

ICMIC 2022 International Conference on Maritime IT Convergence

**"Accelerating Convergence of Maritime,
Terrestrial and Aerial Communications for the 6G Era"**

Final Program

Date September 22 (Thur) ~ 23 (Fri), 2022

Venue Sono Calm, Jeju Island, Korea

Organized by



The Korean Institute of
Communications and
Information Sciences

Patrons



(주)제이와이시스템
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General Information

The International Conference on Maritime IT Convergence (ICMIC) will be inaugurated in 2022 with aims to promote convergence activities of maritime and terrestrial communications as well as related wireless communications. Recognizing that maritime communications will usually involve ship-to-ship and ship-to-shore communication, maritime ICT technologies will bring some mature but still evolving terrestrial wired/wireless communication technologies to its own use for future smart maritime communications. More specifically, the conference will focus on addressing challenges of maritime communications with ICT convergence or advanced wireless communications over various industrial sectors, academia and practice engineers. The conference will include keynote speech sessions, invited special sessions and technical paper sessions.

Message from the Chairs

Dear members of The Korean Institute of Communications and Information Sciences (KICS) and participants of the ICMIC 2022.

It is already close to the end of the September 2022. As we slowly move ahead towards the ordinary life, with the long and tiresome COVID-19 pandemic behind, ICMIC 2022 will be held in September, in the Jeju Island. The event will be on/off hybrid since we are not fully freed from COVID-19, but we are happy to be able to provide offline meetings.

This event is undoubtedly the most promising conference in the field of convergence of maritime, terrestrial and aerial communications. The keynote speech by the Prof. Mohamed-Slim Alouini from the KAUST, Makkah Province, Saudi Arabia is prepared along with various oral and poster presentations.

The Sono Calm in Jeju Island seems to be a perfect place for participants to comfortably enjoy offline events and relaxation. It is expected that many professionals in related fields will be able to exchange ideas and collaborate through the event.

Lastly, we would like to thank the organizing committees and staffs for the generous support. We would like to ask many of you to participate online/offline, and wish everyone good health and well-being.

ICMIC chairs

September 2022

Committees

International Advisory Committee

- Woong Seo Kim (KIOST, Korea)
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- Inoh Choi (Korea Maritime and Ocean University, Korea)

Web Chair

- Yujae Song (Kumoh National Institute of Technology, Korea)

Registration

Registration Schedule

- Author Registration **September 16, 2022**
- Early Registration (Non-Author) **August 31, 2022**
- On-Site Registration **September 22, 2022**

Registration Policy

- To be published at the ICMIC 2022 Conference Proceedings, more than one author from each accepted paper MUST register at the Regular registration fee and the paper must be presented at the conference.

Registration Fee

	Early Birds	On-Site
Regular	₩300,000	₩330,000
Student	₩60,000	₩66,000

Refund Policy

- If you have already registered for IMCIC 2022 and find that you are unable to attend or cancel the paper, please notify ICMIC 2022 secretariat in writing to budget@kics.or.kr to request a refund and cancel your registration. Refund will be made upon receipt of this written notice after the conference.
- Please contact icmic@icmic-conf.org or dmlee@tu.ac.kr for all questions except for registration cancellation.

Category	Refund	No Refund
Regular	Notice Received before early registration Cancellation fee: US\$0.00	Notice Received after early registration No Refund

Program at a Glance

September 22nd

12:30-14:00 **Technical Session #1 : Advanced ICT Technologies**

Chair : Seungjae Baek (KIOST, Korea)

T1-1) Development of a Deep Learning-Based Condition Diagnosis and Prognosis System for Naval Ship Maintenance

Dong Seong Kim (Kumoh National Institute of Technology, Korea); Gi Hyeb Kwon (ICT-Convergence Research Center, Korea); Jae-Woo Kim (Kumoh National Institute of Technology, Korea)

T1-2) Stable Multi Edge Computing System with Blockchain in Industrial Internet of Things

Yunseong Lee and Sungrae Cho (Chung-Ang University, Korea)

T1-3) Machine Learning-Based Fault Monitoring on a Digital Twin-Enabled System for Additive Manufacturing

Gabriel Avelino R Sampedro (Kumoh National Institute of Technology, Korea & University of the Philippines, Philippines); Made Adi Paramartha Putra, Syifa Maliah Rachmawati, Dong Seong Kim and Jae-Min Lee (Kumoh National Institute of Technology, Korea)

T1-4) Toward Deeply Understanding Us in Smart Home

Taesoo Jun (Kumoh National Institute of Technology, Korea)

T1-5) Performance Evaluation of Metaverse Platform to the Type of Game Server Engine

Dongeon Yoon, Hyosang Lee, Changseop Lim and Am-Suk Oh (Tongmyong University, Korea)

T1-6) Lightweight Anomaly Detection Based on Embedded A.I. for Early Failure Detection of Industrial Robots

Hyuntae Cho (Tongmyong University, Korea)

14:00-14:10 Coffee Break

14:10-14:20 **Opening Ceremony**

Chair : Jonathan Tito Burbano (KIOST, Ecuador)

Opening Address

Prof. Yeon Ho Chung, General Co-Chair, Pukyong National University, Korea

Congratulatory Address

Prof. Yoan Shin, President of KICS

14:25-15:00 **Keynote Address #1**

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

Coverage Enhancement of Underwater and Maritime Multi-Level Communication Networks

Prof. Mohamed-Slim Alouini

Distinguished Professor of Electrical and Computer Engineering, KAUST, Makkah Province, Saudi Arabia

15:00-16:30 **Technical Session #2 : Maritime ICT I**

Chair : Wooyeol Choi (Chosun University, Korea)

T2-1) Coding Rate Adjustment of Underwater Optical Wireless Communication Based on Deep Reinforcement Learning

Hui cheol Shin (University of Science and Technology, Korea); Yujae Song (Kumoh National Institute of Technology, Korea); Yongjae Kim (KIOST, Korea)

Program at a Glance

T2-2) Anti-Biofouling for Seawater Battery Systems

Juhyun Kim (Korea Institute of Ocean Science and Technology, Korea); Seungjae Baek (KIOST, Korea); Sungmin Koo (Korea Institute of Ocean Science and Technology, Korea); Ah Hyun Park (Marine Equipment Technology Solutions, Korea); Kim Yoonchil (Korea Institute of Ocean Science and Technology, Korea); Saat Mubarrok (Mulawarman University, Indonesia)

T2-3) Research on the Development of Unmanned Boat Applying Sea-Water Battery for Observation and Detection

Juhyun Kim, Hyoun Kang, Jaeho Choi and Sangwoo Kang (Korea Institute of Ocean Science and Technology, Korea); Dayu Wiyati Purnaningtyas (Bandung Institute of Technology, Indonesia)

T2-4) KIO-Gaon: A Modular Designed Remotely Operated Vehicle for Versatile Operations

Sungmin Koo and Juhyun Kim (Korea Institute of Ocean Science and Technology, Korea); Yazid Ridla (Oceanovision, Indonesia); Seungjae Baek (KIOST, Korea)

T2-5) Improved Efficiency of Small Wind Turbine Using Vertical Dual Axis

Ah Hyun Park (Marine Equipment Technology Solutions, Korea); Hyoun Kang (Korea Institute of Ocean Science and Technology, Korea); Yong Soo Kang (Dual Wind, Korea); Seungjae Baek (KIOST, Korea); Faizal Ade R. Abdullah (Bandung Institute of Technology, Indonesia)

T2-6) A Brief Survey of Massive MIMO SWIPT-Enabled IoT Network

Hyunwoo Jung (University of Maritime ICT, Korea); Yongjae Kim (KIOST, Korea)

16:30-17:20 Poster Session

P-1) Voice Spoofing Countermeasure Using Residual Convolutional Neural Networks and Self-Attention

Changhwan Go, Wooyeon Choi and Chanjun Chun (Chosun University, Korea)

P-2) A Study on the Control of Small Unmanned Surface Vehicles Using Disturbance Learning

Sang Ki Jeong (Korea Institute of Ocean Science and Technology, Korea)

P-3) A Study on the Swarm Control Algorithm of Unmanned Surface Vehicles

Jihyeong Lee, Sang Ki Jeong and Haeyoung Park (Korea Institute of Ocean Science and Technology, Korea)

P-4) Fingerprint-Aided Coordinated mmWave Beam Selection for mmWave UAV Communications

Yuna Sim, Seungseok Sin, Yuna Jeong and Jihun Cho (Chonnam National University, Korea); Sangmi Moon (Korea Nazarene University, Korea); Intae Hwang (Chonnam National University, Korea)

P-5) Experiments of Long-Range Underwater Communication in the East Sea

Donghyeon Kim, Jeongha An, Jeasoo Kim and Kiman Kim (Korea Maritime and Ocean University, Korea); In-soo Kim (Agency of Defense Development, Korea)

P-6) Utility-Centric Partial Offloading in Parked Vehicle-Assisted Multi-Access Edge Computing

Qui Pham and Dong Seong Kim (Kumoh National Institute of Technology, Korea)

P-7) Prospect and Industry Issues of Metaverse and Digital Twin Adoption in Nigerian Maritime

Cosmas Ifeanyi Nwakanma and Judith Nkechinyere Njoku (Kumoh National Institute of Technology, Korea); Cajethan Onyekachi Okafor (Federal University of Technology Owerri, Nigeria); Dong Seong Kim (Kumoh National Institute of Technology, Korea)

P-8) A Study of Open-Source Netwrok Simulator

Dong Seong Kim and Jae Woo Kim (Kumoh National Institute of Technology, Korea); Gi Hyeob Kwon (ICT-Convergence Research)

Program at a Glance

P-9) Primary User Emulation Attack Detection

Vladimir V. Shakhov (University of Ulsan, Korea)

P-10) A Study on the Problems and Solutions in the NFT Ecosystem

Yongbin Choi and Am-Suk Oh (Tongmyong University, Korea)

17:30-18:00 Keynote Address #2

Chair : Jonathan Tito Burbano (KIOST, Ecuador)

ICT Convergence in the Great Acceleration

Prof. Ju Hong Park

Department of Convergence IT Engineering, POSTECH

Institute of Convergence Science, Yonsei University

18:00-20:00 Dinner

September 23rd

08:30-10:00 Technical Session #3 : UAV Communications

Chair : Yujae Song (Kumoh National Institute of Technology, Korea)

T3-1) Non-Negative Matrix Factorization Based Optimization Algorithm for Face Age Prediction

Man Zhang and Dong Myung Lee (Tongmyong University, Korea)

T3-2) UAV-Assisted Real-Time Monitoring and Detection of Maritime Infrastructure Defects

Min Hyuk Kim and Kwonsoon Yong (Hallym University, Korea); Abdallah A Khereishah (New Jersey Institute of Technology, USA); Sung Hoon Lim (Hallym-gil1 & Hallym University, Korea); Wonjong Noh (Hallym University, Korea)

T3-3) Self-Supervised MIMO System for Autonomous Underwater Navigation Operations

Simeon Ajakwe (Kumoh National Institute of Technology, Gumi, Korea); Vivian Uka Makala Ihekoronye, Dong Seong Kim and Jae Min Lee (Kumoh National Institute of Technology, Korea)

T3-4) Aerial Cell Planning Depending on Altitude

Yuna Jeong (Chonnam National University, Korea); Jihyung Kim (ETRI, Korea); Intae Hwang (Chonnam National University, Korea); Moonsik Lee (ETRI, Korea)

T3-5) Maritime UAV Patrol Tasks Based on YOLOv4 Object Detection

Yi-Yu Chang and John A (National Chung Cheng University, Taiwan); Pao-Ann Hsiung (National Chung Cheng University, Taiwan & Amity University, India)

T3-6) DL-Based AUV Position Prediction Using Odometry Data for Internet of Underwater Things

Made Adi Paramartha Putra (Kumoh National Institute of Technology, Korea); Nengah Widya Utami and I Gede Juliana Eka Putra (STMIK Primakara, Indonesia); Dong Seong Kim and Jae Min Lee (Kumoh National Institute of Technology, Korea)

10:00-10:30 Coffee Break

Program at a Glance

10:30-12:00 **Technical Session #4 : Maritime ICT II**

Chair : Yonggang Kim (Kongju National University, Korea)

T4-1) Beam Divergence Angle and Transmission Power Adjustment of Underwater Optical Wireless Communication Based on Reinforcement Learning

Hui cheol Shin (University of Science and Technology, Korea); Yujae Song (Kumoh National Institute of Technology, Korea); Yongjae Kim (KIOST, Korea)

T4-2) Single Enhancement Techniques for Underwater Stereo Vision

Hong-gi Kim (Korea Institute of Ocean Science and Technology, Korea); Jungmin Seo and Soo Mee Kim (KIOST, Korea)

T4-3) A Brief Survey of Massive MU-MIMO User Scheduling in Various Network

Hyunwoo Jung (University of Maritime ICT, Korea); Yongjae Kim (KIOST, Korea)

T4-4) Development of In-Situ Underwater Gamma-Ray Spectroscopy System

Jungmin Seo and Soo Mee Kim (KIOST, Korea)

T4-5) Analysis of Signal Processing Using Water Surface Elevation Data

UkJae Lee (KIOST, Korea); HongYeon Cho (Korea Institute of Ocean Science and Technology, Korea); DongHui Ko (KIOST, Korea); JiYoung Kim (Kepco Research Institute, Korea); Yunzheng Ge (First Institute of Ocean Energy Research Center, Korea)

T4-6) Movable Visualization System for Exterior Monitoring of Outdoor Infrastructures

HongGuk Jeong (Maritime ICT RandD Center, Korea); Jungmin Seo (KIOST, Korea); Jihyeong Lee (Korea Institute of Ocean Science and Technology, Korea); Soo Mee Kim (KIOST, Korea)

12:00-13:30 Lunch

13:30-15:00 **Technical Session #5 : Deep Learning Wireless Communications**

Chair : Dong Myung Lee (Tongmyong University, Korea)

T5-1) Deep Reinforcement Learning-Based Power Allocation in Multi-Cell Massive MIMO

Youngwoo Oh and Wooyeol Choi (Chosun University, Korea)

T5-2) Collaborative Learning for Cyber-Attacks Classification in Maritime Transportation Systems

Ahmad Zainudin, Jung Hyeon Kim, Dong Seong Kim and Jae Min Lee (Kumoh National Institute of Technology, Korea)

T5-3) FED-MARINE: Federated Learning Framework for DDoS Detection and Mitigation in Maritime-SCADA Network

Love Allen Ahakonye, Cosmas Ifeanyi Nwakanma, Jae Min Lee and Dong Seong Kim (Kumoh National Institute of Technology, Korea)

T5-4) Indoor Visible Light LOS Channel Estimation Using Support Vector Regression

Yeong Hae Kim, Young Jae Moon, Sudhanshu Arya and Yeonho Chung (Pukyong National University, Korea)

T5-5) Clustering Algorithm for Cooperative Spectrum Sensing in Cognitive Radio Networks

Chunghyun Lee (Chun-Ang University, Korea); Junsuk Oh, Taeyun Ha and Donghyun Lee (Chung-Ang University, Korea); Geeranuch Woraphonbenjakul (Chung Ang University, Korea); Sungrae Cho (Chung-Ang University, Korea)

T5-6) Deep Reinforcement Learning Based Power Allocation Scheme in Uplink NOMA Systems

Won Jae Ryu and Dong Seong Kim (Kumoh National Institute of Technology, Korea)

Program at a Glance

15:00-15:30 Coffee Break

15:30-17:00 **Technical Session #6 : Underwater Wireless Communications**

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

T6-1) A Study on Space Diversity Gain of Reflective LoS Channel in Maritime Long Range Communication

Woo Yong Lee and Keunyoung Kim (ETRI, Korea)

T6-2) Beamforming and Power Optimization Techniques in Cell-Free Networks

Keunyoung Kim and Woo Yong Lee (ETRI, Korea)

T6-3) Vessel MMSI Forgery Prevention System

Sung-Hwa Han and Young-Sik Park (Tongmyong University, Korea)

T6-4) Density-Based Contention Management for Collision Avoidance in Dense IoT Networks

Sejin Choi, Lee Jaewan, Minwoo Kwon and Yonggang Kim (Kongju National University, Korea)

T6-5) Transmission Loss Analysis of SATCOM Radomes with Wide Incident Angle

Taehyeon Kim (Gyeongsang National University & Electronic Engineering, Korea); Wang-Sang Lee (Gyeongsang National University (GNU), Korea)

T6-6) Channel Estimation for RIS Aided Multi-User SISO System Using Super-Resolution

Jeongbin Seo (PUSAN National University, Korea); Donghwan Kim and Suk Chan Kim (Pusan National University, Korea)

Keynote Address

September 22nd (Thursday)

Keynote Address #1

14:25-15:00 Room : Emerald

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

Coverage Enhancement of Underwater and Maritime Multi-Level Communication Networks

Speaker Prof. Mohamed-Slim Alouini

Distinguished Professor of Electrical and Computer Engineering, KAUST, Makkah Province, Saudi Arabia

Summary Underwater communication networks (UCNs) are considered a key-enabler to the underwater internet of things (UIoT). UCNs are regarded as essential for various marine applications such as monitoring, exploration, and trading. However, a large part of existing literature disregards the 3-dimensional (3D) nature of the underwater communication system. In this talk, we introduce a K-tier UCN that acts as a gateway that connects the UIoT with the Space-Air-Ground-Sea Integrated System (SAGSIS). The proposed network architecture consists of several tiers along the vertical direction with adjustable depths. On the horizontal dimension, the best coverage probability (CP) is computed and maximized by optimizing the densities of surface stations (SSs) in each tier. On the vertical dimension, the depth of each tier is also optimized to minimize inter-tier interference and maximize overall system performance. We also introduce and analyze, in this talk, a cooperative structure of SAGSIS to study the CP for SSs on a large-scale and far-reaching ocean surface. By incorporating the merits of onshore stations (OSs), tethered balloons (TBs), high altitude platforms (HAPS), and satellites (SATs), cooperative communication links between the terrestrial core connected base station and SSs are established via a relay station attached to an OS, TB, HAPS, or SAT. Considering the difference between each propagation environment, and the randomness distribute on SSs, we reconstruct the cooperative communication links and utilize them in our analysis models of the point-to-area models recommended by the International Telecom Union (ITU). We concluded our talk by drawing multiple useful system-level insights that help optimize the design of underwater and maritime networks based on the given distribution of UIoT devices and SSs.

BIO Mohamed-Slim Alouini was born in Tunis, Tunisia. He received the Ph.D. degree in Electrical Engineering from the California Institute of Technology (Caltech) in 1998. He served as a faculty member at the University of Minnesota then at the Texas A&M University in Qatar before joining in 2009 the King Abdullah University of Science and Technology (KAUST) where he is now a Distinguished Professor of Electrical and Computer Engineering. Prof. Alouini is a Fellow of the IEEE and OPTICA (Formerly the Optical Society of America (OSA)). He is currently particularly interested in addressing the technical challenges associated with the uneven distribution, access to, and use of information and communication technologies in rural, low-income, disaster, and/or hard-to-reach areas.

Keynote Address #2

17:30 - 18:00 Room : Emerald

Chair : Jonathan Tito Burbano (KIOST, Ecuador)

ICT Convergence in the Great Acceleration

Speaker Prof. Ju Hong Park

Department of Convergence IT Engineering, POSTECH

Institute of Convergence Science, Yonsei University

BIO Ju Hong Park received the Ph.D. degree in Architecture, Department of Architecture MIT in 2015. He served as an Assistant Professor of Architecture and Urbanism, School of Architecture, University of Miami, USA before joining in POSTECH where he is now an Assistant Professor of Department of convergence IT Engineering. Prof. Ju Hong Park is an Adjunct Professor of Graduate School of Artificial Intelligence, POSTECH, Adjunct Professor of Department of Industrial and Management Engineering, POSTECH, Adjunct Professor of Institute of Convergence Science, YONSEI UNIVERSITY, and Director of POSTECH Meta Maker Space.

Oral Sessions

September 22nd (Thursday)

Technical Session #1 : Advanced ICT Technologies

12:30-14:00 Room : Emerald

Chair : Seungjae Baek (KIOST, Korea)

T1-1) Development of a Deep Learning-Based Condition Diagnosis and Prognosis System for Naval Ship Maintenance

Author Dong Seong Kim (Kumoh National Institute of Technology, Korea), Gi Hyeob Kwon (ICT-Convergence Research Center, Korea); Jae-Woo Kim (Kumoh National Institute of Technology, Korea)

Abstract This paper proposes a condition diagnosis based system for efficient maintenance of naval warship combat and propulsion systems using deep learning. In addition, a state based prognosis mechanism is integrated into the system to enhance the maintenance process using convolution neural network (CNN) algorithms. Finally, a test-bed experiment is conducted to verify the proposed maintenance systems.

T1-2) Stable Multi Edge Computing System with Blockchain in Industrial Internet of Things

Author Yunseong Lee and Sungrae Cho (Chung-Ang University, Korea)

Abstract In edge computing systems in industrial Internet of Things (IIoT) environment, accommodating significant data generated by IIoT devices is a primary concern. This paper proposes a stable multi edge computing system for IIoT with blockchain network.

T1-3) Machine Learning-Based Fault Monitoring on a Digital Twin-Enabled System for Additive Manufacturing

Author Gabriel Avelino R Sampedro (Kumoh National Institute of Technology, Korea & University of the Philippines, Philippines); Made Adi Paramartha Putra, Syifa Maliah Rachmawati, Dong Seong Kim and Jae-Min Lee (Kumoh National Institute of Technology, Korea)

Abstract In maritime engineering, the emergence of additive manufacturing technology is starting to change how maintenance and repair work is done. Additive manufacturing is currently being used for fast production to develop tangible representations of objects modeled using computer-aided design (CAD) software. Despite its functionality, using additive manufacturing technology can be tricky, as the process is still subject to unavoidable errors. Errors caused by unfavorable operational conditions can cause a development job to be delayed, thus wasting time and resources. To help optimize environmental and operational conditions, fault monitoring using a digital twin is being developed. The digital twin will replicate the different qualities of its physical counterpart in the digital world. In this research, machine learning algorithms such as multilayer perceptron, long shortterm memory, and convolutional neural networks will be explored explore in predicting how the digital twin will behave in various conditions. Overall, LSTM has proven to be the most accurate of the three, and its values do not stray far from its regression line.

T1-4) Toward Deeply Understanding Us in Smart Home

Author Taesoo Jun (Kumoh National Institute of Technology, Korea)

Abstract This work proposes a home edge system to help understand family members therein. By keeping the user data within the home, recent privacy concerns can be mitigated. System requirements are firstly presented, and software components are followed. The work discusses design points for an edge device at home, leading to remaining works to complete.

T1-5) Performance Evaluation of Metaverse Platform to the Type of Game Server Engine

Author Dongeon Yoon, Hyosang Lee, Changseop Lim and Am-Suk Oh (Tongmyong University, Korea)

Abstract In this paper, when implementing a video conferencing platform and applying a game server engine to it, we experiment with how different latency is depending on the number of concurrent connectors. As a result, the Amazon Game Lift (AWS) engine showed the best performance with a delay time of 22.146 msec. This experiment will help each individual choose a game server when implementing a metaverse platform.

T1-6) Lightweight Anomaly Detection Based on Embedded A.I. for Early Failure Detection of Industrial Robots

Author Hyuntae Cho (Tongmyong University, Korea)

Abstract Robots are being used as innovative tools to replace human labor, and the application field of robots is rapidly expanding along with artificial intelligence technology in the era of the Fourth Industrial Revolution. Among them, industrial robots are used in most industrial fields; the automobile, electric and electronic industries are the largest consumers. There have been many attempts to diagnose robot failures, but most of the sensor data is extracted from robots and algorithms or machine learning for diagnosis are being carried out on remote servers or clouds. In this case, accurate diagnosis is difficult when communication costs increase excessively and communication is not smooth. In this paper, we propose an embedded DS-CNNbased lightweight artificial intelligence technology that runs on an embedded system mounted on an industrial robot. In addition, we compare and analyze the performance of highperformance algorithms performed in the server by verifying the proposed method on an actual embedded board.

Oral Sessions

September 22nd (Thursday)

Technical Session #2 : Maritime ICT I

15:00-16:30 Room : Emerald

Chair : Wooyeol Choi (Chosun University, Korea)

T2-1) Coding Rate Adjustment of Underwater Optical Wireless Communication Based on Deep Reinforcement Learning

Author Hui cheol Shin (University of Science and Technology, Korea); Yujae Song (Kumoh National Institute of Technology, Korea); Yongjae Kim (KIOST, Korea)

Abstract In this work, we analyze the underwater environmental factors that determine the quality of underwater channel when constructing an underwater optical wireless communication (UOWC) link between an underwater sensor node located on the seabed and the unmanned surface vehicle (USV) located on the sea surface. Furthermore, to improve communication performance, we implement a reinforcement learning algorithm that learns optimal coding rate that satisfy the minimum required symbol error rate (SER) using environmental sensor information attached to USV.

T2-2) Anti-Biofouling for Seawater Battery Systems

Author Juhyun Kim (Korea Institute of Ocean Science and Technology, Korea); Seungjae Baek (KIOST, Korea); Sungmin Koo (Korea Institute of Ocean Science and Technology, Korea); Ah Hyun Park (Marine Equipment Technology Solutions, Korea); Kim Yoonchil (Korea Institute of Ocean Science and Technology, Korea); Saat Mubarrok (Mulawarman University, Indonesia)

Abstract In this paper, we present two anti-biofouling techniques to efficiently reduce attachment organisms. Specifically, we introduced an electric shock and an UV-C LED devices for seawater battery, and then we analyzed the effectiveness of the techniques by applying them to an actual seawater battery system. A long-term real-sea experimental results showed that both techniques can be a good remedy while UV-C LED showed a better electric power efficiency.

T2-3) Research on the Development of Unmanned Boat Applying Sea-Water Battery for Observation and Detection

Author Juhyun Kim, Hyoun Kang, Jaeho Choi and Sangwoo Kang (Korea Institute of Ocean Science and Technology, Korea); Dayu Wiyati Purnaningtyas (Bandung Institute of Technology, Indonesia)

Abstract In this paper developed an unmanned surface vehicle(USJ.) for observation and detection using sea-water batteries. Existing batteries cause damage and environmental pollution when exposed to seawater, while sea-water batteries are a stable new concept of power supply for seawater flooding for a long time. An USV has mainly used lithium-based batteries as a battery-powered unmanned marine vehicle but the demand for a source of electrical power for stable operation in poor marine environments is increasing. Accordingly, this paper developed an USV with sea-water batteries. Through verification of the real sea, it was confirmed that the USV can be stably operated in the seawater environment, and that it is possible to operate the sonar, the mission module of the USV.

T2-4) KIO-Gaon: A Modular Designed Remotely Operated Vehicle for Versatile Operations

Author Sungmin Koo and Juhyun Kim (Korea Institute of Ocean Science and Technology, Korea); Yazid Ridla (Oceanovision, Indonesia); Seungjae Baek (KIOST, Korea)

Abstract A remotely operated underwater vehicle, commonly called ROV, is an unmanned underwater vehicle operated by an aboard crew via a tethered cable [1]. An ROV is widely used in surveys, science expeditions/inspections, constructions, and military use due to its advantages such as long working time, endurance in deep sea, and elimination of life risking hazards [2]. Generally, an ROV system is divided into three parts: ROV's main body, a ground control system (GCS) for conveying the user's input and for displaying the data gathered by the ROV, and a cable that links the two parts for power supply and communication. A prevalent portion of the ROVs main body is made up of a buoyant material to adjust buoyancy of the body, multiple thrusters for a maneuverability, a variety of sensors and tools that each suit a particular task, a couple of pressure-resistant watertight canisters in which all the nonwaterproof devices, such as a controller, are enclosed. All the mentioned components are put together in the main frame. To increase the odds of a successful mission in harsh offshore environments, it would be reasonable to design a ROV specifically tailored to a task. However, this type of design philosophy makes it difficult to expand or modify the ROV to other tasks. For example, it would be difficult (or in some cases impossible) to add more sensors, manipulators, or more canisters. The problem can be moderated by careful design considerations, but the limited number of predesigned extra auxiliary ports and space could eventually fall short. In this paper, we present a ROV designed with a modular architecture that enables versatile modifications. In particular, we build on a common interface concept for designing the ROV. Any canister with the common interface can be connected or disconnected in a daisy chain manner. Specifically, a canister in the proposed modular architecture follows the rules specified below. First, each canister has ethernet IN/OUT and power IN/OUT ports. Second, each canister has additional I/O ports as required. Third, any canister designed by the above two principles can be connected or disconnected to/from the chain. Thus, whatever devices that are required,

Oral Sessions

the ROV can be easily expanded by connecting additional canisters with the appropriate ports for the devices. As shown in Fig. 1, we adapt a picatinny rail system into the main frame for dynamically changing the ROV structure. For example, canisters can be placed anywhere in the system to meet the requirements as shown in Fig. 2. When the canister structure is changed, it is required to adjust the buoyancy of the ROVs main body. To make adjustment procedure simple, we employ modularized buoyancy materials. In short, an ordinary single piece buoyancy material is finely chopped into a uniform size and is attached or detached as required as shown in Fig. 3. As shown in Fig. 4, we build the proposed ROV, called K10-Gaon which means 'KIOST mid-class ROV'. The detailed specifications is summarized in Table 1. We demonstrate the successful operations of the proposed design by conducting field tests in open seas in Korea as shown in Fig. 5.

T2-5) Improved Efficiency of Small Wind Turbine Using Vertical Dual Axis

- | | |
|-----------------|--|
| Author | Ah Hyun Park (Marine Equipment Technology Solutions, Korea); Hyoun Kang (Korea Institute of Ocean Science and Technology, Korea); Yong Soo Kang (Dual Wind, Korea); Seungjae Baek (KIOST, Korea); Faizal Ade R. Abdullah (Bandung Institute of Technology, Indonesia) |
| Abstract | In this work, we develop a high-power vertical dual small wind turbine that can be used for power supply of various devices. Existing wind turbines require a strong wind speed to obtain an effective electric power. However, by adopting a coreless-vertical axis structure, a high-power generation efficiency can be achieved at a relatively weak wind speed. In addition, it is possible to improve wind power generation efficiency by up to 150% compared to the existing turbine at general urban wind speeds by developing a vertical dual axis technology to be less affected by wind direction and upper and lower separated fan structure. |

T2-6) A Brief Survey of Massive MIMO SWIPT-Enabled IoT Network

- Author** Hyunwoo Jung (University of Maritime ICT, Korea); Yongjae Kim (KIOST, Korea)
Abstract A massive multiple-input-multiple-output (MIMO) simultaneous wireless information and power transfer (SWIPT)-enabled system is newly proposed for the internet-of-things (IoT) network. This paper presents a brief introduction to massive MIMO SWIPT-enabled IoT networks and describes related works.

September 23rd (Friday)

Technical Session #3 : UAV Communications

08:30-10:00 Room : Emerald Chair : Yujie Song (Kumoh National Institute of Technology, Korea)

T3-1) Non-Negative Matrix Factorization Based Optimization Algorithm for Face Age Prediction

- Author** Man Zhang and Dong Myung Lee (Tongmyong University, Korea)
Abstract In this paper, the non-negative matrix factorization (NMF) based optimization algorithm is suggested. The optimization algorithm is used to reduce the dimension of the face feature matrix to obtain the characteristic face, and support vector machines (SVM) is used to train and classify the reduced dimension matrix. This paper aims to estimate the age of face images using the proposed algorithm. Currently, this paper has only progressed to algorithm design, and performance experiments are scheduled to be carried out according to dataset construction and performance metrics soon.

T3-2) UAV-Assisted Real-Time Monitoring and Detection of Maritime Infrastructure Defects

- | | |
|-----------------|--|
| Author | Min Hyuk Kim and Kwonsoon Yong (Hallym University, Korea); Abdallah A Kheirishah (New Jersey Institute of Technology, USA); Sung Hoon Lim (Hallym-gil1 & HallymUniversity,Korea); Wonjong Noh (Hallym Universit, Korea) |
| Abstract | In this study, we design a UAV-assisted computing platform model that enables real-time monitoring and detection of marine infrastructure defects. As a core algorithm, we propose low-complexity convolutional neural network (CNN) and U-Net structures that identify whether given images have problems and accurately segment the location of the problem. By conducting experiments, we prove the concept of the proposed systems. This study helps to safely check defects in maritime infrastructure at any time and prevent accidents, without human intervention. |

T3-3) Self-Supervised MIMO System for Autonomous Underwater Navigation Operations

- Author** Simeon Ajakwe (Kumoh National Institute of Technology, Gumi, Korea); Vivian Uka Makala Ihekoronye, Dong Seong Kim and Jae Min Lee (Kumoh National Institute of Technology, Korea)

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Abstract The need for a cyber-edge and cognitive artificial intelligence (AI)-based security strategy to boost autonomous underwater navigation and prevent heterogeneous attacks from pirates is imperative in maritime operations. This paper proposes a split of super-resolution (SR) to reconstruct the channel state information (CSI) through self-supervised learning for a multiple-input-multiple-output (MIMO) system. Compared with the existing system, a split of SR into two disjoint sub-blocks through transfer learning is used to improve the CSI detailed structures in the reconstruction process. The simulation results show that the proposed system significantly improved the quality of the CSI after reconstruction against the existing system in terms of cosine similarity ρ and normalized mean square error, which are essentials for a MIMO system in improving performance, coverage, reliability, and user experience in 5G underwater networks.

T4-4) Development of In-Situ Underwater Gamma-Ray Spectroscopy System

Author Jungmin Seo and Soo Mee Kim (KIOST, Korea)

Abstract Because Korea and neighboring countries, Japan and China are highly dependent on nuclear power generation, it is necessary to monitor periodically the radiation leaks around nuclear power plants. In this study, a underwater gamma-ray spectroscopy system was built with a NaI and PMT-based gamma sensor, a waterproof case and a communication system. We confirmed the normal operation of in-situ acquisition of underwater radiation spectra guaranteeing the waterproofness up to a depth of 3m. The underwater gamma-ray spectrometer can be applied for periodic in-situ monitoring of the accident radiation leakages or the suspicious changes of radiation dose level around nuclear power plants or aquafarms.

T4-5) Analysis of Signal Processing Using Water Surface Elevation Data

Author UkJae Lee (KIOST, Korea); HongYeon Cho (Korea Institute of Ocean Science and Technology, Korea); DongHui Ko (KIOST, Korea); JiYoung Kim (Kepco Research Institute, Korea); Yunzheng Ge (First Institute of Ocean Energy Research Center, Korea)

Abstract This study proposed additional techniques for wave spectrum analysis using water surface elevation observed by an Oceanographic and Meteorological Observation Tower on the west coast of the Korean Peninsula. The additional techniques used in this study constitute a smoothing method, which can solve the confidence interval range problem of the estimated spectrum in the frequency domain. When the smoothing method was applied, the confidence interval range of the estimated spectrum decreased approximately four times compared to that of the existing estimated spectrum. This increased the accuracy of the estimated peak wave period, and the peak wave period distribution showed variations of 10% and 7.3% at two analysis points. Moreover, for optimal smoothing, the smoothing number according to the range of the significant wave height was calculated using the root mean square error. As the significant wave height increased, the smoothing number increased owing to an irregular spectrum energy density.

T4-6) Movable Visualization System for Exterior Monitoring of Outdoor Infrastructures

Author HongGuk Jeong (Maritime ICT RandD Center, Korea); Jungmin Seo (KIOST, Korea); Jihyeong Lee (Korea Institute of Ocean Science and Technology, Korea); Soo Mee Kim (KIOST, Korea)

Abstract In order increase the work safety and efficiency of current human-based status evaluation of port infrastructures, the demand of adopting unmanned automatic evaluation system is growing. In this study, we developed a movable visualization system equipped with a multiple sensor module for exterior monitoring of outdoor infrastructures. The multiple sensor module consisted of two lidars, a stereo camera, and motion sensor. Movement of the multiple sensor module was implemented by remotely controllable toy car. We tested the functional performances of a dual lidar, a stereo, a motion sensor. The measurement error of GPS and IMU of the motion sensor 50 cm and were ± 0.2 degrees. The merged lidar data and stereo helped to visualize the exterior status of the objects to be monitored.

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September 23rd (Friday)

Technical Session #4 : Maritime ICT II

10:30-12:00 Room : Emerald

Chair : Yonggang Kim (Kongju National University, Korea)

T4-1) Beam Divergence Angle and Transmission Power Adjustment of Underwater Optical Wireless Communication Based on Reinforcement Learning

Author Hui cheol Shin (University of Science and Technology, Korea); Yujae Song (Kumoh National Institute of Technology, Korea); Yongjae Kim (KIOST, Korea)

Abstract In this paper, we analyze SNR (signal-to-noise ratio) performance between transmission node (i.e., underwater sensors) fixed to the seabed in an underwater wireless optical communication environment and receive node (i.e., ships, unmanned surface vehicles) where shaking occurs due to wind and wave at sea surface. Furthermore, based on the analysis results, we present a deep reinforcement learning based beam divergence angle and transmission power adjustment algorithm for efficient battery operation of the transmit node while minimizing disconnection of underwater optical wireless communication (UOWC) links.

T4-2) Single Enhancement Techniques for Underwater Stereo Vision

Author Hong-gi Kim (Korea Institute of Ocean Science and Technology, Korea); Jungmin Seo and Soo Mee Kim (KIOST, Korea)

Abstract In order to ensure safety and efficiency of unmanned underwater works underwater situation visualization is an essential technique among unmanned automatic technologies. Although optical color images are used widely for underwater visualization, physical distortions such as color casting and blurring are occurred in underwater color images and it leads to uncertainty in depth estimation for stereo vision. In this study, we applied image fusion and deep learning techniques to improve the underwater image quality. The performance of single image enhancement techniques was evaluated by underwater image quality measure (UIQM) and underwater color image quality evaluation (UCIQE). Single image enhancement increased quantitatively UIQM and UCIQE by 82.8 % and 35.8 % on the average, respectively and improved the color accuracies of reconstructed red, green and blue – depth (RGB-D) point clouds compared to the original images. Single underwater image enhancement techniques improved the accuracies of depth estimation for underwater stereo vision.

T4-3) A Brief Survey of Massive MU-MIMO User Scheduling in Various Network

Author Hyunwoo Jung (University of MaritimeCT, Korea); Yongjae Kim (KIOST, Korea)

Abstract Massive multiple input multiple output (MIMO) is a technique that adopts a thousand or hundreds of antennas in a base station (BS) to simultaneously deliver communication services to a hundred or dozens of users at the same frequency and time resource. Massive MIMO has several advantages such as low power consumption, high data rate, etc. Together with a massive MIMO regime, user scheduling can further improve the sum rate of wireless networks. Thereby, massive multi-user MIMO (MU-MIMO) scheduling is often considered a promising solution for various wireless communication networks. In this paper, the research works on massive MU-MIMO user scheduling in different duplex operations, i.e. time division duplex (TDD) and frequency division duplex (FDD), and in different network schemes, i.e. internet-of-things (IoT) network and millimeter wave (mmWave) network, is briefly studied.

T4-4) Development of In-Situ Underwater Gamma-Ray Spectroscopy System

Author Jungmin Seo and Soo Mee Kim (KIOST, Korea)

Abstract Because Korea and neighboring countries, Japan and China are highly dependent on nuclear power generation, it is necessary to monitor periodically the radiation leaks around nuclear power plants. In this study, a underwater gamma-ray spectroscopy system was built with a NaI and PMT-based gamma sensor, a waterproof case and a communication system. We confirmed the normal operation of in-situ acquisition of underwater radiation spectra guaranteeing the waterproofness up to a depth of 3m. The underwater gamma-ray spectrometer can be applied for periodic in-situ monitoring of the accident radiation leakages or the suspicious changes of radiation dose level around nuclear power plants or aquafarms.

T4-5) Analysis of Signal Processing Using Water Surface Elevation Data

Author UkJae Lee (KIOST, Korea); HongYeon Cho (Korea Institute of Ocean Science and Technology, Korea); DongHui Ko (KIOST, Korea); JiYoung Kim (Kepco Research Institute, Korea); Yunzheng Ge (First Institute of Ocean Energy Research Center, Korea)

Abstract This study proposed additional techniques for wave spectrum analysis using water surface elevation observed by an Oceanographic and Meteorological Observation Tower on the west coast of the Korean Peninsula. The additional techniques used in this study constitute a smoothing method, which can solve the confidence interval range problem of the estimated spectrum in the frequency domain. When the smoothing method was applied, the confidence interval range of the estimated spectrum decreased approximately four times compared

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to that of the existing estimated spectrum. This increased the accuracy of the estimated peak wave period, and the peak wave period distribution showed variations of 10% and 7.3% at two analysis points. Moreover, for optimal smoothing, the smoothing number according to the range of the significant wave height was calculated using the root mean square error. As the significant wave height increased, the smoothing number increased owing to an irregular spectrum energy density.

T4-6) Movable Visualization System for Exterior Monitoring of Outdoor Infrastructures

Author HongGuk Jeong (Maritime ICT RandD Center, Korea); Jungmin Seo (KIOST, Korea); Jihyeong Lee (Korea Institute of Ocean Science and Technology, Korea); Soo Mee Kim (KIOST, Korea)

Abstract In order increase the work safety and efficiency of current human-based status evaluation of port infrastructures, the demand of adopting unmanned automatic evaluation system is growing. In this study, we developed a movable visualization system equipped with a multiple sensor module for exterior monitoring of outdoor infrastructures. The multiple sensor module consisted of two lidars, a stereo camera, and motion sensor. Movement of the multiple sensor module was implemented by remotely controllable toy car. We tested the functional performances of a dual lidar, a stereo, a motion sensor. The measurement error of GPS and IMU of the motion sensor 50 cm and were ± 0.2 degrees. The merged lidar data and stereo helped to visualize the exterior status of the objects to be monitored.

September 23rd (Friday)

Technical Session #5 : Deep Learning Wireless Communications

13:30-15:00 Room : Emerald

Chair : Dong Myung Lee (Tongmyong University, Korea)

T5-1) Deep Reinforcement Learning-Based Power Allocation in Multi-Cell Massive MIMO

Author Youngwoo Oh and Wooyeol Choi (Chosun University, Korea)

Abstract In this paper, we consider a massive multiple-input multiple-output (MIMO) system that has a large number of transmit antennas at the base station serving multiple users in a downlink multi-cell system. In the massive MIMO system, the number of radio frequency chains and the total transmit power is increasing due to a large number of deployed antennas. The conventional energy-efficient optimization techniques are based on iterative numerical algorithms requiring high computational complexity. To solve this problem, we present a deep reinforcement learning-based power allocation scheme to improve the sum-rate and reduce the complexity. The simulation results demonstrate that the reinforcement learning-based power allocation methods achieve higher energy efficiency with lower complexity than existing optimization algorithms.

T5-2) Collaborative Learning for Cyber-Attacks Classification in Maritime Transportation Systems

Author Ahmad Zainudin, Jung Hyeon Kim, Dong Seong Kim and Jae Min Lee (Kumoh National Institute of Technology, Korea)

Abstract Cyber-physical systems (CPS)-based maritime transportation systems (MTS) provide improved navigation, traffic monitoring, real-time tracking, and safety systems. These new features enable intelligent and autonomous capabilities to assert the MTS for increasing connectivity with heterogeneous network devices that impose MTS vulnerability to cyber-attack. This study proposes federated learning (FL)-based multilayer perceptron (MLP) intrusion detection model to maintain data in a decentralized manner, raising privacy concerns. The proposed model was evaluated using publicly available cyber-security benchmarks, CICIDS2017 dataset. Performance evaluation shows that the proposed model outperforms state-of-the-art with an accuracy of 98.79% with computational time of 1.210 ms.

T5-3) FED-MARINE: Federated Learning Framework for DDoS Detection and Mitigation in Maritime-SCADA Network

Author Love Allen Ahakonye, Cosmas Ifeanyi Nwakanma, Jae Min Lee and Dong Seong Kim (Kumoh National Institute of Technology, Korea)

Abstract Information and communication technology (ICT) is continually expanding and converging in various industries, particularly in the maritime industry, and this trend will strengthen Maritime supervisory and data acquisition (SCADA) security. However, these application areas have the challenge of mitigating attacks. The Maritime SCADA systems are critical infrastructure requiring protection. This paper proposes a federated learning orchestration to secure the Maritime SCADA from the distributed denial of service (DDoS) strikes.

T5-4) Indoor Visible Light LOS Channel Estimation Using Support Vector Regression

Author Yeong Hae Kim, Young Jae Moon, Sudhanshu Arya and Yeonho Chung (Pukyong National University, Korea)

Abstract In this work, we present a supervised machine learning solution to indoor visible light channel estimation in optical wireless communications (OWCs). Specifically, we focus on the estimation of the line of sight (LOS) channel based on the support vector regression (SVR). The objective of this paper is to analyze the performance of supervised learning for channel estimation. In particular, we assume that the training data for the SVR are receiver positions and received power with Gaussian noise; therefore, the input of SVR is receiver positions different from the training data, and the output of SVR is the received power.

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T5-5) Clustering Algorithm for Cooperative Spectrum Sensing in Cognitive Radio Networks

Author Chunghyun Lee (Chun-Ang University, Korea); Junsuk Oh, Taeyun Ha and Donghyun Lee (Chung-Ang University, Korea); Geeranuch Woraphonbenjakul (Chung Ang University, Korea); Sungrae Cho (Chung-Ang University, Korea)

Abstract Recently, spectrum sensing schemes are being studied in cognitive radio networks by classifying them into centralized model and decentralized model. A trend is moving from centralized to decentralized as cognitive radio networks focus on increasingly distributed environments in line with the Internet-of-Things. However, these two models each have their pros and cons that complement each other, so there is no guarantee which one is always better. In this paper, we propose an efficient clustering algorithm for secondary users in a clustered cooperative spectrum sensing model that absorbs the advantages of the above two models. The proposed algorithm forms a cluster through two-dimensional spatial correlation and shares sensing information through single-hop transmission between neighbors.

T5-6) Deep Reinforcement Learning Based Power Allocation Scheme in Uplink NOMA Systems

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

Abstract Non-orthogonal multiple access (NOMA) has higher spectrum efficiency and throughput than orthogonal multiple access (OMA). In this study, a deep reinforcement learning (DRL) based power allocation scheme for a near and far user is proposed. As the proposed scheme is based on DRL, the near and the far user find appropriate power ratios when they have to transmit signals to the base station (BS) in uplink channels. As the near and the far user send signals in the uplink channels, there is no shared information between them. Therefore, the power allocation in each user will be decided by only the channel state between BS and each user, and the reception of NACK or ACK. When the decision of success of transmissions is decided based on finite blocklength (FBL) regime. The proposed scheme showed that the users can find appropriate power allocation.

September 23rd (Friday)

Technical Session #6 : Underwater Wireless Communications

15:30 - 17:00 Room : Emerald

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

T6-1) A Study on Space Diversity Gain of Reflective LoS Channel in Maritime Long Range Communication

Author Woo Yong Lee and Keunyoung Kim (ETRI, Korea)

Abstract A long-distance line of sight (LOS) wireless communication environment, such as an extreme cold area made of seawater and glaciers, is a channel with little electromagnetic wave scattering. A wireless communication system for operating unmanned robot exploration in extreme cold regions such as Antarctica requires a high-speed transmission rate of 10Mbps or more over a long range of 50km or more. It is a very challenging study to apply a beamforming technique using omnidirectional multiple antennas to increase the radio signal strength of a moving vehicle on the terrestrial. In this paper, spatial diversity was analyzed to find out the limit of the maximum beamforming gain in a long-distance line-of-sight reflection channel environment where there is little scattering of electromagnetic waves. In this paper, the maximum spatial diversity gain is analyzed by approximating the line-of-sight reflection communication channel environment as a line-of-sight multiple input/output communication system, and a simulation is performed to find out the maximum spatial diversity gain according to the distance in long-range maritime communication.

T6-2) Beamforming and Power Optimization Techniques in Cell-Free Networks

Author Keunyoung Kim and Woo Yong Lee (ETRI, Korea)

Abstract Cell-free networks are expected to provide uniformly high data rates for all users and considered as a candidate for 6th generation wireless communications. Under various beamforming schemes and optimized power allocation we verifies evenly balanced and high spectral efficiency can be achievable regardless of user's locations and an increasing number of users. Beamforming schemes are chosen to maximize the received power, minimize the received interference, or to maximize the signal to interference and noise ratio. Power allocation schemes are optimized for the same level of these quantities.

T6-3) Vessel MMSI Forgery Prevention System

Author Sung-Hwa Han and Young-Sik Park (Tongmyong University, Korea)

Abstract MMSI (Maritime Mobile Service Identify) is a maritime vessel identification number and is used in many countries and various fields. This MMSI is stored in the mobile device in the ship. Malicious users can exploit it by modifying or duplicating the MMSI. This is because the device management subject in which the MMSI is stored is the same as the ship subject. In this study, a certificate-based encrypted MMSI distribution and authentication system was proposed to improve the security environment. Through this, it is possible to identify and deny the abuse of MMSI such as unauthorized modulation.



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T6-4) Density-Based Contention Management for Collision Avoidance in Dense IoT Networks

Author Sejin Choi, Lee Jaewan, Minwoo Kwon and Yonggang Kim (Kongju National University, Korea)

Abstract In Internet-of-things (IoT) networks where IoT nodes are densely deployed, collisions among the nodes are highly expected. Although IoT nodes may perform listen-before-talk approach to avoid collisions as in CSMA/CA protocol, the collision probability increases as the density of IoT nodes increases. Instead of using the fixed initial minimum contention window size, we propose to adjust initial contention window size according to the density of the networks. When the collisions are highly expected, the proposed method increases the initial contention window size for collision avoidance. Through the simulation results, we showed that the proposed method is applicable in dense IoT networks.

T6-5) Transmission Loss Analysis of SATCOM Radomes with Wide Incident Angle

Author Taehyeon Kim (Gyeongsang National University & Electronic Engineering, Korea); Wang-Sang Lee (Gyeongsang National University (GNU), Korea)

Abstract This paper presents analysis of transmission loss for SATCOM(Satellite Communication) radome with wide incident angle. SATCOM radome is mounted on aircraft to protect satellite communication antenna. To protect from external environment and secure electrical performance, SATCOM radome has a sandwich-type structure. Three models of radomes were manufactured for operating frequency of antenna at 10-15 GHz, and transmission loss was compared using calculation and simulation.

T6-6) Channel Estimation for RIS Aided Multi-User SISO System Using Super-Resolution

Author Jeongbin Seo (PUSAN National University, Korea); Donghwan Kim and Suk Chan Kim (Pusan National University, Korea)

Abstract In this working in process paper, we propose a channel estimation technique for reconfigurable intelligent surfaces aided system using deep back projection networks, which is one of the super-resolution deep learning models. In simulation, the proposed channel estimation technique has better performance than least square method.

Poster Sessions

September 22nd (Thursday)

Poster Session

16:30 - 17:20 Room : Emerald

P-1) Voice Spoofing Countermeasure Using Residual Convolutional Neural Networks and Self-Attention

Author Changhwan Go, Wooyeo Choi and Chanjun Chun (ChosunUniversity,Korea)

Abstract The security of the ASV system was improved through the application of deep learning. However, it is still vulnerable to voice spoofing. Since voice spoofing destroys the security of the ASV system, there is a need for countermeasure. In this paper, we propose a voice spoofing countermeasure using the residual block and the self-attention-based transformer encoder or Bi-LSTM. We employ the LFCC, which is referred to as a cepstral coefficient feature extracted by linear filter banks. In addition, we utilize the dataset of the PA task in ASVspoof2021. ASVspoof2021 is a challenge to develop countermeasures to classify spoof or bona fide and provides datasets recorded in various real environments. We evaluate whether the proposed method classifies voice spoofing better than the conventional voice spoofing detection method.

P-2) A Study on the Control of Small Unmanned Surface Vehicles Using Disturbance Learning

Author Sang Ki Jeong (Korea Institute of Ocean Science and Technology, Korea)

Abstract In this study, the study was carried out on the disturbance learning adaptive control algorithm using a Recurrent Neural Network to apply to the control of the trajectory of the unmanned surface vehicle. There are many difficulties in controlling the movement trajectory of an unmanned surface vehicle in the ocean. Current flow in the ocean is a typical disturbance. If the unmanned surface vehicle is not controlled in consideration of disturbance, the performance of the unmanned surface vehicle is deteriorated, and a problem arises that deviates from the correct movement trajectory. Therefore, this disturbance is learned on the move, applied to the control system, and studied the control technology to efficiently control the moving trajectory of the unmanned surface vehicle. To measure the ocean current velocity, GPS is used to measure the ground speed, heading angle, and position (latitude, longitude). And the flow velocity sensor is measured using the velocity at which the hull moves in a fluid having a flow velocity. Based on the calculated velocity and direction of the ocean current the trend is predicted using the learning of the Recurrent Neural Network and applied to the model as a disturbance of the control system. And an Artificial Neural Network PID controller using artificial neural networks was designed to control the trajectory of the unmanned surface vehicle using this. Also, it analyzes whether the moving trajectory of the unmanned surface vehicle is accurately following and validates the control algorithm through simulation and experiment of the applied control system.

P-3) A Study on the Swarm Control Algorithm of Unmanned Surface Vehicles

Author Jihyeong Lee, Sang Ki Jeong and Haeyoung Park (Korea Institute of Ocean Science and Technology, Korea)

Abstract In this study, to overcome the limitations of a single unmanned surface vehicle (USV), a study was conducted on the swarm control algorithm of the USV. Among the various swarm control methods, a leader-follower swarm control was selected and studied, and the performance of the swarm USV control algorithm proposed in this study was verified through an actual sea area test.

P-4) Fingerprint-Aided Coordinated mmWave Beam Selection for mmWave UAV Communications

Author Yuna Sim, Seungseok Sin, Yuna Jeong and Jihun Cho (Chonnam National University, Korea); Sangmi Moon (Korea Nazarene University, Korea); Intae Hwang (Chonnam National University, Korea)

Abstract In this paper, we propose a fingerprint-based beam selection and cooperation scheme for millimeter-wave (mmWave) unmanned aerial vehicle (UAV) communication. The proposed scheme constructs an offline fingerprint database for beam selection and performs online beam cooperation. In the offline phase, the best beam index from serving cells and the interference beam indexes from neighboring cells are stored. In the online phase, the best beams and interference beams are determined using the information from the fingerprint database instead of an exhaustive search, and the beam cooperation is performed to improve the signal-to-interference-plus-noise ratio for aerial user equipment. System-level simulations are performed to assess the UAV effect based on the 3GPP new radio mmWave and UAV channel models. Simulation results show that the proposed beam selection scheme can reduce the beam sweeping overhead and inter-cell interference.

P-5) Experiments of Long-Range Underwater Communication in the East Sea

Author Donghyeon Kim, Jeongha An, Jeasoo Kim and Kiman Kim (Korea Maritime and Ocean University, Korea); In-soo Kim (Agency of Defense Development, Korea)

Abstract Since 2018, several long-range underwater communication experiments have been conducted in the East Sea along various tracks (at least over 23 km range). These experiments aim to (a) understand and confirm the features of long-range propagation in the East Sea, and (b) research the feasibility of long-range underwater communication over tens of kilometers. This paper introduces three long-range underwater communication experiments and the communication results achieved using time reversal processing.

Poster Sessions

September 22nd (Thursday)

Poster Session

16:30 - 17:20 Room : Emerald

P-6) Utility-Centric Partial Offloading in Parked Vehicle-Assisted Multi-Access Edge Computing

Author Qui Pham and Dong Seong Kim (Kumoh National Institute of Technology, Korea)

Abstract Recently, parked vehicle-assisted multi-access edge computing (PVMEC) has been promoted to address the computation resource limitation of conventional MEC paradigms by leveraging the opportunistic resources of parked vehicles (PVs). In this paper, we devise a partial offloading scheme that allows mobile devices to partially process their tasks locally and partially offload to a MEC server or a neighboring PV to maximize the system utility in regard to the latency and the cost of computation resources. Evaluation results verify the superiority of the proposed scheme.

P-7) Prospect and Industry Issues of Metaverse and Digital Twin Adoption in Nigerian Maritime

Author Cosmas Ifeanyi Nwakanma and Judith Nkechinyere Njoku (Kumoh National Institute of Technology, Korea); Cajethan Onyekachi Okafor (Federal University of Technology Owerri, Nigeria); Dong Seong Kim (Kumoh National Institute of Technology, Korea)

Abstract This work reviewed the potentials and need for Metaverse, Digital twin and enhancement of maritime communication infrastructure in Nigerian maritime sector. The preliminary review results reveal the need for a more robust digital twin platform for maritime communication fault detection detection and evaluation in real time. Similarly, Metaverse promises to be a veritable platform for maritime transportation, communication, and vessel maintenance training. Adopting these technologies can help improve Nigerian's linear shipping connectivity index.

P-8) A Study of Open-Source Netwrok Simulator

Author Dong Seong Kim and Jae Woo Kim (Kumoh National Institute of Technology, Korea); Gi Hyeob Kwon (ICT-Convergence Research Center, Korea)

Abstract This study analyzed the simulation method for the currently used open source network simulation tool and classified it according to the simulation method. Furthermore, based on the simulation method, we propose a simulation tool selection guide for effective network simulation design.

P-9) Primary User Emulation Attack Detection

Author Vladimir V. Shakhov (University of Ulsan, Korea)

Abstract Leading IT industry experts are seriously concerned about the low reliability of IoT technologies, especially those based on wireless networks. Cognitive radio solves some of these problems and also provides opportunities for efficient use of the spectrum. However, intrusions that are specific to cognitive radio systems have appeared. We consider one of the most devastating attacks of this type, called the primary user emulation attack. We propose an efficient approach to intrusion detection based on statistical sequential analysis. Performance analysis is also provided.

P-10) A Study on the Problems and Solutions in the NFT Ecosystem

Author Author Yongbin Choi and Am-Suk Oh (Tongmyong University, Korea)

Abstract Web 3.0 currently used as a decentralized web in conjunction with blockchain technology. In this web 3.0 service, NFT serves as a certificate of digital content, that is, ownership. In order to register and trade this, an underlying platform is essential. In addition, by creating and building this platform, it is possible to preoccupy the leading position in the web 3.0 era. Therefore, this paper aims to study the underlying technology that actively used in metaverse, games, etc. through the development of the NFT platform.

Venue

Information

Sono Calm Jeju is located by the southern coast of Jeju Island. The resort complex has a beautiful garden and a walking path along the beach. It is also fully equipped with relaxation, leisure, and entertainment facilities, and business centers.

Sono Calm Jeju has three lodging facilities: Shineville, Luxury, and Royalville buildings. The rooms in Shineville and Luxury are hotel rooms that are inspired by neo-classic designs while the Royalville offers an ocean-view villa-style room for a more personal feel. Some of the facilities available include a fitness club, restaurants, karaoke, cocktail bar, saunas, an outdoor swimming pool, banquet hall, and more.

Location

242 CSono Calm Jeju
6347-17 Iljudong-ro, Pyoseon-myeon, Seogwipo-si, Jeju-do





Memo



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