Future Communications Research and Development Programme (FCP) to jumpstart cutting-edge communications and connectivity research, especially on Open RAN research and development.

Bio

Tony Q.S. Quek received the B.E. and M.E. degrees in Electrical and Electronics Engineering from Tokyo Institute of Technology, respectively. At Massachusetts Institute of Technology, he earned the Ph.D. in Electrical Engineering and Computer Science. Currently, he is the Cheng Tsang Man Chair Professor with Singapore University of Technology and Design (SUTD) and ST Engineering Distinguished Professor. He also serves as the Head of ISTD Pillar, Director for Future Communications R&D Programme, Sector Lead for SUTD AI Program, and the Deputy Director of SUTD-ZJU IDEA. His current research topics include wireless communications and networking, 6G, network intelligence, non-terrestrial networks, and open radio access network.

Dr. Quek has been actively involved in organizing and chairing sessions and has served as a TPC member in numerous international conferences. He is currently serving as an Area Editor for the IEEE Transactions on Wireless Communications. He was an Executive Editorial Committee Member of the IEEE Transactions on Wireless Communications, an Editor of the IEEE Transactions on Communications, and an Editor of the IEEE Wireless Communications Letters.

Dr. Quek received the 2008 Philip Yeo Prize for Outstanding Achievement in Research, the 2012 IEEE William R. Bennett Prize, the 2016 IEEE Signal Processing Society Young Author Best Paper Award, the 2017 CTTC Early Achievement Award, the 2017 IEEE ComSoc AP Outstanding Paper Award, the 2020 IEEE Communications Society Young Author Best Paper Award, the 2020 IEEE Stephen O. Rice Prize, the 2020 Nokia Visiting Professorship, and the the 2022 IEEE Signal Processing Society Best Paper Award. He is a Fellow of IEEE and a Fellow of the Academy of Engineering Singapore.

Keynote Addresses

August 08 (Thursday)

Keynote Address 3

10:40-11:20 Concorde Ballroom Chair : Prof. Sevia M Idrus (Universiti Teknologi Malaysia, Malaysia)

Connecting the unconnected: MY Journey

Speaker Dr. Ahmad Nasruddin 'Atiqullah
Malaysian Communications and Multimedia Commission

Abstract Malaysia has launched Pelan Jalinan Digital Negara or JENDELA in September 2020 with the goal of improving the quality of digital infrastructure and services across the country. By the end of the five-year national digital infrastructure plan, JENDELA aims to deliver fibre connection for nine (9) million premises, 100% Internet connectivity for populated areas, and increased the mobile broadband speed to 100 Mbps. The unwavering commitment to build this robust digital infrastructure will be pivotal to Malaysia's digital transformation and in bridging the digital divide for rural, urban and even B40 communities. Ending 2022 saw JENDELA Phase 1 achieve: These achievements exceeded the initial target set at the beginning of this initiative with 7.5 million premises passed with gigabit speed, 96.9% 4G coverage in populated areas and 35 Mbps* mobile broadband speed. As of 31 December 2022, the 5G network rollout in populated areas has reached 47.1% from the target of 37.9%. It is expected that the target of 80% coverage in populated areas at the end of 2023 can be realized.

BIO

Dr Ahmad Nasruddin 'Atiqullah is currently the Chief Officer for the Technical and Monitoring Sector in the Malaysian Communications and Multimedia Commission (MCMC), the regulator for the converged communications and multimedia industry. He was also the chairman of 5G Testbed Working Group under National 5G Task Force in 2019. Dr Nasruddin has served in MCMC since 2004, where he has held various portfolios in Spectrum Planning Division, the Head for MCMC Academy, the Head of Technology and Standards Division and Head of Infrastructure Planning and Management Division. He began his career as a telecommunication engineer in TM Touch prior joining MCMC.

Dr Nasruddin holds BEng. (Hons) in Electronics Engineering from Multimedia University, and Masters in Information Management from Universiti Teknologi MARA. In March 2018, Dr. Nasruddin was awarded the degree of Doctor of Engineering (Engineering Business Management) from Universiti Teknologi Malaysia (UTM). He was appointed as UTM Adjunct Professor in recognition if his contribution to the advancement of telecommunications infrastructure in Malaysia.

Keynote Address 4

11:20-12:00 Concorde Ballroom Chair : Prof. Trio Adiono (Bandung Institute of Technology, Indonesia)

Malaysia's First Oil and Gas Enterprise 5G Deployment : A Success Story

Speaker Dr. M Zurix Mohamed
Custodian Instrument & Control Group Technical Solution PETRONAS

Abstract 5G technology is the most advanced cellular last-mile technology that has the superiority to deliver high bandwidth data speeds, ultra-low latency and massive network capacity. 5G usage will provide a remarkable technical leap advantages as compared to the 4G and Wi-Fi technology which are currently being deployed across PETRONAS. With 5G technology are readily available, all the current use cases and applications supported by 4G and Wi-Fi will be enhanced with better user experiences and future proof infrastructures. 5G will even speed-up the adoption of IIoT which are crucial in supporting bigger digitalization agendas such as Digital Twin, Artificial Intelligence and Machine Learning. Whilst 5G technology are ready to be deployed, the lack of 5G use cases could potentially hamper the 5G deployment pace. The Oil and Gas end users are still looking for more use cases to be readily available in the market to justify the 5G technology deployment. While Oil and Gas companies may aim for its individual 5G site deployment, collaboration between oil and gas companies, technology solution providers, 5G chipmakers, telecommunication service providers, universities and related government agencies are keys in expediting 5G solutioning's time to market. This would spur the development of 5G-enabled IIoT solutions and Use Cases. Our drive is for the technology to be deployed at faster pace to reap the benefit of 5G technology, upholding the digitally enabled operation aspirations and improve business performances.

BIO

Dr. Ir. M Zurix Mohamed is the distinguished Custodian for Instrument & Control, specializing in Measurement within PETRONAS Group Technical Solutions (GTS). With a profound 20 years of industry experience, he has made significant strides in refinery operations, mega projects, and the advancement of digital tool development, positioning him as a pivotal figure in PETRONAS's journey towards innovation and operational excellence. Holding the prestigious title of Professional Engineer recognized by the Board of Engineers Malaysia, Dr. Zurix has augmented his professional standing with a PhD in Engineering Management. Since joining PETRONAS in 2003 as a Maintenance Engineer, he has ascended through the ranks, demonstrating exceptional leadership and technical acumen.

Dr. Zurix's tenure is marked by his leadership in the development of multiple PETRONAS technologies, all of which are IP-patented and now integral to the functionality of oil and gas plants. His commitment to innovation extends to plant optimization, leveraging digital tools and artificial intelligence to enhance operational efficiency. His efforts have not only led to the patenting of various optimization technologies in instrument and control but have also positioned PETRONAS at the forefront of technological advancements in the industry. As an active contributor to the engineering community, Dr. Zurix regularly engages in multiple conferences, sharing his insights and breakthroughs. His exceptional work has been recognized with multiple awards, celebrating his contributions to instrument and control engineering and his impactful role in developing cutting-edge technologies for PETRONAS.

Oral Sessions

August 07 (Wednesday)

Oral Session 1A : Maritime/Underwater Communication Technology

08:30-10:00 Concorde Ballroom — Chair : Dr. Seungjae Baek (KIOST, Korea)

1A-1) Experimental Study of Light Wave Propagation in Underwater Optical Wireless Commmuncation Channel using Visible Light Communication Transceiver

Author Wan Hafiza Wan Hassan (Universiti Malaysia Terengganu), Kong Jia Wen (Intel Malaysia), Faezah Jasman (Princess Norah bint Abdulrahman University), Md Rabiul Awal and Muhd Shahir Mukhtar (Universiti Malaysia Terengganu), Sevia Mahdaliza Idrus (Universiti Teknologi Malaysia)

Abstract The latest advancements in technology have driven interest in underwater optical wireless communication (UOWC) as a key technology for underwater applications. However, UOWC faces challenges in the underwater optical channel, such as absorption, scattering, and turbulence. Previous studies have mainly focused on absorption and scattering, often overlooking the impact of underwater optical turbulence. This turbulence can cause significant signal intensity fluctuations at the receiver, resulting in poor UOWC system performance. Recent research tends to oversimplify turbulence by assuming it remains constant, even though factors like water temperature and salinity cause turbulence to vary. Therefore, this study aims to investigate the effect of salinity on UOWC through practical experiments. A customized visible light transceiver is employed in this experiment as the transmitter and receiver pair. The green and blue LED are used to generate optical signal propagation in saline water channel. The interaction between the selected light and the saline water is analyzed by varying the salt concentration levels. Subsequently, the attenuation constant, c, is estimated. The analysis reveals that the received light intensity decreases as the salt concentration in the water increases. The estimated c increases with higher salt concentrations, indicating that UOWC performance declines as water salinity rises. This finding provides valuable insights for designing optimal underwater communication devices and maximizing UOWC channel capability.

1A-2) Adjusting Repetitions for Error Reduction in Underwater Optical Wireless Communication

Author Huicheol Shin and Seungjae Baek (KIOST)

Abstract In this paper, we analyze the impact of underwater environmental factors such as turbidity on the communication performance of underwater wireless optical links established between underwater sensor node deployed on the seabed and unmanned surface vehicles (USV) on the sea surface. Furthermore, to reduce the error rate of UOWC, we implement a deep reinforcement learning (DRL) algorithm that adjusts the coding rate of the repetition code based on the environmental information from sensors attached to the USV. The DRL algorithm collects turbidity data in real-time to calculate the bit error rate (BER) and determine the number of data repetitions to meet the required packet error rate (PER). To evaluate the performance of the proposed algorithm, simulations in a virtual environment with irregular variations in turbidity and water tank experiment with optical model based UOWC system were conducted, both of which confirmed satisfying the required communication performance.

1A-3) Aerodynamically Considered Antenna Housing with Dielectric Lens for Extreme Environments

Author Jinkyu Bang, Man-Woong Heo and Seungjae Baek (KIOST), Jae Hee Kim (Korea University of Technology and Education)

Abstract This paper introduces an antenna housing design intended for use in extreme environments. Typically, antenna housing for wireless communication is designed in a flat-shaped structure to minimize distortion of the radiation pattern. However, while a curved structure offers advantages in environments with significant wind impact, it can also lead to decreased antenna gain due to phase distortion resulting from the housing shape. To address this issue, this study proposes an antenna housing structure for extreme environments that incorporates both the aerodynamic drag and the dielectric lens.

1A-4) Reusable Fish Biologger

Author Juhyun Kim (KIOST), Chulsu Park (MET-Solutions), Seungjae Baek (KIOST)

Abstract A biologger is a data storage device that is attached to a living organism to collect and record environmental and ecological data such as location, temperature, light intensity, and humidity. Marine biologgers used for fish and marine mammals are designed to be watertight and pressure resistance, with an integrated battery and electronic components. However, this integrated structure makes reuse after retrieval impossible and poses challenges in conducting sufficient pre-testing to maximize actual data collection period after the target is released. Therefore, in this paper, we propose a fish biologger with a replaceable battery. The proposed biologger is divided into a system part consisting of sensors, storage devices, and antennas, and a battery part, which includes the battery and detachment unit. The replaceable battery biologger has been proven to collect various marine environmental data over long periods in actual marine environments and can be reused by replacing the battery when necessary.

Oral Sessions

1A-5) A Sonar Micro-Doppler Analysis Study for the Estimation of Diver Motion Parameters

Author Min Kim, Doyoung Kim, Jihyeong Lee, Jaeho Choi and Seungjae Baek (KIOST)

Abstract In radar technology, micro-Doppler (m-D) signature have enabled the distinction between different types of targets, and the identification of indoor human behaviors and estimation of locomotion parameters. Despite significant advances in radar-based m-D signature applications, the potential of m-D signature in sonar signal processing, especially for underwater micro-motion recognition such as submarine propulsion systems or diver stroke styles, remains underexplored. To address this gap, we propose a new scheme for analyzing underwater diver motion parameters using sonar m-D signatures. In experiments performed using a constructed Doppler sonar system, we observed that the proposed scheme can perform effective motion parameter estimation of a diver in indoor water tank.

Oral Session 1B : 5G/6G, LTE, LTE-Advanced Communications I

08:30-10:00 Gallery I Chair : Prof. Yonggang Kim (Kongju National University, Korea)

1B-1) Relative Precise Positioning Method for Two Moving Vehicles and UGV-UAV System based on Moving Baseline RTK

Author Gyeongmin Kim (Sejong University), Hyojung Yoon (Korea Institute of Aviation Safety Technology), Eunyeong Lee (LG Uplus), Wonwoo Park and Byungwoon Park (Sejong University)

Abstract In this paper, we propose a relative precise positioning solution called MB-RTK (Moving Baseline RTK), utilizing an RTK (Real-Time Kinematics) solution and the velocity of a reference station. Traditional RTK methods do not account for the movement of the reference station, leading to errors when the reference station is in motion. The proposed MB-RTK method compensates for these movements by incorporating the velocity of the reference station and eliminates errors caused by the movement of the reference station, thereby eliminating errors caused by its movement. Unlike other MB-RTK research, this method provides a position solution synchronized to the current time while requiring only a small amount of data. Additionally, we develop an MB-RTK based UGV (Unmanned Ground Vehicle)-UAV (Unmanned Aerial Vehicle) system. This system estimates the relative position between two moving vehicles using the baseline vector estimated by MB-RTK, allowing the UAV to control its position relative to the moving UGV. Consequently, the UAV can follow the UGV without additional control commands. The effectiveness of the control system was validated through flight experiments.

1B-2) Performance Analysis of Multiple High-Altitude Platform Stations According to Architecture

Author jaeyeol lee, Won-Jae Lee, Jongtae Lee and Jae-Hyun Kim (Ajou University)

Abstract Recently, there has been a significant increase in research efforts aimed at realizing the goals of 6G technology. In this context, high altitude platform stations (HAPS) are receiving considerable attention as potential solutions for achieving objectives such as hyper-connectivity and expanded spatial coverage. HAPS operate for extended periods using solar panels at an altitude of 20 km within the stratospheric environment, thereby providing stable communication services to the ground. This capability is crucial in specific scenarios, such as hotspots or disaster situations, when a base station is present. Additionally, the flexibility of deploying ground communication services is enhanced by the choice between transparent and regenerative architectures. This paper we explain the transparent and regenerative architectures of HAPS. We also analyze the signal to interference plus noise ratio (SINR), data rate, and propagation delay according to the architecture of HAPS and the gains from repeaters.

1B-3) An LSTM-based Enhanced Mobility Prediciton Mechanism

Author Kamrul Hasan and Seong Ho Jeong (Hankuk University of Foreign Studies)

Abstract Accurate mobility prediction is essential for optimizing the usage of the network resources in dynamic environments. Existing prediction mechanisms often struggle with precise GPS location prediction due to the proximity of sequential GPS values, making it challenging to accurately forecast the next location based on current data. This paper presents an enhanced mobility prediction mechanism utilizing a Long Short-Term Memory (LSTM) network within a grid-based model. The grid-based approach mitigates the issues of closely spaced GPS values by transforming continuous location data into discrete grid cells, enhancing the LSTM's ability to capture movement patterns. Our extensive simulations show that the predicted movements closely resemble actual movements, demonstrating significant improvements over traditional methods. The proposed mechanism offers a robust solution for mobility prediction, with potential applications in network optimization and intelligent mobility management systems.

1B-4) Complexity analysis to obtain maximum performance of successive cancellation (SC) decoder for Reed-Muller codes with dynamic frozen bits

Author Woo Yong Lee and Keunyoung Kim (Electronics and Telecommunications Research Institute), Dongwook Cho (Korea Association of University, Research Institute and Industry)

Oral Sessions

Abstract The wireless communication environment in extreme cold areas consisting of seawater and glaciers is limited in terms of power consumption and the size and weight of equipment, but the condition for unmanned exploration is long-distance, high-speed communication. The wireless communication system for operating unmanned robotic exploration in Antarctica requires a high-speed transmission rate of more than 10Mbps over long distances of more than 50km. At this time, we want to redesign the beam forming technique to concentrate limited power in a specific direction and the encoding technique to optimize channel gain to satisfy the long-distance communication requirements of mobile objects. Recently, interest in channel coding research has increased due to new applications requiring short-length data transmission. This paper analyzed the possibility of further improving complexity in the successive cancellation list decoding technique for RM codes using dynamic frozen bits. It is expected that these results can be used as a conceptual basis for an encoder and decoder design that can be applied to a wireless communication system for operating unmanned robotic exploration in Antarctica.

1B-5) Spectum status and issues in Korea

Author Seung-Hoon Hwang (Dongguk University)

Abstract This paper summarizes spectrum status and issues in Korea. Both 5G and 6G status are described.

Oral Session 2A : Artificial Intelligence, Machine Learning, and Pattern Awareness I

13:20-14:50 Concorde Ballroom Chair : Prof. Norhana Arsad (Universiti Kebangsaan Malaysia, Malaysia)

2A-1) Improved Human Echolocation Click Detection and Ranging with Gammatone Filter Banks

Author Nur Luqman Saleh, Alyani Ismail and Sali Aduwati (Universiti Putra Malaysia), Nur Emileen Abdul Rashid (Universiti Teknologi MARA)

Abstract This paper proposed improved pulse compression technique based on the summation of gammatone filter banks for detecting and estimating the range of human echolocator mouthclicks. This approach extends previous work by incorporating multi-phase correlation and summation within the gammatone filterbank scheme. Compared to the conventional matched filter technique, the proposed method achieves a significant improvement in signal power exceeding -8 dB. Additionally, simulations demonstrate reliable accuracy in the estimation of the target range using the proposed technique. These findings suggest that the multi-phase summation of gammatone filterbanks offers a promising approach for enhancing both detection and range estimation in applications utilizing human echolocation mouthclick signals.

2A-2) Exploring Machine Learning Models for Real-Time Maritime Vessel Monitoring on Interlinked Camera-Mounted Buoys

Author Michael Ralph Estrada, Margrette Yebes, Emilio Escobillio and Gabriel Avelino Sampedro (De La Salle University)

Abstract Undocumented maritime vessels traversing the Philippines pose significant threats, from potential smuggling of contraband and illegal harvesting of its natural resources due to the archipelagic nature of the country, it gives additional challenges to law enforcement to foresee activities on the bodies of water. In this paper, the proponent's objective is to develop a device that can be used for monitoring territorial waters. Using Buoys that are equipped with real-time monitoring cameras with built-in algorithms for image processing and detection of ships passing through, the paper aims to determine which algorithm has the highest accuracy. Based on the results of the three algorithms, YOLOv8 had the highest score vs Faster RCNN and SSD.

2A-3) Deep Learning Model for Anomaly Detection in Water Supply Pipes Based on Sensor Data

Author Jinhyung Cho, Hwansoo Kang and Heejin Lee (Dongyang Mirae University), Yoorim Cho (The University of Sheffield), Yudoo Kim (Dongyang Mirae University)

Abstract The primary aim of this research is to devise a robust anomaly detection model for pipelines, enabling the differentiation of leakage status based on sensor data integrated into intelligent water distribution systems. To accomplish this objective, a series of experiments employing various deep learning models were conducted to craft an optimal anomaly detection framework. Through meticulous analysis of the training data, significant feature variables influencing leakage were identified. Additionally, leveraging a fundamental multi-class classification model, coupled with CNN-based training, facilitated the development of a sophisticated deep learning architecture tailored for anomaly detection in pipeline systems.

2A-4) Towards Time-Aware Decentralized Federated Learning for Bearing Fault Detection

Author Made Adi Paramartha Putra, Nengah Widya Utami and Gede Juliana Eka Putra (Primakara University), Nyoman Karna (Telkom University)

Abstract Federated Learning (FL) presents a promising alternative, bolstering system reliability by decentralizing the learning process. In our research, we advocate for a Decentralized FL (DFL) approach to collaborative bearing fault detection. DFL stands out for its elimination of a single point of failure inherent in centralized FL setups. By embracing the decentralized FL paradigm, vulnerabilities to attacks in collaborative frameworks can be mitigated. Our proposed DFL model incorporates continual learning techniques to streamline communication and reduce overhead. Experimental results showcase the efficacy of decentralized collaborative learning, achieving a commendable accuracy rate of 96.08% and significantly reducing learning time by up to 37.52%.

Oral Sessions

2A-5) Interactive Tablet Menu for Information-underprivileged Class

Author Yoon-Jong Lee, Yoon-Seo Koh, Min-Ju Jeon, Tae-Yun Rho, Han-Eum Lee, Su-Min Goo, Seo-il Han and Kwansang Na (Kyonggi University)

Abstract This study deals with the digitalization trend of the food service industry and the accessibility problem of the information-underprivileged class. Mainly, the goal is to combine tablet menus and AI interactive chatbots to make it easier for users to order and choose food. To this end, voice input technology and AI models are used to interact with users and are specially designed to meet the needs of the information-underprivileged class. In addition, a backend system and an administrator webpage are implemented to support efficient service operation. This approach aims to promote social integration by making digital services more inclusive and having equal opportunities for all users.

Oral Session 2B : 5G/6G, LTE, LTE-Advanced Communications II

13:20-14:50 Gallery I Chair : Dr. Siti Hasunah Mohammad (Pukyong National University, Korea)

2B-1) Impact of Beam Split on BER Performance of IRS-aided THz Communications

Author Sanjeev Sharma (Indian Institute of Technology (Banaras Hindu University) Varanasi), Yeon Ho Chung (Pukyong National University)

Abstract Intelligent reflecting surfaces (IRS) and multipleinput and multiple-output (MIMO)-based design are considered for mitigating the effects of molecular absorption in terahertz (THz) systems operating at high-frequency bands. However, the phenomenon of beam splitting occurs at both the transceiver and IRS in the THz system. In this paper, time-delay (TD) and delayphase (DP) based precoding at the transmitter (Tx) and IRS are introduced to overcome the effect of beam splitting. The average bit error rate (BER) of the THz system is analyzed by considering the impact of transmitting antennas, reflecting elements, and inphase and quadrature (IQ) mismatch for a multi-carrier system. Beam splitting results in a reduction in BER performance of up to 20 dB, as observed in the study.

2B-2) Analysing of 90-100 GHz Radar using Triangular Trihedral Corner Reflector for Airport Runway Safety

Author Nur Aqilah Yusri, Sevia Mahdaliza Idrus, Sumiaty Ambran and Muhammad Al Farabi Muhamad Iqbal (Universiti Teknologi Malaysia), Nobuhiko Shibagaki (Hitachi Kokusai Electric Inc.), Shunichi Futatsumori (Electronic Navigation & Research Institute)

Abstract Triangular trihedral corner reflectors (TTCR) are passive radar targets that provide the best solution in characterizing the radar system performance. The Radar Cross Section (RCS) of the TTCR plays an essential role for estimating the characterizing parameters and hence the backscattering properties. RCS characterization for three sizes of TTCR considering airport runway at clear weather condition is addressed. This work introduces an experimental measurement of 90-100 GHz millimeter-wave radar detection. These measurements were carried out at runway 2, Kuala Lumpur International Airport for 93.1GHz using Frequency Modulated Continuous Wave (FMCW) radar. The characterization method for radar detection system performance considering radar incident angle and transverse slope, the reflectivity characteristic and experimental site measurement and findings are presented in this paper.

2B-3) Performance Comparison using various LDPC coded and CSK modulated Schemes

Author Daekyeong Kim amd Hong-Yeop Song (Yonsei University)

Abstract In this paper, the performance of LDPC encoded and CSK modulated signals are compared. 500-bit messages are encoded with LDPC codes of length 600, 700, 800, 900, 1000 and they are modulated by CSK with order 6, 7, 8, 9, 10 respectively. From the simulation result, the frame error rate are analyzed considering trade-off between data rate and error rate performance.

2B-4) Deep Reinforcement Learning in Wireless Communications: Challenges and Solutions

Author Seungnyun Kim (Massachusetts Institute of Technology), Byonghyo Shim (Seoul National University)

Abstract The proliferation of internet-connected mobile devices necessitates a shift from traditional mathematical model-based wireless communication systems to an intelligent architecture that incorporates artificial intelligence. Reinforcement learning (RL), particularly its enhancement through deep reinforcement learning (DRL), has emerged as a promising solution for making autonomous and effective decisions in wireless networks. DRL addresses complex, non-convex problems within dynamic environments by calculating the optimal policy through a deep neural network (DNN), thus enabling efficient decision-making for applications such as spectrum access and resource allocation. This paper focuses on overcoming the practical challenges of implementing DRL in wireless communications by integrating conventional system knowledge to enhance the learning process.

2B-5) Differentiated Traffic Class Mean Delay of Degradation Attack in XG-PON

Author Fadila M Atan (Universiti Teknologi MARA Johor Branch), Nadiatulhuda Zulkifli, Sevia Mahdaliza Idrus, Nor Affida M.Zin, Nur Asfahani Ismail and Azizul Azizan (Universiti Teknologi Malaysia)

Oral Sessions

Abstract The Next-Generation Gigabit Passive Optical Network (NG-PON) enhances bandwidth, data rate, and allows for ongoing network expansion. Given the closed-loop nature of NG-PON, security measures are typically concentrated on the downstream channel transmission due to its broadcast nature. As a result, the upstream point-to-point direction has been assumed to be secure. However, because Time Division Multiple Access (TDMA) is used as a transmission mode in the upstream channel, each packet is assumed to go from end to end, leading to a less stringent approach to its security. This paper introduces a secured DBA mechanism for XG-PON to address this specific threat. The Security-Enhanced DBA (SE-DBA) algorithm includes a detection phase to identify abnormal user behavior. Once an attacker is identified, a mitigation phase follows, reducing the bandwidth of the identified users in the next bandwidth cycle. Network simulations, both standard and attacked, were conducted using a network testbed based on OMNET++. The results show that SE-DBA improves the mean delay to all Transmission Containers (TCONT) compared to the GIANT DBA. Specifically, the simulations show a performance increase of 5%, 30%, and 58% in upstream delay for TCONT2, TCONT3, and TCONT4, respectively, compared to the unprotected DBA scheme. This indicates the effectiveness of the proposed SE-DBA mechanism.

Oral Session 3A : Artificial Intelligence, Machine Learning, and Pattern Awareness II

15:10-16:40 Concorde Ballroom Chair : Prof. Adam Wong Yoon Khang (Universiti Teknikal Malaysia Melaka, Malaysia)

3A-1) Semantic Communication with Adversarial Defense for Malware Detection in Metaverse E-Commerce

Author Ebuka Chinaechetam Nkoro, Cosmas Ifeanyi Nwakanma, Jae-Min Lee and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract With the proliferation of the Internet of Things, artificial intelligence, and virtual reality, securing Metaverse E-commerce against malware has become increasingly critical. This study introduces a novel framework integrating Semantic Communication (SemComm) with Deep Learning for Intrusion Detection Systems (IDS) in Metaverse E-commerce. Leveraging Stochastic Activation Pruning (SAP), the proposed adversarial defense mechanism enhances model robustness against adversarial attacks. Through comparative evaluation using the CICMalDroid2020 malware dataset, the defense model demonstrates improved resilience against adversarial samples while maintaining competitive detection rates. The results show the effectiveness of the dual-model approach, combining pruned and unpruned IDS models, in strengthening IDS in Metaverse E-commerce.

3A-2) A Survey on Cybersecurity Techniques for AI based Intelligent Systems

Author Insoo Sohn (Dongguk University)

Abstract In this paper, we present technological trends related to cybersecurity in communication system intelligence, defense system intelligence, and medical system intelligence. Furthermore, a possible trend in the future security technology for AI is provided.

3A-3) PhishNet: Exploring Machine Learning Techniques for Advanced URL Phishing Detection

Author Sean Andrei Olores, Renee Althea Khan, Shanley Valenzuela and Gabriel Avelino Sampedro (De La Salle University)

Abstract Cyber threats, particularly phishing — a prevalent cybercrime exploiting human vulnerabilities to steal sensitive information — are rapidly evolving, leading to an increased number of organizations and individuals falling prey to these attacks. As cyber attackers become more sophisticated in their tactics, organizations must continually update their cybersecurity measures to stay ahead of potential threats. To help address this growing issue, this research explores the use of various machine learning models for detecting phishing URLs across a dataset of 10,000 web pages. Random Forest (RF), Support Vector Classifier (SVC), Logistic Regression (LR), and Naïve Bayes (NB) are all explored and ensembled to form the algorithm PhishNet, possibly increasing performance. This research shows that the PhishNet outperformed individual models in detecting phishing URLs with a notable accuracy of 0.9880, demonstrating the potential of machine learning in enhancing cybersecurity measures. By leveraging these advanced technologies, organizations can better protect themselves against evolving cyber threats and safeguard sensitive information.

3A-4) Reinforcement Learning-Based Optimal Task Offloading for Multi-Tier Cloud-Edge Computing Systems

Author Avilia Kusumaputeri Nugroho (Pusan National University), Min Sang Yoon (Fujitsu Network Communications), Taewoon Kim (Pusan National University)

Abstract This work introduces online resource scheduling in a multi-tier cloud-edge computing system that integrates Proximal Policy Optimization (PPO) reinforcement learning with state stacking. By integrating PPO with state stacking, our approach allows agents to effectively balance between exploration and exploitation, thereby allowing agents to effectively capture long-term dependencies and patterns in the environment. The proposed approach aims to enhance system efficiency through integrating load balancing and optimal resource allocation. For extensive evaluation, we have implemented a customized reinforcement learning environment and evaluated the effectiveness of the proposed strategy in ensuring prompt task completion while minimizing energy consumption for task processing.

Oral Sessions

3A-5) Differentiated Traffic Class Delay Modeling for XG-PON Using ANN

Author Nur Asfahani Ismail, Farabi Iqbal, Sevia Mahdaliza Idrus, Nor Affida M.Zin and Fadila Mohd Atan (Universiti Teknologi Malaysia)

Abstract Passive Optical Networks (PONs) play a crucial role in providing broadband services with high capacity and low latency. The XG-PON, a 10 Gigabit-capable Passive Optical Network, improves data speeds and scalability, effectively catering to numerous clients with varying bandwidth requirements. Dynamic Bandwidth Allocation (DBA) in XG-PON is essential for the flexible distribution of bandwidth among users, guaranteeing equitable and efficient utilization of the network. This research presents a novel methodology for predicting delays in various traffic containers in XG-PON. By employing supervised training, we show that Artificial Neural Networks (ANN) can accurately simulate upstream delays, thereby aiding in making informed decisions on bandwidth allocation. The suggested approach seeks to enhance the efficiency of DBAs by offering precise delay estimates, hence improving the overall performance of the network.

Oral Session 3B : 5G/6G, LTE, LTE-Advanced Communications III

15:10-16:40 Gallery I Chair : Prof. Sumiaty Ambran (Universiti Teknologi Malaysia, Malaysia)

3B-1) Queuing Delay Analysis Based on Statistical Quality-of-Service Guarantee for Latency-Sensitive Mobile Edge Computing

Author Gusun Joung, Mintae Kim and Inkyu Lee (Korea University)

Abstract In this paper, we study the queuing delay in mobile edge computing (MEC) networks, which consist of a single-antenna base station (BS) equipped with an edge server (ES) and single-antenna user equipment (UE) that executes multiple tasks in each time slot. In particular, we derived closed-form expressions and analyzed the queuing delay-bound overflow probability under the quality-of-service (QoS) requirements of the UE. This analysis can be applied to scenarios where real-time application tasks, transmitted with time-varying channel state information (CSI), continuously arrive at the UE in each time slot, resulting in incomplete task computations.

3B-2) WIP: Analysis of Distance-based Handover Parameters in LEO Satellite Communications

Author Jongtae Lee, Yujeung Ahn, Jaeyeol Lee, Wonjae Lee and Jae-Hyun Kim (Ajou University)

Abstract Low-Earth orbit (LEO) satellites, operating at high speeds, result in frequent handover (HO) for user equipment (UE). In the Earth-moving cell (EMC) environment, where cell locations change with satellite movement, HOs are even more frequent. Such frequent HOs significantly degrade the communication service quality of the UE. The 3rd generation partnership project (3GPP) proposed EventD2, a distance-based HO mechanism in EMC, to address these issues. However, in an EMC environment, the continuous movement of cells leads to various situations depending on the location and time. Therefore, EventD2 parameters must be empirically derived for all possible situations, and relevant studies have been insufficient to date. This paper proposes a method for empirical parameter derivation based on the average signal-to-interference plus noise ratio (SINR) of the UE and determines the effective threshold ranges for triggering through performance analysis. Also, the analysis identifies improvements in single key performance indicator (KPI) analysis and suggests future research to further narrow the effective range.

3B-3) A Review on Resource Allocation in FL-assisted IoT Networks: Overview, Research Challenges and Future Trends

Author Manh Cuong Ho, Dongwook Won, Thanh Phung Truong, Jaemin Kim and Sungrae Cho (Chung-Ang University)

Abstract Recently, Federated Learning (FL) has gained traction as a promising approach, prioritizing user data security and privacy while optimizing communication resources effectively. FL serves as a decentralized machine learning technique commonly utilized in various Internet of Things (IoT) applications, facilitating collaboration between a central server and user devices to train a global model from multiple IoT devices (IoTDs). As the IoT continues to proliferate and integrate into various fields, merging it with FL models presents a notable challenge that requires significant research investment. While the constrained resources of IoTDs necessitate tailored design considerations in structuring FL models, FL confronts communication and computation challenges akin to those prevalent in IoT networks. Hence, optimizing the utilization of resources becomes imperative when contemplating the integration of IoTDs into FL frameworks. This paper undertakes a comprehensive review of the foundational principles of FL and delves into problems and goals for resource allocation within IoT systems facilitated by FL. Subsequently, it delineates the challenges encountered and outlines future research avenues about resource allocation in FL-assisted IoT networks.

3B-4) Advancing Green Network Communication through TRIZ: Analyzing Patented Technologies for Sustainable 6G Connectivity

Author Zulhasni Abdul Rahim, Muhammad Saqib Iqbal and Sevia Mahdaliza Idrus (Universiti Teknologi Malaysia)

Abstract The study explores the use of TRIZ methodology and green network communication within the context of sixth generation (6G) of wireless networks connectivity. The telecommunications industry's expansion towards sustainable practices to mitigate environmental impact. TRIZ, renowned for inventive problem-solving, presents an opportunity for such innovation strategy for technological growth. This study aims to apply TRIZ concept to analyze patented technologies, identifying contradictions in technology development and proposing innovative solutions to enhance sustainability and reduce the environmental footprint of 6G networks. The study involves reviewing patented literature on green network communication and TRIZ methodology, describing our analytical methodology, and presenting case studies of selected patents. Through this analysis, it contributes to the advancement of green network communication and support the development of sustainable telecommunications infrastructure. This paper outlines our findings and offers recommendations for future research and technological growth.

Oral Sessions

Oral Session 4A : Artificial Intelligence, Machine Learning, and Pattern Awareness III

16:50-18:20 Concorde Ballroom Chair : Dr. Muhammad Yusof Mohd Noor (Universiti Teknologi Malaysia, Malaysia)

4A-1) Enhancing the Dynamic Range of Refractive Index Sensors Using Neural Network Classification with MMI Coreless Fiber

Author Athi Shankhara, Muhammad Yusof Mohd Noor, Fauzan Ahmad and AZIZUL AZIZAN (Universiti Teknologi Malaysia)

Abstract A supervised classification machine learning (ML) algorithm is proposed for measuring refractive index (RI) values both below and above the RI of the fiber material using a multimode interference (MMI) fiber sensor. The sensor is constructed by splicing a coreless multimode fiber (CMF) segment between two single-mode fiber (SMF) leads. Measurement of low and high RI regimes is accomplished through the Decision Tree (DT) classification algorithm. The trained model algorithm demonstrates a wide dynamic range in RI measurement, covering the ranges of 1.30 to 1.39 (low RI regime) and 1.46 to 1.55 (high RI regime) without significant RI ambiguity, achieving an average accuracy of 58.1% for each RI range.

4A-2) Deep Neural Network Towards URL Classification Using Effective URL Tokens

Author Zafar Ali and Siti Sophiayati Yuhaniz (Universiti Teknologi Malaysia), Ghulam Mujtaba Shaikh (Sukkur Institute of Business Administration)

Abstract Methods for real-time web page classification are currently required due to the exponential growth of the Internet user base and the volume of web pages. To tackle these challenges, scholars have suggested URL-based methods in the literature, which offer classification speed and computational efficiency gains over content-based approaches. This study empirically evaluated deep neural networks using a large dataset of URL classification using simple URL tokens extracted from URl and Query String. This study aims to diversify the range of URL tokens using the CNN network and enrich URL Tokens by extracting features from Query String and improving the quality of the training dataset. Such improvements have enabled the model to attain an F1 score of 0.8787, signifying a superior level of accuracy relative to prior models.

4A-3) On-Device Plastic Waste Classification for Waste Sorting Robots

Author Hyuntae Cho (Tongmyong University), Young Jin Lee (RobOne)

Abstract The ecological crisis, threats to biodiversity, threats to human health, and climate change caused by various types of plastic pollution are being seriously addressed globally. This paper proposes an on-device plastic waste classification system for waste sorting robots. The proposed system essentially operates on an embedded system, acquiring waste images and utilizing YOLOv8 to classify the types of plastic waste. We gathered a custom waste dataset from a waste recycling center in reality and trained the model to enhance classification accuracy. This paper also outlines the performance evaluation conducted to validate the effectiveness of the proposed approach.

4A-4) SmartRSD: An Intelligent Multimodal Approach to Real-Time Road Surface Detection for Safe Driving

Author Adnan Md Tayeb, Mst Ayesha Khatun, Mohatsin Golam, Md Facklasur Rahaman, Ali Aouto, Oroceo Paul Angelo, Min-Seon Lee, Dong-Seong Kim, Jae-Min Lee and Jung-Hyeon Kim (Kumoh National Institute of Technology)

Abstract Precise and prompt identification of road surface conditions enables vehicles to adjust their actions, like changing speed or using specific traction control techniques, to lower the chance of accidents and potential danger to drivers and pedestrians. However, most of the existing methods for detecting road surfaces solely rely on visual data, which may be insufficient in certain situations, such as when the roads are covered by debris, in low light conditions, or in the presence of fog. Therefore, we introduce a multimodal approach for the automated detection of road surface conditions by integrating audio and images. The robustness of the proposed method is tested on a diverse dataset collected under various environmental conditions and road surface types. Through extensive evaluation, we demonstrate the effectiveness and reliability of our multimodal approach in accurately identifying road surface conditions in real-time scenarios. Our findings highlight the potential of integrating au ditory and visual cues for enhancing road safety and minimizing accident risks.

4A-5) Vision-Based Black Ice Detection using Convolutional Neural Networks for Road Safety

Author Ali Aouto, Jae-Min Lee and Jung-Hyeon Kim (Kumoh National Institute of Technology)

Abstract Black ice poses a significant hazard to road safety, especially during winter months when its transparent nature makes it virtually indistinguishable from the road surface. Traditional methods of black ice detection rely on environmental sensors and pavement temperature monitoring, which often lack precision and real-time capabilities. In this paper, we propose a novel approach utilizing Convolutional Neural Networks (CNNs) for vision-based black ice detection. Our method leverages high-resolution images captured by onboard cameras mounted on vehicles to identify regions of potential black ice formation. We present a custom CNN architecture designed to process these images efficiently and accurately classify road segments as either safe or potentially hazardous due to black ice. Training data for the CNN model is collected from diverse driving scenarios, encompassing varying weather conditions, road surfaces, and lighting conditions. Extensive experiments conducted on real-world datasets demonstrate the effectiveness of our approach, achieving high detection accuracy and robustness against environmental factors. Additionally, we discuss the integration of our black ice detection system with existing vehicle safety systems, enabling proactive alerts to drivers and stakeholders for mitigating the risk of black ice-related accidents. Overall, our vision-based approach offers a promising solution for enhancing road safety by providing timely and reliable detection of black ice hazards.

Oral Sessions

Oral Session 4B : Maritime Applications and Transporation Systems

16:50-18:20 Gallery I

Chair : Dr. Jinkyu Bang (KIOST, Korea)

4B-1) Input feature analysis for LSTM-based maximum wave height prediction

Author Geonwoo Hong and Yonggang Kim (Kongju National University)

Abstract This study investigates the effect of varying input features on the prediction of maximum wave height and evaluates the prediction accuracy and computational efficiency of a Long Short-Term Memory (LSTM) model under varying numbers of input features. Using oceanographic data from the National Weather Service, the research selects combinations of 2 to 7 features out of a possible 13 to predict maximum wave height. It identifies an optimal balance between model accuracy and computational time, highlighting the trade-offs inherent in feature selection. The results show that including up to five input features significantly improves model performance without significantly increasing training time or computational requirements. This research enhances marine forecasting by highlighting the strategic selection of input features, which improves the efficiency of predictive models within feasible computational limits.

4B-2) Derivation of controllable region of towfish according to change in towing point, towing speed, and center of gravity

Author Min-Kyu Kim, Jihyeong Lee and Sang-Ki Jeong (KIOST)

Abstract This paper derives a controllable region to improve the image quality of a sound navigation ranging (sonar) system for a towfish (underwater towed vehicle) equipped with two elevators and a single rudder. The towfish connected to the mother ship though a towing cable changes its movement characteristics not only according to the movement of the cable but also according to the towing point, towing speed, and center of gravity, and can be able to respond to fluctuations caused by the unpredictable underwater environment and various operating conditions. Specifically, in order to properly control the attitude of the towfish, we propose a method to derive the feasible region of the towing point according to changes in the center of gravity and towing speed. A water tank experiment was conducted to verify the proposed method, and it was confirmed that the feasible region can be used as an indicator to ensure attitude control of the towfish.

4B-3) A study on composite platform and field test

Author Jihyeong Lee, SangKi Jeong and Haeyong Park (KIOST)

Abstract This paper presents the development and sea area testing results of a composite marine unmanned platform consisting of USV (Unmanned Surface Vehicle) and ROV (Remotely Operated Vehicle). The platform's structure, control system, sensor system, and control algorithms are developed and introduced. The composite platform collects information on underwater structures such as walls, floors, bridges, and harbors. The ROV can be launched and recovered using a winch system installed on the USV. Data collected from both vehicles can be transmitted in real-time to the operations center via RF (Radio Frequency) communication. A new CTE (Cross Track Error) tracking algorithm and dynamic positioning algorithm are proposed. The proposed algorithms are implemented through sea area testing, and performance test results are presented. Particularly, for the hovering control of the ROV, a PID controller and robust SMC (Sliding Mode Control) are applied, demonstrating the excellent performance of SMC.

4B-4) Enhancing Maritime Security via Blockchain Integration for Cross-Border Vehicle Authentication

Author Mohamed Abubakar Dini, Esmot Ara Tuli, Dong-Seong Kim and Taesoo Jun (Kumoh National Institute of Technology)

Abstract Maritime borders hold significant importance for a nation's economic and political stability. Ensuring the security of these extensive maritime frontiers is a task of priority importance for naval forces, particularly in managing and mitigating unauthorized entries by foreign vessels into international maritime zones. To simplify and automate this task, this paper proposes a blockchain-enabled maritime vehicle authentication and verification system. The system employs octopus robots, designed for monitoring and performing authentication checks. A smart contract is utilized to implement the demonstrative authentication process, ensuring that operations are secure, decentralized, and tamper-proof. This integration enhances the efficiency and reliability of maritime security measures.

4B-5) Infrastructure-Linked CAV Overtaking Decision Algorithm

Author Jihun Kim, Youngjin Yoon, Seoksan Shin (Korea Automotive Technology Institute), Dong Seog Han (Kyungpook National University)

Abstract Autonomous vehicles have been the focus of extensive research, through which they have been developed beyond those relying on standalone functions to connected autonomous vehicles (CAVs). Connected autonomous vehicles are connected to various objects based on Vehicle-to-Everything (V2X) communication technology, thus enabling high-level autonomous driving functions. In this paper, we propose an overtaking decision algorithm that links CAVs with road infrastructure. The proposed algorithm is implemented and evaluated using road infrastructure and autonomous vehicle data collected on real roads. We aim to overcome the limitations of the perception area and driving strategy by leveraging road infrastructure. Ultimately, this work is expected to contribute to the realization of high-level autonomous vehicles.

4B-6) Analysis of Safety Regulation Violations by Electric Kick Scooter Users

Author Chang-Ryul Park, Gangmin Lee, Yukang Kim and JaeYeong Lee (Kyonggi University), Dae-Won Jeong (401SPAG Co., Ltd.), Kyungyong Chung (Kyonggi University)

Abstract In recent years, the urban traffic environment has been rapidly evolving. The widespread adoption of personal modes of transportation, such as electric kick scooters, has significantly influenced our mobility patterns. However, these advancements have also introduced new traffic safety challenges, prompting increased calls for stricter safety regulations. This study investigates the violations of safety regulations by electric kick scooter users through image analysis using YOLOv5 and OpenCV. By analyzing these violations, this research aims to enhance the monitoring and enforcement of safety regulations, contributing to improved urban traffic safety.

Oral Sessions

August 08 (Thursday)

Oral Session 5A : Maritime Internet of Things

08:30-10:00 Concorde Ballroom Chair : Prof. Sophiayati Yuhaniz (Universiti Teknologi Malaysia, Malaysia)

5A-1) Beam Propagation Method Simulation of Uncoated Coreless Silica Fiber for Humidity Sensing

Author Athi Shankhara Velusamy, Muhammad Yusof Mohd Noor, Fauzan Ahmad and Siti Mahfuza Saimon (Universiti Teknologi Malaysia)

Abstract Coreless silica fiber or known as (CSF) is a type of no core fiber (NCF) which is considerably one famous optical fiber for its application as humidity sensitive materials. However, because of inherent limits and the nature of foreign materials or substances, there is a significant rise in cost and a complicating factor during the fabrication process of CSF based humidity sensors. Apropos, this paper introduces a simulation of a bare CSF design for sensing humidity of CSF is. We evaluated the sensor's performance by simulating changes in the analyte refractive index, ranging from 1.00 RIU (representing air) to 1.20 RIU (representing water), to evaluate its capacity for humidity sensing. To evaluate its humidity-sensing capabilities. These findings show that the naked or uncoated CSF design is effective at detecting dampness (1.00 to 1.20 RI), reaching a sensitivity of 313.1 x 10-9 RIU per unit of RI shifting and exhibiting a strong linear relationship with an R2 value of 0.987. Consequently, the findings established the foundation for potential design changes that could be made in the future to improve the performance of the uncoated CSF humidity sensor.

5A-2) Applicability of block pavement in a harbor based on deflection and settlement characteristics

Author Yong-Soo Ha (KIOST), Yun-Tae Kim and Minh-Vuong Pham (Pukyong National University), Haeyong Park, Sang Ki Jeong and Myounghak Oh (KIOST)

Abstract In ports, the pavement often experiences differential settlement and cracks due to soft ground and heavy equipment. This study explores two configurations of port blocks applied in a harbor to understand deflection and settlement characteristics. Falling weight deflectometer (FWD) tests were conducted on asphalt pavement and block pavements to assess deflection. A cement-treated base showed better bearing capacity and settlement management during harbor operations compared to asphalt pavement. LiDAR measurements detected multiple settlements in the crushed-stone base post-construction due to surface loads. The relative deflection ratio correlated with settlements. Settlements were minimal (less than 5 cm), indicating that block pavement, with its versatile application and the strength of the cement-treated base, can be effectively used in various harbor settings.

5A-3) Simulation of Bare Trench Silica Fiber Sensors for Humidity Sensing between Length of Depths of 50µm and 110µm

Author Athi Shankhara Velusamy, Muhammad Yusof Mohd Noor, Fauzan Ahmad and Siti Mahfuza Saimon (Universiti Teknologi Malaysia)

Abstract One kind of coreless silica fibre (CSF) that is highly well-known for its use in humidity-sensitive materials is trench coreless silica fibre, or TCSF. However, because of inherent limits and the nature of foreign materials or substances, there is a significant rise in cost and a complicating factor during the fabrication process of TCSF or CSF-based humidity sensors. Relevant to this paper introduces a simulation of a two TCSF which the width and depth of 50µm design and another width of 50µm and depth of 110µm design for measuring humidity as opposed to mimicking a CSF to determine the TCSF's sensitivity. To test the sensor's ability to sense humidity, we simulated variations in the analyte refractive index, which ranges from 1.000 RIU (representing air) to 1.350 RIU (representing water). These, results indicate that the two bare or uncoated TCSF designs successfully detect humidity (1.00 to 1.35 RI), with one achieving a sensitivity of 375.6 x 10-9 RIU per unit of RI change and another achieving a sensitivity of 593.7 x 10-9 RIU per unit of RI and demonstrating strong linearity with two different R2 values of 0.9412 and 0.9299. As a result, the findings set the stage for potential design changes that could be made in the future to improve the performance of the uncoated TCSF humidity sensor.

5A-4) Weight Monitoring with Calorie Management System Using Fiber Bragg Grating Sensor

Author Nurfarhana Mohd Sapiee, Mohd Hadri Hafiz Mokhtar, Mohd Saiful Dzulkefly Zan, Ahmad Ashrif A Bakar and Norhana Arsad (Universiti Kebangsaan Malaysia)

Abstract Athletes need accurate ways to track their food intake for optimal performance. Current methods like food diaries are subjective due to the difficulties in measuring these variables especially in free-living conditions and in unobtrusive ways, the exact role of these variables relative to other dietary and lifestyle factors remains uncertain. Researchers are exploring sensors to improve measurement. Existing weight sensors require calibration and are affected by placement. A new sensor using fiber optic technology, fiber Bragg grating (FBG) shows high potential. When combined with a cantilever beam, FBG can precisely measure weight (up to 1kg) even with interference. This sensor offers high accuracy (hysteresis of 0.00025) and sensitivity (0.0157 pm/g) within a specific range. Implementing FBG sensor into the calorie monitoring system could provide athletes with a more objective and unobtrusive way to track their food intake.

Oral Sessions

5A-5) Construction of a simulation environment for federated learning-based LEO satellite communications systems

Author Gwangun Yu and Yonggang Kim (Kongju National University)

Abstract Low-earth orbit (LEO) satellite communications have attracted substantial research attention because they are feasible and applicable in next-generation communications systems compared to medium-earth orbit (MEO) and geostationary (GEO) satellites. However, the low altitude of an LEO satellite results in a limited coverage area per satellite, unlike MEO or GEO satellites, which provide wireless connectivity services to broader regions. The limited network coverage of LEO satellites can be enhanced by deploying an increased number of LEO satellites. However, as the diversity of satellites increases, the constellations of LEO satellites and constellation-aware resource management become important to efficiently enhance the satellite services. For efficient resource management, a federated learning approach could be adopted between a ground station and LEO satellites. Information from multiple satellites could be aggregated to produce a global model, which can be utilized by satellites that contact the ground station. In this paper, we construct simulation environments for efficient federated learning in LEO satellite communications systems. With the constructed environments with actual parameters of federated learning updates, we show the feasibility of federated learning with an insight into learning delays impacts on LEO satellite systems.

Oral Session 5B : Advanced Communication Systems and Networks I

08:30-10:00 Gallery I Chair : Prof. Widad Ismail (Universiti Sains Malaysia, Malaysia)

5B-1) Proof of Concept (POC) for Queue Management in Sustainable Smart Community Automated Convocation

Author Jing Huey Khor (University of Southampton (Malaysia Branch)), Widad Ismail (Universiti Sains Malaysia)

Abstract Universiti Sains Malaysia (USM) conducted a proprietary convocation system using barcode technology before the year 2010. The proprietary system employed a vendor lock-in system which it was not a customizable system. In addition, the slow detection rate of barcode technology caused the congestion and long queue issues during a convocation ceremony. This paper presents a sustainable smart community automated convocation (SSCAC) using the integration of USM roll call system (USM CRC) with UHF RFID technology. The SSCAC system was utilized in the convocation ceremony at USM since the year 2010 and onwards to ease management of about 5700 graduates per year. Based on the results from the proof of concept, the SSCAC system has been proved and it was able to develop a simple, reliable and systematic flow movement with lesser human intervention as well as a faster detection rate than the proprietary convocation system.

5B-2) Design of a Scheme to Enhance Real-Time Performance for DDS-Based Encrypted Communication in ROS2

Author Hee-Jae Shin, Jae-Min Lee, Tae-Soo Jun and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract ROS/ROS2 is a robot software development framework used in many robots. ROS2 is based on DDS (Data Distribution Service) to improve security and real-time performance. ROS2's encrypted communication uses individual symmetric keys specified between particular Publishers and Subscribers, which are not duplicated with other Publishers or Subscribers. This is because ROS2 follows the DDS-security standard, encrypting with unique keys for each corresponding node pair. As a result, unlike plaintext communication that can be multicast, encrypted communication uses a unicast method, which has been pointed out as causing excessive communication time depending on the number of Subscribers. This paper aims to address the issue of having to send data individually due to the use of individual keys in ROS2's encrypted communication and seeks to ensure both security and real-time performance.

5B-3) Hybrid Energy Harvesting Development for Internet of Things (IoT)

Author Shum Kar Yen and Widad Ismail (Universiti Sains Malaysia)

Abstract Energy harvesting (EH) is an attractive and green solution to the problem in powering internet of things (IoT) in a rural environment which do not support power supply. Energy harvesting harvest energy from the ambient environment and replenishes its rechargeable battery had overcome the pitfalls associated with defining lifetime, which arise because EH never stops but can occasionally run out of energy. Due to the small dimension of a sensor node and exterior environment, the power supply attached to the sensor node has to be very limited in size and not able to produce enough power continuously. The proposed solar powered energy-harvesting system is the key technology for solving finite power problem. This scheme works on the principle of photo-voltaic effect. In order to enhance the efficiency and robustness of the system, the solar energy-harvesting system is designed by using a switching circuit and managing the charging of lithium battery. Lithium battery-charging is also used to afford a stable power supply with 5-V output voltage through a standard Universal Series Bus (USB) interface. The battery is charged once the voltage of lithium battery drops below the predetermined level with sufficient illumination of sun. The circuit was built and tested by a several series of experiment to investigate its performance and characteristic. It is demonstrated that the proposed energy harvesting mechanism could operate perpetually, given that the system is exposed to voltage more than 5V from solar panel for at least 5 to 6 hours in a day. It is tested that the solar panel implemented operates best in between 8V to 11V, in which providing a power of more than 1.465W. When the sun shines perpendicularly to the solar panel, the solar panel will also provide a relatively high output power which is at 4.219W.

Oral Sessions

5B-4) Model Plant Mismatch in FCS-MPC Implementation: A Tuning Guideline for Robust Performance

Author Ahmad Takiyuddin Abdullah, Sevia Mahdaliza Idrus and Shahrin Md Ayob (Universiti Teknologi Malaysia)

Abstract Finite Control Set Model Predictive Control (FCS-MPC) is essential for managing multilevel inverters in mobile, military, and maritime communication systems. However, discrepancies between the model and actual plant dynamics, known as Model Plant Mismatch (MPM), can degrade system performance and communication reliability. This paper addresses MPM in FCS-MPC by proposing a comprehensive tuning guideline to enhance robustness and control accuracy. The guideline includes systematic procedures for identifying critical parameters, adaptive tuning techniques to counteract parameter variations, and strategies for real-time model adaptation. Simulation confirm the effectiveness of this approach in improving performance and stability of multilevel inverters, ensuring reliable communication across diverse and challenging environments. This study provides a valuable framework for optimizing FCS-MPC systems, supporting the advancement of ICT convergence and resilient communication infrastructures.

5B-5) Recent Studies on Serverless Computing: Addressing the Cold Start Problem

Author Jaehwan Lee, Yeunwoong Kyung and Seungmin Oh (Kongju National University)

Abstract Serverless computing continues to be a promising and growing area of study in the field of cloud computing. In this paper, we investigate current research trends in serverless computing, focusing on addressing the cold start problem. Future research directions to enhance resource management efficiency are also discussed. Key areas include improving cold start latency and accurate workload prediction using machine learning techniques.

Oral Session 6A : Civil-Military ICT Convergence & System I

13:20-14:50 Concorde Ballroom Chair : Prof. Taesoo Jun (Kumoh National Institute of Technology, Korea)

6A-1) Short-Packet Based Power Allocation Using Quantum Neural Network in Downlink NOMA Systems for Military Communication

Author Won Jae Ryu (ICT-CRC), Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract The integration of the Internet of Things (IoT) into military operations represents a transformative advancement in leveraging technology for strategic military purposes. This study introduces a cutting-edge approach that enhances IoT functionalities in military applications by utilizing Non-Orthogonal Multiple Access (NOMA), short-packet communications, and Quantum Neural Networks (QNNs) for optimization tasks. With the imminent deployment of 6G networks, which promise enhanced connectivity and support for real-time, complex data analytics and machine learning, our research focuses on utilizing these advancements to improve communication systems crucial for military operations. We present a novel QNN-based power allocation strategy within NOMA systems, optimized specifically for the conditions of military communications within the Finite Block Length (FBL) regime. This method addresses the critical need for real-time radio resource optimization, while also ensuring massive connectivity in dynamic military environments. By effectively managing power distribution among NOMA user pairs, our approach aims to maximize spectral efficiency and enhance user connectivity, ensuring robust, reliable, and secure communications in line with the performance metrics required by military operations. Our findings indicate that the QNN-enhanced NOMA framework offers improvements in energy efficiency, delay reduction, and reliability—key factors in the operational success of military IoT systems in the 6G era.

6A-2) Federated Learning-Based Joint Radar-Communication mmWave Beamtracking for V2X-Communications

Author Sanjay Bhardwaj and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract Robust beamforming in millimeter-wave (mmWave) communication, vital for Vehicle-to-everything communication, faces challenges like short-range links due to path loss and obstacles. Privacy concerns and bandwidth constraints make transmitting the entire dataset impractical. To tackle this, a federated learning (FL)-based joint radar and communication mmWave beamtracking approach, FL-JRC, is proposed. FL-JRC employs a federated convolutional neural network (CNN) for vehicle users (local clients) and road side user (RSU) (main server) to estimate arrival/departure angles, optimizing beam tracking. Simulation results demonstrate superior performance compared to contemporary methods and two Kalman filter versions (extended and unscented).

6A-3) Node Election Scheme for Energy-Efficient Autonomous Underwater Vehicles

Author Young-June Kwon, Jae-Min Lee, Tae-Soo Jun and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract Recent research is being conducted on the operational concepts of the Korean-style unmanned maritime system. In particular, the operation of the Autonomous Underwater Vehicle (AUV), which is a component of the unmanned maritime system, is emphasized. AUVs require high energy efficiency because they perform underwater operations and must be able to transmit data to warships without tampering or alteration for military detection purposes. Recently, an energy-efficient blockchain-based multi-AUVs cooperative operation system has been proposed, featuring a leader node selection method based on residual energy. However, this method does not consider the distance to the sink node, which can affect energy efficiency, nor does it account for interoperability among heterogeneous devices. Therefore, this paper proposes a leader node selection method based on the residual energy and distance to the sink node, as well as communication based on Data Distribution Service (DDS). The proposed method shows higher energy efficiency compared to existing systems.

Oral Sessions

6A-4) Performance Analysis for Next Generation Integrated Naval Ship Network

Author "Min-Hui Jang and Neul-Som Lee (Kumoh National Institute of Technology), Hyeong-Jin Kim (NS Lab Co., Ltd), Jae-Min Lee (Kumoh National Institute of Technology), Young-Keun Go and Nak-Jung Choi (Agency for Defense Development), Jae Ho Lee and Jaehak Yu (Hanwha Systems), Taesoo Jun and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract The naval ship system includes functions to perform various missions and achieve military objectives through weapon systems, radar and sensors, and communication equipment. These systems can vary depending on the mission and operational environment of the ship, and they continue to develop with the advancement of technology. However, complexity is increasing due to the increase in various sensors and software and systems as the requirements increase due to technological advances. This may improve the ability to perform various tasks but may lead to difficulties in management and operation. Therefore, the need for changing the structure of trap networks is emerging to understand and manage this complexity. In this paper, an analysis of the new network structure was conducted to improve the combat and operational efficiency of the naval ship by systematically integrating the naval ship's system. This was simulated by modeling in consideration of the node and network characteristics of the naval ship's combat system, and reliable performance analysis was conducted by comparing values measured in a real system environment with the same structure and reference values.

6A-5) Intent Inference Method for an Intent-based System in Military Communications

Author So-Yeon Lee (Soonchunhyang University), Jungwook Choi and Soobum Park (LIG Nex1), Dae-Young Kim (Soonchunhyang University)

Abstract The rapid expansion of networked devices and the complexity of managing modern networks have led to the need for more sophisticated and automated solutions. This paper introduces Intent-based System (IBS), which extends the capabilities of traditional Intent-based Networking to cover a wide range of systems and applications beyond simple network management, and discusses in detail the intent inference methodology targeting military communications. The methodology automates the data-driven decision-making process based on user needs, which is especially beneficial in areas that require high reliability and adaptability, such as military communications. We expect that the IBS proposed in this paper will not only transform system management into a more proactive and preventive approach but also result in higher user satisfaction.

Oral Session 6B : Advanced Communication Systems and Networks II

13:20-14:50 Gallery I Chair : Dr. Wan Hafiza Wan Hassan (Universiti Malaysia Terengganu, Malaysia)

6B-1) Low Complexity MU-MIMO Scheduling for B5G Cellular Network

Author Satoshi Denno, Akihito Yamada and Yafei Hou (Okayama University)

Abstract This paper proposes a low complexity scheduling for uplink multi-user multiple-input-multiple-output (MU-MIMO) that takes an approach of iterative heuristic search. The proposed scheduling randomly selects some of all the users in a cell, and searches the best combination of users in the possible combinations of the selected users for the MU-MIMO communication. The proposed scheduling iterates the above user search, while the best combination of the user is carried over to the user combination search at the next iteration. The performance of the proposed scheduling is evaluated in a three-dimensional wireless network by computer simulation. Even though the proposed scheduling can be implemented with much less complexity than the optimum scheduling, the performance of the proposed scheduling is shown to be near as superior as that of the optimum scheduling.

6B-2) Channel Modeling Based on Ray Tracing for Wireless Transmission on Wood Materials

Author Nurul Fahmi Arief Hakim (Universitas Pendidikan Indonesia), Alyani Ismail, Nur Luqman Saleh and Aduwati Sali (Universiti Putra Malaysia), Nabil Taufiq Nur Izzat (Universitas Pendidikan Indonesia)

Abstract This article discusses the application of ray tracing techniques to channel modeling for MIMO-OFDM wireless communication systems in complex indoor environments. Signal propagation characteristics are analyzed using ray tracing methods, specifically the Shooting Bouncing Ray (SBR) method, which considers the variations in position between the transmitter (Tx) and receiver (Rx) as well as the impact of reflector material on the channel. The article aims to determine the interactions between propagation distance and path loss, power delay profile, and BER of 64-QAM modulation using ray tracing modeling. The method involves simulation with LDPC coding at a frequency of 3.5 GHz and AWGN channels. The modeling results show a path loss value of 92.88 dB for Rx1 and 97.20 dB for Rx2. BER increases with transmission distance due to increased degradation and interference encountered by the transmitted signal. Rx1 has a lower BER value compared to Rx2. Long-range signals are more susceptible to attenuation and possible interference, including multipath fading, noise, and interference, all of which can contribute to increased BER.

Oral Sessions

6B-3) A DDPG-based Framework to Optimize Hierarchical Rate Splitting Multiple Access

Author Anh-Tien Tran, Thanh Phung Truong, Manh Cuong Ho, Tung-Son Do, Quang Tuan Do and Dongwook Won (Chung-Ang University), Nhu-Ngoc Dao (Sejong University), Sungrae Cho (Chung-Ang University)

Abstract Rate-splitting multiple access (RSMA) is recognized as a promising solution for strengthening the performance of densely populated downlink networks that seek to meet the demanding needs of networks beyond 5G.These etworks may need the capacity to accommodate a substantial number of users concurrently using a single bandwidth spectrum.RSMA employs rate splitting during transmission and successive interference cancellation (SIC) during reception as its core principles. As the user count rises, the number of broadcast streams and possible decoding instructions grows exponentially. This study introduces a rate splitting method rooted in learning principles. It classifies users into hierarchical clusters and attaches a shared stream to each cluster. This hierarchical grouping ensures user clusters are of equal size, thus negating the necessity for user prioritization. The objective of this work is to enhance the efficiency of beamforming vectors, power allocations for transmission streams, and rate allocation of common messages by using the deep deterministic policy gradient (DDPG) approach.

6B-4) Design of an Antenna for Electronic Article Surceillance System Capable of Receving all Polarizations

Author Jinkyu Bang (KIOST), Jae Hee Kim (Korea University of Technology and Education)

Abstract This paper introduces the design of a new transmission (Tx) antenna for an Electronic Article Surveillance (EAS) system aimed at maximizing tag detection from various directions. Traditionally, Tx antennas used in EAS systems are designed to generate magnetic fields in specific directions. However, the orientation of tags attached to items is difficult to predict accurately, leading to areas where tag detection does not occur. To address this issue, this study proposes an antenna that uses three Tx coils to apply signals of different phases, thereby creating a magnetic field distribution that varies over time.

Oral Session 7A : Civil-Military ICT Convergence & System II

15:10-16:40 Concorde Ballroom Chair : Prof. Jae Min Lee (Kumoh National Institute of Technology, Korea)

7A-1) Blockchain-Inspired GPS Spoofing Detection for Zero-Trust Mission-Critical Military IoT Networks

Author Ahmad Zainudin and Revin Naufal Alief (Kumoh National Institute of Technology), Made Adi Paramartha Putra (Primakara University), Dong-Seong Kim and Jae-Min Lee (Kumoh National Institute of Technology)

Abstract Advanced battlefields utilize the Internet of Military Things (IoMT) devices with accurate global positioning system (GPS) information for communication and navigation. However, these modern battlefields are vulnerable to GPS signal spoofing attacks, which create an incorrect GPS signal as the legitimate navigation point. Furthermore, in the IoMT environment, one does not trust others, making it more challenging to develop secured military services. To address those issues, this study introduces a blockchain-inspired collaborative GPS spoofing detection (CGPS-SD) for zero-trust mission-critical military IoT networks. A blockchain-based decentralized authentication is employed to provide a trusted CGPS-SD framework. Based on the measurement results, the proposed CGPS-SD system outperforms existing approaches with enhanced security capabilities.

7A-2) Blockchain-enabled Token for Military Equipment Logistics

Author Ikechi Saviour Igboanusi, Cosmas Ifeanyi Nwakanma, Mirian Odigomma Igboanusi and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract This research explores the integration of blockchain technology into military equipment logistics, aiming to enhance security, transparency, and efficiency. By leveraging blockchain, a decentralized and tamper-resistant ledger, we establish a robust system for tracking and managing military assets throughout their lifecycle. Digital identity tokens, IoT-Driven updates, smart contracts, and security are the components of this blockchain-enabled system model. Each military equipment item is assigned a unique digital token on the blockchain. This token serves as its verifiable identity, containing essential information such as origin, maintenance history, and current location. Blockchain-enabled Internet of Things (IoT) devices are strategically deployed at various checkpoints (e.g., supply depots, and transport hubs). These devices continuously update the equipment's token as it moves from one location to another. Immutable records ensure data integrity. We implement smart contracts on the Ethereum blockchain. These self-executing contracts automate processes such as equipment transfer, maintenance scheduling, and compliance checks. Smart contracts enhance efficiency and reduce manual intervention. The blockchain's cryptographic security mechanisms protect against unauthorized access, fraud, and data manipulation. Additionally, redundancy across nodes ensures resilience even in challenging operational environments. Our empirical evaluation demonstrates that this blockchain-based approach achieves 98\% security, making it a promising solution for modernizing military logistics.

Oral Sessions

7A-3) Detecting DDoS in Internet of Military Things (IoMT) Data Caching: Machine Learning Approach

Author Love Allen Chijioke Ahakonye, Cosmas Ifeanyi Nwakanma and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract With its networked military equipment, the Internet of Military Things (IoMT) is bothered by severe security issues, hampering data accessibility and service delivery. Distributed Denial of Service (DDoS) incidents are risks that disrupt mission-critical activities. To detect DDoS assaults within IoMT data caching systems, this article investigated machine learning algorithms. Leveraging machine learning techniques, it adapts dynamically to evolving attack patterns, enhancing the resilience and availability of the cached data in the intricate IoMT networks. Extensive experiments demonstrate the significance of ensemble learning in addressing the intricacies of multiclass DDoS instances in IoMT networks.

7A-4) Revolutionizing Naval Logistics through NFT and Hyperledger Besu Integration

Author Gifar Arif Haryadi (Kumoh National Institute of Technology), Revin Naufal Alief (NS Lab Co., Ltd), Jae-Min Lee and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract The integration of blockchain technology holds significant promise in addressing the complex challenges of naval logistics. Centralized systems often fall short in ensuring data integrity, privacy, and traceability. This paper introduces a blockchain-based framework leveraging Hyperledger Besu and Non-Fungible Tokens (NFTs) to enhance naval logistics operations through improved asset management and operational efficiency. The system design incorporates privacy groups and permissioning to secure sensitive military data. Performance testing indicates that the system can effectively handle high transaction rates, with throughput capabilities of up to 191 transactions per second, while maintaining a latency of 2.38 seconds under high-load scenarios. This framework offers a scalable and secure approach to managing naval logistics, ensuring compliance with the stringent demands of military environments and operations.

7A-5) Bit extension method for improving dynamic degradation of digital chaotic maps

Author Hyojeong Choi, Gangsan Kim and Hong-Yeop Song (Yonsei University), Hongjun Noh (LIG Nex1)

Abstract This paper introduces a bit-extension method to improve the dynamic degradation occurring when implementing chaotic maps in digital systems. We first compare the periods and random characteristics of pseudo-chaotic sequences generated by this method with those generated by fixed-point operations at the same precision. Furthermore, for applications in secure communication requiring chaotic behavior, we introduce a combined chaotic system with improved period and random characteristics.

Oral Session 7B : Optical Communication Technology I

15:10-16:40 Gallery I Chair : Prof. Trio Adiono (Bandung Institute of Technology, Indonesia)

7B-1) Deterministic Bandwidth Allocation in Passive Optical Network with a Preemptive Approach

Author Nor Affida M.Zin, Sevia Mahdaliza Idrus, Arnidza Ramli, Fadila Mohd Atan and Nur Asfahani Ismail (Universiti Teknologi Malaysia)

Abstract Automation has become a prevalent change for many industrial systems nowadays. With increased real-time Human-to-Machine (H2M) and Machine-to-Machine (M2M) communications, stringent networking performance in terms of low latency and jitter are required. Hence, advanced optical access technologies should be capable of supporting the bursty development of IoT sensors, microchips, data centers, and cloud technologies. The rethinking of newest networking policy has proposed the deterministic Passive Optical Network (PON) with deterministic performance. For this goal, we propose a deterministic bandwidth allocation in PON with a preemptive approach. We model, validate and analyze the latency performance of each transmission container (T-CONT) class with the use of M/G/1 preemptive priority queue in Optical Network Unit (ONU). It is worth noticed that with preemption, transmission of high priority traffic has been guaranteed while achieving the network requirements.

7B-2) Performance Evaluation Transporting Multiservice RoF WDM System

Author R Mohamad (Telekom Research & Development), SM Idrus and NH Awang (Universiti Teknologi Malaysia), T Kanesan (Telekom Research & Development), S Yaakob (Universiti Putra Malaysia), Adam Wong Yoon Khang (Universiti Teknikal Malaysia Melaka)

Abstract RoF technology capable to carry multiples services as mobile backhaul technology. Experimental of multiservice RoF using WDM system are archieved and performance evaluation was done. Two services were considered are WiFi 802.11ac at 5.8GHz center frequency with 40MHz bandwidth, using 64QAM (2/3) data modulation and LTE FDD at 875MHz carrier frequency with 20MHz bandwidth and 64QAM data modulation. Quality signal (EVM) over 10km SMF distances is evaluated for both services respectively. An optimum range of received optical power at PD to ensure EVM value meet IEEE and 3GPP standard was recorded. The findings shows that transporting multiservice RoF using WDM system with 10km distance can be operated optimumly at received optical power -11dBm to -17dBm to ensure EVM for both signals are meet IEEE and 3GPP standard requirement (below 8%).

Oral Sessions

7B-3) Research Trends of WDM QKD and Satellite QKD in Quantum Communication

Author Seungho Yoon and Jun Heo (Korea University)

Abstract In this paper, we show the latest trends in recent WDM-QKD and QKD-satellite research. Recently, the QKD technique is used alone by QKD technology, but it is also merged with the WDM technique for application with the actual communication network. In addition, research on merging QKD technology and satellite communication for long-distance communication is being conducted. This paper analyzes how the QKD technique is being studied in these WDM and satellite techniques.

7B-4) Simulation Of Radar Cross Section of Foreign Object Debris Using High Frequency Simulation Software

Author Firdaus Hakimi, Sumiaty Ambran, Sevia Mahdaliza Idrus and Puteri Nadiah Syamimi Said Ja'afar (Universiti Teknologi Malaysia)

Abstract Safety term in aviation world is the most important thing. Foreign Object Debris (FOD) is the common thing that can be found on the airport runway around the world. Any type of FOD might cause an accident to the airplane. According to the Australian Transport Safety Bureau, on 27 November 2018, the nose wheel of Piper PA-31 was punctured caused by FOD on the runways. Effective ways to detect any hazardous on the runway is needed to ensure the safe and smooth airplane operations. The use of radar in FOD by reading the value of the radar cross section (RCS) continues to be developed over time. However, the use of radar in FOD detection is not effective without sufficient information because of the many types of FOD and also the many possible angles for each FOD which will result in various RCS values. Therefore, the focus of this project is simulation of edge light in different angles using Ansys High Frequency Structure Simulator at frequency of 93.1 GHz. The 12 different angles in the simulation will result in different surface areas reflecting the radar signal, and will also produce different RCS values. The wider surface area will give larger RCS value, and vice versa. Comparison of RCS values in simulation with experiments is also included in this project, where there is a large difference in values between experiment and simulation. This is due to distance, azimuth, and also the FOD environment. However, both have the same RCS value pattern. This project can be used as the basis information of detection FOD on the runway. This will improve the FOD detection system for aviation security systems.

7B-5) Performance Evaluation of Sampling Clock Offset Compensation in OFDM VLC System

Author Trio Adiono, Erwin Setiawan, Michael Jonathan, Rahmat Mulyawan, Nana Sutisna and Infall Syafalni (Bandung Institute of Technology)

Abstract In this paper, we present simulation and FPGA verification results of the sampling offset effect in visible light communication (VLC) orthogonal frequency division multiplexing (OFDM) system. We model the sampling clock offset effect that consists of frequency offset (SFO) and phase offset (SPO). These effects cause rotation in the constellation, thus increasing the BER. We found that the SFO can be compensated using SFO compensator, while the SPO can be compensated using MMSE equalizer. Our simulation results show that the SFO compensator can compensate SFO effect from -100 to 100 ppm with EVM values below 10% and the MMSE equalizer can compensate SPO effect from -0.5 to 0.5 with EVM values below 10%.

Oral Session 8A : Civil-Military ICT Convergence & System III

16:50-18:20 Concorde Ballroom Chair : Prof. Gabriel Avelino Sampedro (University of the Philippines, Philippines)

8A-1) Comparison of YOLO-NAS and Roboflow 3.0 for Local Firearms Detection and Recognition

Author Cosmas Ifeanyi Nwakanma (Kumoh National Institute of Technology), Ikenna Uzoma Ajere (Federal University of Technology Owerri), Ebuka Chinaechetam Nkoro, Judith Nkechinyere Njoku, Love Allen Chijioke Ahakonye and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract Mass shootings, terrorism, and small firearm trafficking account for the rise in causes of death and grave injuries in most countries. However, one of the critical security concerns is the detection, screening, and recognition of small and locally handcrafted firearms. Deep learning though has played promising roles, more research options are still available. This work compared two recent object detection models - YOLO-NAS and Roboflow 3.0. In addition, we demonstrated the potential for collecting gun datasets that recognized the local guns to increase the robustness of the performance evaluation of deep learning models for gun detection. Results show that the hybrid adoption of YOLO-NAS and Roboflow 3.0 offers a potential for accurate, efficient, and real-time firearm detection and recognition for security and screening.

8A-2) Design and Implementation of Simulator for Large-scaled Naval Combat Systems

Author Jae-Woo Kim, Gi-Hyeob Kwon and Dong-Seong Kim (Kumoh National Institute of Technology), Won-Jae Ryu (ICT-CRC), Jae-Ho Lee and Jae-Hak Yu (Hanwha Systems)

Abstract This paper proposes and implements a simulator design method for analyzing the performance of large-scaled naval combat systems. Through the simulator, it is possible to analyze the performance of the naval combat system network and ensure its suitability before actual network configuration. The proposed simulator is a comprehensive tool that not only tests the performance of the network devices constituting the naval combat system but also considers the performance of processing units. Additionally, it takes into account characteristic network traffic used in naval combat networks. Therefore, this paper derives requirements for simulating naval combat system and designs and implements a comprehensive simulator that meets these requirements. The simulator analyzes network performance and parameterizes the resources of each processing unit in the naval combat system to reflect the performance results. The proposed comprehensive simulator enables optimization of network configuration for naval combat systems and facilitates stability assessment, among other functionalities.

Oral Sessions

8A-3) Visualization Scheme for Naval Combat System Network Simulator

Author Seung-Min Lee, Neul-Som Lee, Min-Hui Jang, Jae-Min Lee, Tae-Soo Jun and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract The initial naval combat system was designed to meet requirements such as navy performance, safety, survivability, and scalability. However, the next generation naval combat system requires design considerations beyond these requirements, including increased system efficiency, reduced system weight, improved operability, and enhanced security, among others. Therefore, it is difficult to meet these additional requirements with the initial design alone. Furthermore, sensor nodes in the distributed control network exchange large amounts of data in real-time, placing a burden on CPU processing capabilities and causing performance degradation and other issues. To address this, research on network performance analysis and optimization schemes is needed. While there are various network simulation tools available, NS-3, which offers advantages in data collection, visualization, and analysis of simulation results, is suitable for validating naval network designs. However, NS-3 has complex initial setup requirements and lacks visualization tools. Therefore, in this paper, we design a naval combat system scheme based on 3D network simulation. Through a 3D virtual environment, we can design a network model similar-to the real environment and provide a 3D-based GUI for effectively validating simulation results.

8A-4) TwinMil: Semantic Segmentation-based Digital Twin Framework for Military Surveillance

Author Judith Nkechinyere Njoku, Cosmas Ifeanyi Nwakanma and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract This study proposes a novel framework that combines instance segmentation and digital twin technology to improve military surveillance. Integrating precise object identification with dynamic environmental modeling addresses critical surveillance challenges. This integration enables enhanced asset recognition and decision-making support- representing a substantial advancement in surveillance capabilities.

8A-5) Modular Open System Approach (MOSA) for Defense Unmanned Systems

Author Min-Seon Lee, Jae-Min Lee, Tae-Soo Jun and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract The U.S. defense unmanned systems face numerous limitations due to inefficiencies such as technological redundancies resulting from the development of various small-scale and diverse unmanned systems, as well as difficulties in maintaining operations due to high-performance requirements for achieving complex missions. In response, the U.S. Department of Defense has introduced and mandated the implementation of the Modular Open System Approach (MOSA) to achieve significant cost savings, schedule reductions, rapid adoption of new technologies, technological upgrades, interoperability between systems, and mission integration, among other benefits. Recently, the South Korean Ministry of National Defense has been pursuing a policy of defense unmanned system standardization and modularization, known as the Korea-tailored Modular Open System Approach (K-MOSA). Therefore, this study aims to explore the research trends for the advancement of South Korea's defense unmanned systems through an analysis of the Modular Open System Approach (MOSA) in the United States.

Oral Session 8B : Optical Communication Technology II

16:50-18:20 Gallery I Chair : Prof. Yonggang Kim (Kongju National University, Korea)

8B-1) Deep Learning-Based Classification of Laguerre-Gaussian OAM Beams in Atmospheric Turbulence and Thermal Convection

Author Young Jae Moon and Yeon Ho Chung (Pukyong National University)

Abstract This paper discusses a free-space optical communication system that uses a Laguerre-Gaussian beam carrying orbital angular momentum. Through the optical channel, both intensity and phase images suffer from atmospheric turbulence and mirage from the high-thermal environment. We demonstrate the distorted original image and the topology of the regeneration process with the help of the convolutional neural network system. With this result, we simulate more realistic transmission and produce empirical outcomes by implementing various transmission conditions for optical communication.

8B-2) Mathematical Detection Modeling for OAM-based MIMO Free Space Optical System

Author Merhawit Berhane Teklu and Yeon Ho Chung (Pukyong National University)

Abstract In free space optical (FSO) communications, orbital angular momentum (OAM) multiplexing has recently gained considerable attention. The propagation of OAM modes through free space can be affected by atmospheric turbulence distortions that cause intermodal crosstalk and power disparities between OAM modes, as well as mode-dependent losses (MDL), which can degrade system performance. In this paper, we propose an improved reduced-search maximum likelihood (ML) detection that offers near-ML performance while avoiding the computational complexity of ML detection.

Oral Sessions

8B-3) Orbital Angular Momentum States Beamforming for Multiuser Optical Wireless Network

Author Siti Hasunah Mohammad and Yeon Ho Chung (Pukyong National University)

Abstract Recognized because of its orthogonal characteristic which can provide high-capacity communication channel, orbital angular momentum (OAM) has become one of the promising technologies to enhance the Internet of Things (IoT) applications. As the orthogonality of the OAM beam provides big advantages in multiuser optical wireless network (OWC), it is the key interest that the higher capacity can be achieved further by beamforming method of the OAM states. In this paper, we proposed the derivation of ultraviolet (UV) channel impulse response considering the Laguerre-Gaussian beam with OAM states based beamforming to increase the channel capacity of the OAM-carrying UV communication system. It is shown via simulation that the proposed OAM states beamforming using UV channel impulse response achieves higher channel capacity and better error performance than the conventional single OAM state carrying UV beam.

8B-4) Precoding Scheme for Indoor Channel Modelling in OAM-based MIMO Communication System

Author Merhawit Berhane Teklu and Yeon Ho Chung (Pukyong National University)

Abstract Due to its low transceiver complexity, mode division multiplexing (MDM) using orbital angular momentum (OAM) has recently been explored as a new physical layer indoor wireless transmission technique. In practical applications, there are interferences between multiple users/pairs using OAM-based communication techniques. To mitigate the interferences and optimize the system performance, we mathematically characterize the OAM wireless channel using Laguerre-Gaussian (LG) beams, and then optimize the sum rate by designing the precoder matrix for each transmitter using leveraging of leakage concept.

8B-5) Beam Pointing for FSOC with Spatial Diversity

Author Hong-Seol Cha (Korea University), Byungju Lim (Pukyong National University), Young-Chai Ko (Korea University)

Abstract Free space optical communications (FSOC) which adopt spatial diversity is actively underway to mitigate the effects of atmospheric turbulence and pointing error. Although beam pointing greatly affects the performance of FSOC, the beam pointing that maximize the performance have not been studied yet. In this paper, we analyze the convexity condition of the optimization problem for the center coordinates of the transmitted beam footprint maximizing the received signal-to-noise ratio (SNR) in a single-input multiple-output (SIMO) FSOC, which is affected by the atmospheric turbulence and pointing error.

Oral Sessions

August 09 (Friday)

Oral Session 9C : Blockchain and security for ICT convergence

08:30-10:00 Gallery II — Chair : Dr. Azizul Azizan (Universiti Teknologi Malaysia, Malaysia)

9C-1) Transactions Time Synchronization for Time-Critical Blockchain

Author: Ahmad Akmaluddin Mazlan, AZIZUL AZIZAN, Noor Hafizah Hassan, Abdul Ghafar Jaafar and MOHD SYAHID MOHD ANUAR (Universiti Teknologi Malaysia), Mohamad Sofian ABU TALIP (Universiti Malaya)

Abstract: Time synchronisation is crucial in the field of time-critical applications. Although blockchain networks are chronologically ordered, Hyperledger Fabric (HLF) sequential processing during transaction validation causes time drift, impacting inaccurate transaction timestamps. These drifted transaction timestamps are exacerbated and decreased validity with increased number of nodes for time-critical applications. This research adopts and compares time synchronisation methods; (1) Tiny-Sync (TS) protocol and (2) Maximum Likelihood Estimator (MLE) to correct inaccurate timestamps for time-critical transactions, reflecting real-world time, for different node counts (two and three nodes). This research evaluates both methods through accuracy metrics. The results show that MLE outperforms TS in homogeneous setups with higher accuracy evaluations. This implies that both adopted methods can effectively synchronise and improve transaction timestamp accuracy, even in larger setups.

9C-2) Study on Trends in Blockchain-Based Energy Trading

Author: Da-Jung Lee, Ik-Hyun Kwon and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract: This study investigates cases where blockchain technology is applied in the energy trading sector, examining the potential value and prospects of blockchain technology in the energy trading market. Through previous research, it was found that blockchain-based energy trading offers advantages such as decentralization, transparency, security, trustworthiness of energy transactions, and efficient management with real-time monitoring. However, additional research is needed to address regulatory constraints and ensure the stability and scalability of practical industrial applications. Furthermore, to overcome inefficiencies in energy markets worldwide, blockchain-based distributed trading systems, including automated demand-supply contracts and incentivized compensation mechanisms, are expected to contribute to driving innovation in future energy markets.

9C-3) Enhanced Secure Communication in Maritime Tactical Networks Using Quantum Cryptography

Author: Esmot Ara Tuli, Mohatsin Golam, Jae-Min Lee and Dong-Seong Kim (Kumoh National Institute of Technology)

Abstract: The growing occurrence of cyber attacks requires advancing more complex encryption methods to protect sensitive communication in marine tactical networks. The study introduces Quantum DNA Partial Permutation (QDPP), a cryptographic system that combines quantum cryptography, DNA computing, and permutation-based methods to secure confidential communication in marine tactical networks. The protocol entails the interchange of two tables: a DNA Mapping table and a Rules table, which facilitate the sender and recipient's encoding and decoding of messages. The encryption procedure entails applying permutation rules from a pre-shared Rules database, selected according to a specific basis selection. The proposed approach uses the IBM Qiskit simulator, demonstrating its viability and capacity to enhance security in demanding underwater conditions.

9C-4) Study on development of security requirements for CMVP security level1

Author: Sun-Woo Lee, Tae-Hun Kim and Jun-Young Lee (KEPCO KDN), Ieck-Chae Euom (Chonnam National University)

Abstract: This study focuses on the application and evaluation of anti-tampering techniques within the Cryptographic Module Validation Program(CMVP) for software-based cryptographic modules. It recognizes the need for enhanced security measures against tampering attempts and proposes a new methodology to integrate anti-tampering requirements into cryptographic module validation. To this end, experiments were conducted on Windows, Linux and Embedded Linux platforms to select appropriate anti-tampering techniques for cryptographic modules and evaluate them from the perspective of CMVP security requirements. This contributes to strengthening the security of cryptographic modules and is expected to help establish new standards for enhancing the reliability of information security systems.

9C-5) Exploring network security with MTD in Mininet

Author: Gilhan Choi and Yonggang Kim (Kongju National University)

Abstract: This paper presents a comprehensive exploration of moving target defense (MTD) in virtual network environments utilizing Mininet. The study delves into the theoretical underpinnings of MTD technologies, elucidates the practical implementation process within the Mininet framework, and provides a detailed exposition of employing IP hopping for constructing virtual networks. Additionally, Python code snippets are provided to facilitate understanding and replication of the setup. The findings underscore the efficacy of MTD strategies in enhancing network security and resilience against evolving threats.

Oral Sessions

Oral Session 10C : Big data and its applications

10:20-11:50 Gallery II Chair : Dr. Siti Hasunah Mohammad (Pukyong National University, Korea)

10C-1) 3D Positioning Algorithm based on Decision Tree Classification Model in Indoor UWB Environment

Author Ho Chul Lee and Dong Myung Lee (Tongmyong University), Hee Min Park (Sky-Tech Co.Ltd.), Gyoungbae Kim (Seowon University)

Abstract In this paper, we propose a novel 3-dimensional (3D) positioning algorithm based on a decision tree classification model using heuristic depth searching and the median absolute deviation (MAD) cost function. Our algorithm enables accurate 3D positioning of tags, even in challenging blind spots commonly encountered in indoor ultra-wideband (UWB) environments, thereby enhancing the reliability of indoor positioning systems. To train our algorithm, we leverage a heuristic depth search method designed to handle limited distance measurement data, particularly in scenarios where trilateration is impractical. Additionally, we optimize the decision tree classification model using the MAD cost function to refine tag positioning, particularly in complex indoor settings.

10C-2) Smart Farm: Acquiring and Analyzing Environmental Data

Author Hoon-Seok Jang (Korea Electronics Technology Institute)

Abstract Thanks to the advancement of information and communication technology (ICT), the development of Internet of Things (IoT)-based technologies is enhancing the quality of life and expanding its applications to diverse fields. In particular, smart farms have been gaining attention as a solution to the sustainability crisis faced by rural areas of Korea. A smart farm is a farm that optimizes the growing environment for crops to increase productivity and quality. If the relationships between environmental data in smart farms are analyzed, additional productivity enhancement and crop management will be possible. This paper proposes a method for analyzing the relationship between environmental data in a testbed for smart farm. To achieve this, nine data is initially acquired through RS-485 communication between the main and sensor boards, and stored in a database. Subsequently, the stored data is downloaded in Excel sheet format and subjected to analysis via histogram analysis, data chart analysis, and correlation coefficient heatmap analysis. This enables the confirmation of data distribution, trends in data changes, and correlations. We plan to conduct more detailed and accurate data analysis through the acquisition of long-term data in the future.

10C-3) Design of Performance Measurement System for Non-Face-To-Face Remote Workers

Author Min Goo Lee and Yong Kuk Park (Korea Electronics Technology Institute), Kyung Kwon Jung (Dongshin University)

Abstract The COVID-19 pandemic triggered an unprecedented shift in work practices, propelling millions towards remote work arrangements. However, the companies are seeking methods for assessing the productivity and effectiveness of their non-face-to-face employees. This paper proposed the complexities of performance measurement in the remote work landscape, proposing a framework for evaluating employer efficacy in this new normal. A few indices were developed to reflect the performance measurement for remote workers who work from home or remote office is presented through the combined use of the fuzzy comprehensive evaluation and the entropy weight decision-making method. The fuzzy set approach was adapted to identify the membership degree of each index to various evaluation results, whereas the entropy weight method is used to acquire the sets of weighting factors. This method represented a unified one of the quantitative results obtained from the system data and the qualitative results based on the judgment of human resource domain experts. Finally, practical examples were served for demonstrating the developed approach.

10C-4) Forecasting Daily Demand in the Busan Metro Using LSTM-Based Encoder-Decoder

Author San-Hyun Hwang, Jun-Hyeong Park and Jeong-Won Seo (Pukyong National University), Pil-Goo Jeong and Jung-Tae Kim (Busan Transportation Corporation), Jun-Pyo Hong (Pukyong National University)

Abstract In this paper, we investigate deep learning-based time series forecasting for predicting the daily number of passengers in the Busan metro. To achieve this, we use daily passenger data from the past ten years provided by the Busan transportation corporation and employ an LSTM (Long Short-Term Memory) based encoder-decoder model. In addition, we analyze the correlation coefficients between Busan metro passenger numbers and various external independent variables, followed by constructing a time series forecasting model for passenger numbers. The experimental results show that the model performs best when trained with independent variables that have an absolute correlation coefficient of 0.25 or higher with passenger numbers. The proposed advanced metro demand forecasts can improve the cost efficiency of the Busan metro system by enabling appropriate train scheduling and budget planning.

Oral Sessions

10C-5) Leveraging Data Mining and NLP for Service Readiness: The Case of Hotel Industry

Author Moner Alajeli Farj Abouoden and Siti Sophiayati Yuhaniz (Universiti Teknologi Malaysia)

Abstract The rapid advancement of technology and the increasing availability of customer feedback through digital platforms have created new opportunities for evaluating service readiness across various industries. This study introduces a general-purpose framework utilizing data mining and natural language processing (NLP) techniques to assess service quality and operational efficiency. The framework is demonstrated through a case study focused on the hotel industry, where customer reviews from multiple web platforms are analyzed to extract insights into service readiness. Our approach involves systematically extracting aspect words from reviews, filtering relevant aspects, categorizing these aspects into predefined dimensions of service quality, and scoring their polarity to determine readiness levels. By leveraging these advanced techniques, we provide a comprehensive and data-driven assessment of hotel readiness, highlighting strengths and areas for improvement. The findings offer valuable insights for hotel management, enabling more informed decision-making to enhance service quality and customer satisfaction. Furthermore, the versatility of the proposed framework allows its application to other sectors such as retail, healthcare, and military, demonstrating its broad utility in assessing service readiness. This research underscores the potential of integrating data mining and NLP techniques to transform traditional service evaluation methods and drive improvements in various industries.

10C-6) Application of Big Data Analytics in Airside Operations To Improve Wildlife Hazard Management For The Case of Malaysia Airports

Author Tisiyanah Abd Baki, Badriyah Noordin, Norliza Mohamed and Sevia Mahdaliza Idrus (Universiti Teknologi Malaysia), Nor Azlina Mohd Isa | Malaysia Airports Holdings Berhad, Syamil Azmin (Universiti Teknologi Malaysia)

Abstract Air travel provides vital links for the burgeoning global tourism industry. It is estimated that over half (58%) of all international tourists travel by air, so the aviation and tourism industries depend on each other for sustainable growth. In the aviation industry, big data plays a transformative role across various facets of aviation operations to ensure seamless traveling. Moving together with other countries towards Big Data Analytics, Malaysia Airports Holdings Berhad (MAHB) without exception also embarked in this journey. With many layers of operations, each layer has its own way of integrating with Big Data Analytics. For instance, by using web-based application, IoT, radar over fiber and many more, many system like Airport Collaborative Decision Making (A-CDM), MAVCOM Bus Performance Report, the biometric facial recognition system called EZPaz, self-bag drop facility called EZBagz, Digital Integrated Airside Services System (DIASS), the Foreign Object Debris Detection System (FODDS), Airside Wildlife Safety Data, the Airside Closure Coordination Platform, Customer Real-Time Feedback & Survey System (CRFSS) at the terminal and Operational Information System, Electronic Centralized Documents Management System (eCDMS), and many other operational systems are available at KL International Airport (KLIA). Airside Wildlife Hazard Management at KL International Airport (KLIA) in the perspective of Big Data Analytics will be discussed in this research.

Poster Sessions

August 08 (Thursday)

Poster Session

16:50-18:20 Lobby

Chair : Dr. Jinkyu Bang (KIOST)

P-1) Performance Analysis of Ultrasonic-Based Localization: Impact of Receiver Spacing and Array Distances

Author JaeJun Lim, Jaehan Joo, Hunyoul Lee, Dongjhin Noh and Suk Chan Kim (Pusan National University)

Abstract In this paper, we investigate the impact of transmitter and receiver placement on Active ultrasonic localization. We analyze the variation in localization performance based on the distance between transducers and receiver arrays, the spacing between receivers, and the arrangement of objects. Through simulation, we demonstrate and analyze the effect of transmitter and receiver placement on position estimation and Angle of Arrival (AOA) estimation when employing the Threshold Crossing algorithm.

P-2) Enhancing IoT connectivity: Implementation of Zigbee Direct for interoperability in multiprotocol network

Author Seonghyeon Park, Jaehan Joo, Minseok Kim and Suk Chan Kim (Pusan National University)

Abstract In this Work-in-process paper, we investigate Zigbee Direct, wireless communication technology between Zigbee and Bluetooth Low Energy(BLE). Through simulation, we demonstrate that Zigbee and BLE devices can communicate through a Zigbee Direct device. Additionally, we show that a BLE device can monitor the status of a Zigbee Direct device.

P-3) Covertness Analysis for the Covert Communications in Multi-antenna Two-way Relay Systems

Author Zhilin Fu (Korea University), Jihwan Moon (Hanbat National University), Sangwon Hwang and Sangmin Kim (Korea University), Di Zhang (Zhengzhou University), Inkyu Lee (Korea University)

Abstract In this paper, the covert communications in multi-antenna two-way relay systems is studied. While the relay primarily assists in forwarding public messages between two source nodes, it also attempts to deliver covert information without being detected by an illegitimate node, who is often referred to as a Warden. The detection error probability (DEP) at the warden is a key metric for determining covertness, which is also essential in the subsequent design of covert communication strategies. We derive the closed-form solution of DEP and analyze the DEP performance in different scenarios.

P-4) A Localization Algorithm using k-Nearest Neighbors in Indoor UWB Environment

Author Mookyung Jung (Goodmorning Information Technology), Dong Myung Lee (Tongmyong University), SooK Kyoung Cho (Nestors Co.,Ltd.), Kwangchul Jung (Dankook University)

Abstract This paper proposes a localization algorithm using k-nearest neighbors (k-NN) in an indoor ultra-wideband (UWB) environment. The experimental data under non-line of sight (NLOS) conditions and the actual coordinate performance with distance compensation using k-NN are analyzed. The proposed system utilizes learning data generated from experiments to determine line of sight (LOS) or NLOS states using k-NN, allowing for the calculation of standard deviation to account for distance value variations in LOS. This system aims to enhance reliability by reducing localization errors caused by NLOS and multipath effects typical in indoor positioning, thereby improving accuracy.

P-5) An Indoor Localization Algorithm using Pose Estimation Method in Obstacle Environments for Pedestrians

Author Tae Wan Kim and Dong Myung Lee (Tongmyong University), SooK Kyoung Cho (Nestors Co.,Ltd.), Kwangchul Jung (Dankook University)

Abstract In this paper, we propose an indoor localization algorithm named weight real-time model using pose estimation method for pedestrians (WRTMDet PEM), designed to detect pedestrian objects and accurately estimate their locations based on real-time images in indoor environments with obstacles. Our experiments demonstrate the effectiveness of the proposed algorithm in estimating pedestrian locations under these challenging conditions. Additionally, we evaluate the algorithm's performance across various pose models in non-obstacle, virtual obstacle, and actual obstacle environments.

P-6) Real-Time Sports Pose Estimation Training based on Skeleton Simulation

Author Geon-Woo Kim, Ji-Yoon Kweon, Ji-Soo Kim, Woo-Hyeon Kim, Jeong-Eun Kim and Kyungyong Chung (Kyonggi University)

Abstract In modern society, as awareness of health increases, the importance of exercise is emphasized. However, many people are unable to exercise adequately due to time and economic constraints. Furthermore, incorrect exercise postures can lead to injuries, making it essential to maintain accurate poses. This study aims to develop a program that precisely identifies users' exercise postures through pose estimation of exercise videos using YOLOv8-pose, and suggests personalized exercise methods based on this information.

Poster Sessions

P-7) Data Placement Policy considering File System Input/Output Characteristics for Maritime IoT Platform

Author Sungmin Koo (KIOST), Gunhee Choi and Jongmoo Choi (Dankook University), Juhyun Kim and Seungjae Baek (KIOST)

Abstract For an efficient maritime IoT platform, it is essential to consider the lifespan and performance of storage devices. IoT devices generally adopt flash memory as storage devices, which has many advantages over HDDs. In flash memory, the data placement policy highly influences the computer system performance and storage lifetime. In this paper, we propose a novel data placement policy considering file system input/output characteristics for maritime IoT platform. In terms of the file system, meta and journal data are hot data as they are more frequently accessed than user data. Using the file system's semantic information, the proposed scheme discerns hot data, including meta and journal data, and then places hot data into the same block. As our hot data classification is inferred from the immovable file system structure, our scheme is free from faulty classification. The proposed scheme is implemented with a QEMU-based flash memory simulator called FEMU, and demonstrated by Postmark benchmark. The results show that our scheme improves the storage performance by about 38.67% in EXT4 and by about 10.55% in XFS. Also, we demonstrated that the proposed scheme can lengthen the storage lifetime by about 9.1% in EXT4 and by about 3.9% in XFS.

P-8) Design of Smart Urban Environmental Monitoring System using Personal Mobility Devices

Author Kyung Kwon Jung (Dongshin University), Yeon Man Jeong (Gangneung-Wonju National University), Byung Sang Choi, Ho Soon Jang and Yong Joong Kim (Korea Polytechnics Wonju-Campus)

Abstract This paper presents a smart urban environmental monitoring system that utilizes personal mobility devices, specifically electric scooters and bikes, equipped with low-cost environmental IoT sensor modules. These modules comprise ESP32 microcontroller units, LTE-Cat.M1 device for real-time data communication, GPS for location tracking, and environmental sensors for measuring temperature, humidity, PM10, PM2.5, volatile organic compounds (VOCs), and nitrogen oxides (NOx). Data collected from these sensors are logged in real-time to server, including latitude, longitude, and sensor readings, enabling comprehensive urban environmental analysis. Furthermore, the use of Google Maps API enhances the system's ability to depict the routes taken by the e-scooters along with sensor readings. This feature offers a clearer understanding of the varying environmental conditions throughout distinct urban sectors.

P-9) Research On The Development Of Suction Pump Packages for Installation and Dismantling of Co2 Subsea Injection System

Author Hyun Kang and Osoon Kwon (KIOST)

Abstract In this paper, we conducted research on a suction pump package, which serves as the foundational equipment for CO2 subsea injection systems aimed at reducing carbon emissions. In South Korea, where securing onshore CO2 storage sites is challenging, the development of deep-sea CO2 injection technology utilizing the East Sea and the West Sea is crucial. This technology is primarily employed to connect CO2 emission sources such as power plants and refineries located along the coast to storage sites, making CO2 subsea storage systems indispensable. While research on CO2 subsea storage systems is ongoing domestically as a vital component of marine plants, there is a lack of investigation into CO2 fluid subsea storage systems for deep-sea conditions. Moreover, existing CO2 subsea injection facilities face various challenges during installation and decommissioning processes. To address these challenges, we developed a CO2 subsea injection suction pump package and conducted research on design technologies optimized for South Korea's subsea soil conditions. Additionally, we derived the design and fabrication techniques for a suction and pile batch installation package tailored to domestic subsea soil conditions, which can be operated under deep-sea conditions.

Travel Information

Petronas Twin Towers

The Petronas Towers also known as the Petronas Twin Towers and colloquially the KLCC Twin Towers, are an interlinked pair of 88-story supertall skyscrapers in Kuala Lumpur, Malaysia, standing at 451.9 meters (1,483 feet). From 1998 to 2004, they were officially designated as the tallest buildings in the world until they were surpassed by the completion of the Taipei 101. The Petronas Towers are the world's tallest twin skyscrapers and remained the tallest buildings in Malaysia until 2019, when they were surpassed by The Exchange 106. The Petronas Towers are a major landmark of Kuala Lumpur, along with the nearby Kuala Lumpur Tower and Merdeka 118, and are visible in many places across the city.

Batu Caves

Batu Caves is a mogote with a series of limestone caves in Gombak, Selangor, Malaysia. It is located about 13 km (8.1 mi) north of the capital city of Kuala Lumpur. The cave complex consists many Hindu temples, the popular of which is a shrine dedicated to Hindu god Murugan. It is the focal point of the Tamil festival of Thaipusam in Malaysia. The complex also hosts of a 43 m (141 ft) high Murugan statue, one of the largest Murugan statues in the world.

Langkawi

Langkawi, officially known by its sobriquet Langkawi, the Jewel of Kedah, is a duty-free island and an archipelago of 99 islands (plus five small islands visible only at low tide in the Strait of Malacca) located some 30 km off the coast of northwestern Malaysia and a few kilometres south of Ko Tarutao, adjacent to the Thai border. Politically, it is an administrative district of Kedah, with Kuah as its largest town. Pantai Cenang is the island's most popular beach and tourist area.

Penang

Penang is a Malaysian state located on the northwest coast of Peninsular Malaysia along the Strait of Malacca. It has two parts: Penang Island, where the capital city, George Town, is located, and Seberang Perai on the Malay Peninsula. These two halves are physically connected by the Penang Bridge and the Second Penang Bridge. The state shares borders with Kedah to the north and east, and Perak to the south.

Travel Information

Malacca (Melaka)

Malacca (Malay: Melaka) is known as the historic city of Malaysia owing to its deep connection with the historic era of both the Sultanate period and the colonialism. The state is located in the south-west direction of the Malay Peninsula and is territorially bordered by Johor and Negeri Sembilan. Malacca is actually an area of low-lands with the occasional presence of some hills. The state is like Malaysia's pride owing to the rich reserves of history that still breathes in the Malaccan air. The richness of culture and heritage made it a UNESCO protected heritage site in the year 2008 and since then it has attracted flocks of tourists from all over the world.

Cameron Highlands

Cameron Highlands in Pahang is one of Malaysia's most popular tourist destinations, a collection of peaceful townships perched 1500 meters high on a nest of serene mountains. Cooling resorts, tea plantations and strawberry farms sprawl lazily across lush valleys and meandering hillslopes, the perfect setting for a relaxing holiday. The sea of tranquility, pleasant landscapes and cold climate impart a special experience upon the multitudes of visitors each year. Meanwhile, a different world lies hidden away among the natural surroundings - a rainforest ecosystem rich with the wonders of nature, long held with fascination by researchers and naturalists across the world.

Taman Negara

Taman Negara is home for wildlife and untouched tropical rainforest. The size of Taman Negara is 4,343 km² equal to 7 size of Singapore. Taman Negara covers an area of over a million acres spanning 3 state: Pahang, Kelantan and Kuala Terenggranu. The highest peak is "Mout Tahan" with height of 2187m. Although is not the highest but it's the hardest to climb

Perhentian Islands

Northeast of Peninsular Malaysia, nearby the city of Kota Bharu, there are two small islands that form the Perhentian Islands. The names are Perhentian Besar, the larger of the two and popular among couples and families with children, and Perhentian Kecil, the smaller island and very popular among budget travelers. Both the islands have plenty of accommodation available to stay overnight. This ranges from luxurious resorts that offer cabanas complete with air-conditioning, to simple lodges where you will have to do with cold water and a fan. There are no (internationally renowned) hotels. Perhentian is most popular because the great places for diving and snorkeling; in most cases you can enjoy the underwater world right in front of the resort. It is also very popular because the island is easy to reach; though during the monsoon season (October to March) practically the whole island is closed to tourists. As Perhentian Island is part of a marine park visitors have to pay a conservation fee of RM5. The island is situated about 20 kilometers off the northeastern coast of Peninsular Malaysia.

Memo

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