IAS18 - 2023

Program Booklet

18th International Conference on

Intelligent Autonomous Systems

July 4 – 7, 2023 • Suwon, Korea

Photo: Suwon Hwaseong Fortress

ICROS Institute of Control, Robotics and Systems

IAS Society intelligent autonomous systems

Suwon Convention Center

Gyeonggi Tourism Organization 경기관광공사

Korea Tourism Organization

Kyung Hee University

Contents

Program at a Glance p. 2

Welcome Message p. 4

Organizing Committee p. 5

Technical Program Committee p. 7

List of Partners p. 9

General Information p. 11

Social Events p. 12

SNU Lab Tour p. 13

Floor Map p. 14

Vicinity of Suwon Convention Center p. 15

Understanding Session Code p. 16

Plenary Sessions p. 17

Tutorials and Workshops p. 21

List of Special Sessions p. 25

Technical Program Details p. 26
- D-2, Wednesday, July 5th p. 27
- D-3, Thursday, July 6th p. 35
- D-4, Friday, July 7th p. 45

Author Index p. 53

Program at a Glance

	D-1, Tuesday 4 July
Room	**304**
08:00	Registration
09:00-12:00	Tutorial 1: Prof. *Jemin Hwangbo*
12:00-13:00	Lunch Break
13:00-16:00	Tutorial 2: Prof. *Seungchul Lee*
16:00-16:30	Break
16:30-18:30	Workshop 1: Prof. *JongWoo Kim*
18:30-20:00	Welcome Reception

	D-2, Wednesday 5 July				
Room	**Conv#3**	**304**	**305**	**306**	**Conv#3**
08:00-08:30	Morning Break				
08:30-09:00	Opening Ceremony				Exhibition
09:00-10:00	W1P Plenary Talk - Prof. *Sukhan Lee*				
10:00-10:30	Coffee Break				
10:30-11:45	W2A Autonomous Navigation	W2BS Digital Twinning for Robots and Artificial Intelligence	W2CS Digital Twin and Haptic Interface	W2D Object Detection	
11:45-13:30	Lunch Break				
13:30-14:30	W3P Keynote Talk - Prof. *Richard M. Voyles*				
14:30-14:50	Coffee Break				
14:50-16:05	W4A Pose Estimation	W4BS Rehabilitation Robots for Upper Extremity	W4CS SLAM for Robotics Digital Twin in Challenging Environment	W4D Smart Sensors in Autonomous Agents	
16:10-21:00	Suwon City Tour				

Program at a Glance

D-3, Thursday 6 July

Room	Conv#3	304	305	306	Conv#3
08:00-08:30	Morning Break				
08:30-10:00	Workshop 2 *Profs. Myunghee Kim & Ashutosh Tiwari*	T1B HRI (Social Robotics)	T1C Robot Dynamics & Kinematics	T1D Robot Manipulation	Exhibition
10:00-10:30		Coffee Break			
10:30-11:45		T2B Digital Health	T2C Humanoid Robotics	T2DS Smart Haptics & Teleoperation	
11:45-13:30	Lunch Break				
13:30-14:30	T3P Keynote Talk - Prof. *Kazuya Takeda*				
14:30-14:50	Coffee Break				
14:50-16:05	T4AS Metaverse and XR Applications in Intelligent Autonomous Systems	Workshop 3 *Dr. Hyun-Joon Chung*	SNU Lab Tour		
16:05-17:30			T5I Interactive Session		
17:30-19:00	Industrial Session/ Award Ceremony				
19:00-21:00	Conference Banquet				

D-4, Friday 7 July

Room	Conv#3	304	305	306	Conv#3
08:00-08:30	Morning Break				
08:30-09:00					Exhibition
09:00-10:00	F1P Keynote Talk - Prof. *Gábor Orosz*				
10:00-10:30	Coffee Break				
10:30-11:45	F2AS Autonomous Vehicle in Adverse Weather: Challenges and Opportunities	F2B HRI (Collaborative Robotics)	F2C Intelligent Autonomous Mobility	F2D Knowledge Inference, Software Modeling	
11:45-13:30	Lunch Break				
13:30-15:15	F3A Smart Factory, Digital Twin, VR	F3B Autonomous Aerial Vehicle	F3C Multi Agent System	F3DS Field Robots and Intelligent Autonomous Systems	
15:15-15:30	Closing Ceremony				

Welcome Message

Greetings from the General Chair

On behalf of the organizing committee, I would like to welcome you to the 18th International Conference on Intelligent Autonomous Systems (IAS18 - 2023), which will be held from July 4 to 7, 2023, in Suwon, Korea. The IAS Society was established in Amsterdam in July 1994 to share knowledge and recent research information, hold annual meetings, and foster collaboration in autonomous systems technology. IAS conferences have been successfully hosted in leading countries around the world. Looking back, we had the 12th IAS in Jeju in 2012, where Professor Sukhan Lee served as the General Chair, attracting more than 300 participants. The last two IAS meetings were affected by COVID-19, resulting in virtual or hybrid conferences in Singapore (2021) and Zagreb, Croatia (2022). I am delighted to announce that this conference will be held fully in person in Suwon, marking 11 years since IAS-12 on Jeju Island.

The organizing committee has worked hard to create an excellent and exciting conference program. I express my gratitude to the invited speakers, special session organizers, tutorial lecturers, and workshop organizers for their enthusiastic participation. We are pleased to feature four plenary and keynote sessions, 15 oral sessions, 8 special sessions, one interactive session, and an industrial session. A total of 136 papers will be presented in oral and poster formats. Furthermore, I am grateful to have 10 autonomous and robot corporations participating in the exhibition as sponsors, showcasing their products during the conference. In addition to the technical program, there will be social events including a welcome reception, Suwon city tour, lab tour, and conference banquet, offering memorable experiences.

Suwon has a rich historical heritage, notably the Hwaseong Fortress, which was designated as a World Heritage site by UNESCO in 1997. Today, Suwon is one of the largest satellite cities near Seoul and takes pride in its well-developed traffic networks connecting metropolitan cities across the country. With the support of the Suwon Government, I am pleased to provide you with a valuable experience in this remarkable location. I hope that all attendees will enjoy the conference program, further enhancing their expertise. Thank you.

Sincerely yours,

Soon-Geul Lee

Soon-Geul Lee

IAS18-2023 General Chair

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List of Partners

Silver Partner

Korea Institute for Robot Industry Advancement	KIRIA is established in 2010 to support the development of various projects and related policies to foster the intelligent robot industry. We'll show you one of our infrastructure construction projects, constructing "5G-based advanced manufacturing robot substantiation center", which support verification & validation of 5G-based advanced manufacturing robots. We would like to introduce the 5G-based advanced manufacturing robot application exhibition, evaluation & certification system for each advanced manufacturing robot product and system, and the ongoing R&D activities of KIRIA in this regard.

Partners

CALMAN TECH	We are creating a new mobility paradigm based on a robot mobility platform that can move freely in all directions – forward, backward, left, and right. We have developed a ball wheel-based mobile robot platform and robot navigation solution that allows for free movement in all directions.
FunctionBay	RecurDyn is an interdisciplinary, (computer-aided engineering) CAE software package whose primary function is the simulation of Multi-Body Dynamics (MBD). RecurDyn simulates both rigid and flexible body dynamics by combining traditional rigid MBD with cutting-edge finite element technology for modeling flexible bodies. (MFBD: Multi Flexible Body Dynamics)
Enerteks Co.,Ltd	LiDAR and Sensor Product for Optical Ice Detection
LumiSol	Founded in 2008, LumiSol Co., Ltd. is an official Korean distributor of Velodyne Lidar. Velodyne Lidar is a global leader in the world's Lidar market with the best technology. LumiSol Co., Ltd. supplies lidar sensors to various industries such as security, autonomous driving, mapping, robotics, and UAV. Velodyne Lidar is a laser sensor that measures the distance by calculating the time of light return. With 16~128 of diodes, 905 nm of light can be emitted to collect data up to 300 meters in real time. It has high distance accuracy, durability, and the advantage of not being affected by day and night.
WeGo Robotics	Self-driving robots are being used in various areas such as unmanned quarantine systems, self-driving security systems with patrol functions, miscellaneous research robots, exploration robots, distribution transport, and so on. That is why WeGo Robotics is focusing system integration and content development for robots with various applications such as patrol robots, distribution transport robots, quarantine robots, and self-driving robot education based on self-driving robot technology.

List of Partners

Daegu Manipulator Regulation-Free Special Zone	Daegu Mobile Manipulator Regulation-Free Special Zone is a designated area for the expansion of the scope of use of mobile manipulator and the promotion of the commercialization of robots that can coexist with humans through regulatory innovation of the robot industry, the future growth industry of Daegu.
TWINNY	TWINNY Co.,Ltd. is an autonomous mobile robot specialized company. It is characterized by technology that enables autonomous driving without any infrastructure in wide indoor and outdoor environments such as factories, distribution centers, hospitals, high-rise buildings, and parks.
BNSoft, Inc.	BNSoft,Inc. provides a variety of technology development and services including its own Solution, TIIS(Technology Integration Intelligence Solution). TIIS provides the best information by analyzing various data and extracting features based on Rule & Deep learning with expert consulting and optical customization solution. TIIS enables you to build an accurate decision-making environment through optimal learning models and analysis applications.
Innovusion	Innovusion Falcon Lidar – 1550nm Wavelength Lidar Validated for World's Most Produced, and Through Using a Few Vehicle Models
WISEITECH	1. WiseProphet (AI): AI development platform with various industrial applications 2. WiseIntelligence (BigData): Big data analytics for effective business decision-making 3. WiseMetaEngine(Metaverse): Efficient metaverse development engine that reuses content

Media Partner

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The Intelligent Autonomous Systems (IAS) Society

Organized by

The Institute of Control, Robotics and Systems (ICROS)

Technically co-sponsored by

- Korea Robotics Society
- Field Robot Society (FIROS)

Financially contributed by

- Suwon Convention Center (SCC)
- Gyeonggi Tourism Organization (GTO)
- Korea Tourism Organization (KTO)
- Kyung Hee AI Graduate School and Research Institute of Convergence Tech

General Information

Conference Venue

IAS18-2023 will be held on the 3rd floor of the Suwon Convention Center. See the floor map and the vicinity of SCC in this booklet. The Center is located near Gwanggyo Lake Park, which is a beautiful lake surrounded by a 1.6 km trail with a refreshing breeze. There are Galleria Department Store Gwanggyo and Courtyard by Marriott Hotel next to the SCC, which is established for part of a convention and business complex.

Suwon Convention Center (SCC)
Address: 140, Gwanggyojungang-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16514, Republic of Korea
Website: https://www.scc.or.kr/en/
Email: sales@scc.or.kr

Registration Information

Registration will be open from 8 am to 6 pm from Tuesday to Friday, 4 - 7 July at the 3rd floor lobby of the SCC.

Exhibition

Exhibition will be open from 9 am to 6 pm, Wednesday through Friday, at Convention Hall #3. Exhibitors will display state-of-the-art autonomous vehicles, robot components, and devices. They will provide you with their stickers to be placed on the sticker sheet.

Green MICE Compliance

IAS18-2023 Organizers will comply with the Green MICE Guidance (ISO20121: Event Sustainability Management System) that makes the conference more sustainable and less impact on global environment. Accordingly, we will offer you electronic distribution of materials (proceedings, program booklet, receipt, or a certificate of attendance), reusable badge, and tap water instead of plastic bottles. Attendees are encouraged to use public transport.

Conference Dates, Times, and Language

Conference dates and times are based on Korean time (GMT +9 hours). Please note that Korea is 14 hours ahead of the Eastern Standard Time (EST). The official spoken language is English. Translation service is not provided.

Social Events

Welcome Reception

Tuesday July 4th, 6:30 pm @ Lobby (3F), SSC

We will welcome anyone who attends the symposium to the Welcome Reception; workshop applicants, accompanying persons, exhibitors, or conference attendees. You can explore the conference venue, enjoy ice breaking freely with newcomers. We will offer you light meals and refreshments.

Conference Banquet

Thursday, July 6th, 7 pm @ Suwon Kitchen (2F), Courtyard by Marriott Suwon

Conference registrants are invited to attend the banquet. The award ceremony will take place at Convention Hall #3 before the banquet. Additional banquet is available at $100 (KRW 120,000) per each.

Suwon City Tour

Wednesday, July 5th, 4:10 pm @ Suwon Hwaseong Fortress

Walk around Suwon Hwaseong Fortress, visit Suwon Fried Chicken Street, where all you can eat and drink; Korean styled sweet and delicious hand-made fried chicken**.** Tour fee is available at US$$10 (12,000 KRW) per each, including tour bus, English guide, and dinner (fried chicken and draft beer).

Special Event for Lunch

Discount Lunch Voucher

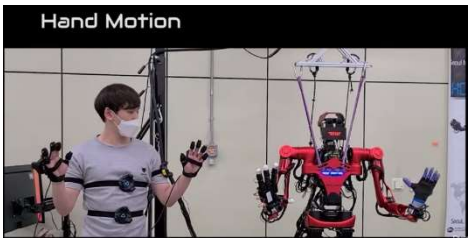
If you receive three different stickers daily from each exhibitor, you can get a 5,000 KRW discount lunch voucher at the registration desk and buy a lunch at food court (B1 and 9F), Galleria Department Store Gwanggyo. The voucher is valid only for the indicated amount, date and time, and is non-refundable or non- transferable. For more details, please see the voucher given on site.

SNU Lab Tour

Thursday, July 6, 2:30 pm – 4 pm @ DYnamic RObotic Systems Lab (DYROS), Seoul National University

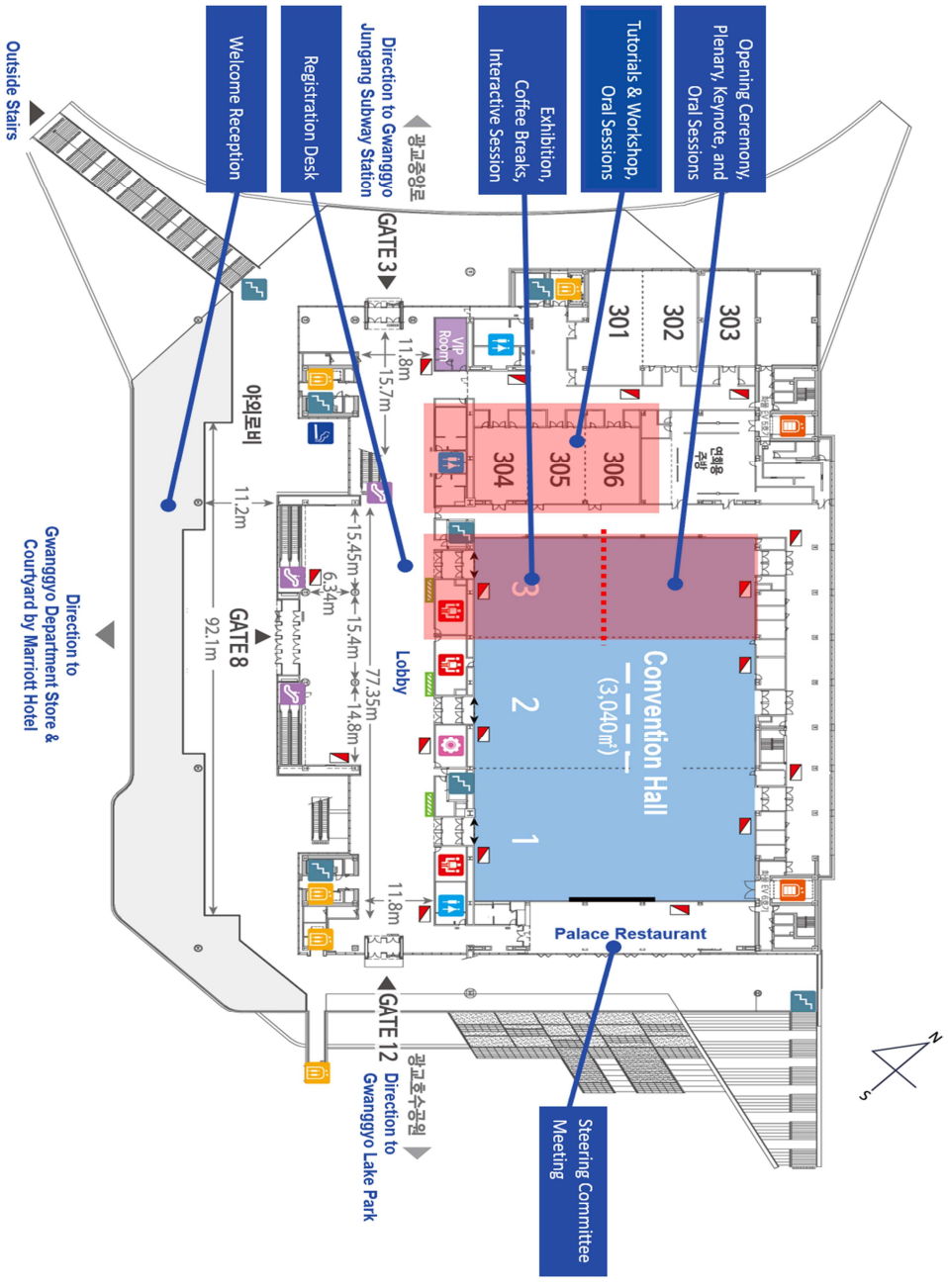
- Director of Lab: Prof. Jaeheung Park, Seoul National University
- Description: The DYROS laboratory focuses on studies of a compliant motion control framework, natural human motion, a new software architecture for complex robotic systems, and medical robotics. We have developed intelligent and agile robots that can adapt to natural conditions through robot-environment interaction. During the tour, we will demonstrate the following:

1. Avatar Robot: These robot systems have interactive and intuitive features controlled with visual, auditory, tactile, haptic, and grasping devices.
2. Robotic Furniture Assembly: The robots perform the assembly process, including task planning, motion planning, and assembly control.
3. Autonomous Valet Parking: This study focuses on performing autonomous valet parking safely and efficiently by establishing path planning and driving strategies that minimize reliance on global-provided information.



Floor Map

Floor Map of Level 3, Suwon Convention Center (SCC)



Vicinity of Suwon Convention Center

Understanding Session Code

Each session in the technical program is assigned a unique number which clearly indicates when and how the paper is presented. A typical number is shown below:

Typical Session Number: T1A.2

The first letter (i.e. T) indicates the day of the conference.

W = Wednesday

T = Thursday

F = Friday

The second number (i.e. 1) indicates the time of the day.

1 = the first time

2 = the second time

3 = the third time

4 = the fourth time

5 = the fifth time

The third letter (i.e. A) shows the presentation type and place.

A, B, C, D = Oral

P = Plenary and Keynote

I = Interactive

S = Special Session

A, B, C, D = Convention Hall #3, Room #304, 305, 306

The fourth number (i.e. 2) shows the presentation order in the session.

1 = the first presentation

2 = the second presentation

3 = the third presentation

4 = the fourth presentation

5 = the fifth presentation

Plenary Sessions

W1P: Plenary Talk

Wednesday 5-Jul, 09:00 - 10:00 @ Convention Hall #3

Chair: Jinung An, Daegu Gyeongbuk Institute of Science & Technology, Korea

Deep 3D Vision for Intelligent Autonomous Systems

Speaker: Prof. Sukhan Lee, Sungkyunkwan Univ., Korea

Abstract: Similar to what it is for human and most animals, 3D vision is indispensable for autonomous systems and agents to carry out real-world activities and tasks based on autonomous navigation, manipulation and interaction. In particular, it is the capability of autonomous agents to understand, model and measure surrounding 3D scenes and workspaces in a space-time context that plays a fundamental role for achieving human-like autonomy. The increased complexity in dealing with 3D, due to an extra dimension leading to massive 6D geometric variations, causes conventional engineering approaches based on an extension of 2D vision with exploiting 3D geometric features could offer only a limited success, hampered by efficiency and accuracy trade-off. Recent progress in end-to-end deep learning approach to 3D scene and workspace modeling and object 6D pose estimation, combined with detection, panoptic segmentation and tracking, opens a possibility for autonomous systems and agents to break through the trade-off toward human-like performance in real-time understanding, modeling and measuring 3D scenes and workspaces in a space-time context. In this talk, first, advancement in deep learning approach to 3D vision is reviewed, in which focus is given to the end-to-end deep learning approaches to 3D scene and workspace modeling and 6D object pose estimation. Then, the end-to-end deep learning approaches to 3D vision developed in my laboratory are presented, including the approaches to partial-to-full point cloud reconstruction and 6D pose estimation in both object and category levels that are integrated with deep object detection and panoptic segmentation into real-time modeling of 3D scenes. This is followed by presentation on how the developed deep 3D vision has been applied to smart manufacturing, autonomous navigation and human-robot interaction. Finally, the talk will be concluded with discussions on future direction on deep 3D vision for intelligent autonomous systems.

Biography: Sukhan Lee is currently a Professor of Artificial Intelligent and Robotics at Sungkyunkwan University and the Founding Director of Intelligent Systems Research Institute. Previously, he has served as the Dean of the University Graduate Studies from 2011 to 2013, a Chaired University Professor from 2014 to 2018, a WCU Professor of Interaction Science from 2008 to 2013, a Professor of Information and Communication Engineering from 2003 to 2014. He also served as a Vice President of Korea National Academy of Science and Technology from 2016 to 2019. Prior to Sungkyunkwan University, he was with the Samsung Advanced Institute of Technology as an Executive Vice President and a Chief Research Officer from 1998 to 2003. From 1990 to 1997, he worked for Jet Propulsion Laboratory/NASA, California Institute of Technology, as a Senior Member of Technical Staff. From 1983 to 1997, he was with the Department of Electrical Engineering and Computer Science at the University of Southern California as a Professor. Prof. Sukhan Lee received his Ph.D. degree in Electrical Engineering from Purdue University, West Lafayette, and his M.S. and B.S. degrees in Electrical Engineering from Seoul National University. He is currently a life fellow of IEEE and a fellow of Korean National Academy of Science and Technology. He served as a Vice President of IEEE Robotics and Automation Society from 2004-2008. He has published over 400 technical papers in Scientific Journals and Major Conferences, over 120 Domestic/International Patents and 6/35 Books/Book Chapters. He has his research interest in robotics, artificial intelligence, computer vision and micro systems.

Plenary Sessions

W3P: Keynote Talk

Wednesday 5-Jul, 13:30 - 14:30 @ Convention Hall #3

Chair: Marcus Strand, Cooperative State University Baden-Wuerttemberg Karlsruhe, Germany

The Irony of Autonomy: The Increasing Involvement of Humans in Assistive Monitoring and Active Interaction

Speaker: Prof. Richard M. Voyles, Purdue Univ., USA

Abstract: An ironic twist to Autonomous Systems research over the past thirty-five years has been the inclusion of more humans in the loop. In fact, since at least the times of Aristotle, humans have been intrigued by the idea of creating automatons in their image to escape the bondage of labor. Hence, the goal of the first factory robots -- some sixty years ago – was to create 'lights-out factories' that operated rigidly-timed assembly lines without human involvement. Yet, almost as old as the desire to create subservient automatons, has been the fear of rebellion of our own intelligent machines. Humans, it seems, want to conflate the near-mystic unpredictability of human emotions with the logical toil of their mechanical progeny. So, it may not be such a surprise that the current pinnacle of autonomy research is moving toward machines that seamlessly work alongside untrained human beneficiaries in unstructured and chaotic environments. This talk explores that evolution in Autonomous Systems research from standalone machines to machines that interact increasingly with humans of greater technical naivete. From robotic assembly to self-driving cars, to emergency response, and robotic surgery, we are gradually pushing the boundaries of the state-of-the art toward more human involvement with increasingly intelligent machines in less-structured situations. Within this space, the emergency response research community made a determined effort to attack highly-unstructured environments in such difficult scenarios that human cooperative control was assumed to be a necessity. The 9/11 attack on the World trade Center in the US was the first use of robots in a real disaster scenario and almost no autonomy was allowed on-site. In that case, the search for victims was so difficult that roughly 60% of victims found were only discovered in post-analysis of video footage, rather than in real-time. Search in deconstructed environments is difficult because a priori model-based information is mostly unusable and dust and debris makes recognition unreliable. In early attempts, teleoperation was the only viable solution with humans lives potentially in the balance. The DARPA Robotics Challenge later brought researchers from around the world to incorporate higher degrees of autonomy and offline and online simulation to the augmentation of both machines and humans. That evolution has continued into the unstructured world of battlefield robotic surgery, in which virtualized reality fuses teleoperation with full autonomy to allow machines to learn from human experts to support full autonomy in times of crisis.

Biography: Dr. Voyles, the Daniel C. Lewis Professor of the Polytechnic, received a B.S. in Electrical Engineering from Purdue University in 1983, an M.S. in Manufacturing Systems Engineering from Dept. of Mechanical Engineering at Stanford University in 1989, and the Ph.D. in Robotics from the School of Computer Science at Carnegie Mellon University in 1997. He is currently Professor of Engineering Technology at Purdue University and an IEEE Fellow. He was a tenured faculty member at the University of Minnesota from 1997 to 2007 and at the University of Denver from 2006 – 2013. He served as lead Program Director for the National Robotics Initiative at NSF and was a co-founder of the NSF Innovation Corps program. He also served as Assistant Director of Robotics and Cyber-Physical Systems at the White House Office of Science and Technology Policy. Dr. Voyles' research interests are in the areas of robotics and artificial intelligence. Specifically, he is interested in the development of small, resource-constrained robots and robot teams for urban search and rescue and surveillance. Dr. Voyles has additional expertise in sensors and sensor calibration, particularly haptic and force sensors, real-time control, and Form + Function 4D Printing. Dr. Voyles' industrial experience includes Dart Controls, IBM Corp., Intergrated Systems, Inc., and Avanti Optics. He has also served on the boards of various start-ups and non-profit groups.

Plenary Sessions

T3P: Keynote Talk

Thursday 6-Jul, 13:30 - 14:30 @ Convention Hall #3

Chair: Nak Young Chong, Japan Advanced Institute of Science and Technology, Japan

AI technology for mitigating the risk of AI

Speaker: Prof. Kazuya Takeda, Nagoya University, Japan

Abstract: As the Autonomous Driving (AD) becomes a reality of the society, technical, legal and ethical systems that can mitigate the damage caused by the inevitable error of human or autonomous system become important. Due to their highly complicated or even black-box nature, how an AI for AD 'understands' the current traffic context is difficult to be shared. Particularly for the perception, depicting the attention heatmap is often used for sharing the 'understanding' of the AI for AD with that of a human. However, detecting the risk is impossible with only visual cue. The AD system must understand the situation so that it properly avoids the risk.

As the first step, we built a signal transcription system which converts the multi-modal sensor signal sequences used by AD – consisting of a frontal camera, kinematic sensor and the vehicle control channel – into the natural language sentences. The generated sentences represent how the AD understands the current traffic context and human beings can share its understanding. We are currently trying to apply this to AD risk management in the insurance business, for the digital aid of the human risk analysts. In this talk, I will introduce details of this project and future research goals that include describing a set of standard traffic scenarios which spans 99% of urban traffic.

Biography: Prof. Kazuya Takeda is working in the field of signal processing technology research for acoustic, speech and vehicular applications. In particular, understanding human behavior through data centric approaches utilizing signal corpus in real world has been his main interest.

Prof. Takeda is a Professor and a Vice President at the Nagoya University, Japan. He received his B.E.E., M.E.E. and Ph.D in 1983, 1985 and 1995, respectively from Nagoya University. After graduating from the university, he worked for ATR and KDD R&D Lab. He visited MIT as a visiting scientist before joined in Nagoya University in 1995. He is a fellow of IEICE (the Institute of Electronics, Information and Communications Engineers) and a senior member of IEEE.

Prof. Takeda has served as an academic leader in various signal processing fields. Currently, he is a BoG (Board of Governors) member of the IEEE ITS Society, the Asia-Pacific Signal and Information Processing Association (APSIPA). He served as a general chair of FAST-zero 2017, Universal Village 2016 and as a program chair of IEEE ICVES 2009, IEEE ITSC 2017 and other scientific meetings. He is serving as the general chair of IEEE Intelligent Vehicle Symposium (IV2021), which is a flagship conference of the Society. He is a co-founder and director of the university startup "Tier IV", a company which is aiming to democratize autonomous driving technologies through developing the open-source software platform, Autoware.

He has published more than 150 journal papers, 8 co-authored/co-edited books and 15 patents. He received 2020 IEEE ITS Society Outstanding Research Award. He is also winner of 6 best paper awards from IEEE international conferences and workshops in addition to domestic awards.

Plenary Sessions

F1P: Keynote Talk

Friday 7-Jul, 09:00 - 10:00 @ Convention Hall #3

Chair: Yongseob Lim, DGIST, Korea

Connected and automated vehicles: improving safety and efficiency across the scales

Speaker: Prof. Gábor Orosz
Univ. of Michigan, Ann Arbor, USA

Abstract: Automated vehicles are entering our roadways and are expected to have a large impact on the road transportation of the 21st century across the globe. They rely on a large array of optical sensors to perceive their environment and utilize complex algorithms to plan and control their motion while maneuvering through traffic. In addition, they may use vehicle-to-everything (V2X) communication to obtain information about road participants beyond their line of sight. In this talk we describe the promises and challenges of automation and connectivity in mixed traffic scenarios where automated vehicles share the roadways with human-driven vehicles. We present our recent results on how V2X connectivity may benefit automated vehicles responding to complex traffic scenarios and how such benefits scale for large transportation systems. In particular, we focus on improving safety, time efficiency and energy consumption in mixed traffic environments. Tools from time delay systems, nonlinear dynamics and control, network control, and machine learning are utilized and the theoretical results are validated using experiments on closed tracks and on public roads.

Biography: Dr Gabor Orosz received the MSc degree in Engineering Physics from the Budapest University of Technology, Hungary, in 2002 and the PhD degree in Engineering Mathematics from University of Bristol, UK, in 2006. He held postdoctoral positions at the University of Exeter, UK, and at the University of California, Santa Barbara. In 2010, he joined the University of Michigan, Ann Arbor where he is currently an Associate Professor in Mechanical Engineering and in Civil and Environmental Engineering. His theoretical research includes dynamical systems, control, and machine learning with particular interests in the roles of nonlinearities and time delays in such systems. In terms of applications, he focuses on connected and automated vehicles, traffic flow, and biological networks. He has published more than 50 journal papers in leading international journals. He has been serving as associate editor for the Transportation Research Part C since 2018, for the IEEE Transactions on Control Systems Technology since 2021, and for the IEEE Transactions on Intelligent Transportation Systems since 2022. He served as the program chair for the 12th IFAC Workshop on Time Delay Systems, as the general chair for the 17th IFAC Workshop on Time Delay Systems, and as the general chair for 3rd IAVSD Workshop on Dynamics of Road Vehicles, Connected and Automated Vehicles.

Tutorial 1

Tuesday 4-Jul, 09:00 – 12:00 @ Room #304

Reinforcement Learning using Raisim

Lecturer: Prof. Jemin Hwangbo, KAIST, Korea

Description: Robotics is seeing a rising trend in the use of reinforcement learning, which has proven to be more effective than traditional control methods for handling some complex robots. However, implementing reinforcement learning requires a sophisticated software architecture that includes a high-performance simulator, neural network implementations, and sometimes graphics rendering pipeline. In this workshop, I will demonstrate how you can easily access all of these features using Raisim, a rigid-body physics engine that was specifically designed for reinforcement learning in simulation. Raisim now includes a photorealistic visualizer based on Unreal Engine, which can stream RGB and depth images to the C++ side. By the end of the tutorial, you will be equipped with the skills necessary to write a complete reinforcement learning session for your robot..

Biography: Jemin Hwangbo serves as an assistant professor in the Department of Mechanical Engineering at KAIST and concurrently holds the position of Director at the Robotics and Artificial Intelligence Lab (RAI Lab). His group's research is primarily centered around legged robotics, encompassing areas such as design, vision, control, and navigation. He obtained his B.S. degree from the University of Toronto, while his M.S. and Ph.D. were conferred by ETH Zurich. Jemin Hwangbo has contributed significantly to the field of legged robotics, with four published papers in Science Robotics, one of which was featured as one of the top ten most remarkable papers of 2019 by the prestigious journal, Nature.

Tutorial 2

Tuesday 4-Jul, 13:00 – 16:00 @ Room #304

Physics-informed Neural Networks with Data

Lecturer: Prof. Seungchul Lee, POSTECH, Korea

Description: Physics-informed Neural Networks (PINNs) have emerged as a promising approach for solving partial differential equations (PDEs) with high accuracy and efficiency. In this tutorial, I will present a PINN framework that integrates data from diverse sources to improve the accuracy and robustness of the network. This approach combines physics-based constraints with data-driven regularization to achieve better convergence and generalization. I will demonstrate the effectiveness of our method on several benchmark problems from fluid dynamics and solid mechanics. Based on the results, it can be concluded that integrating data with PINNs provides a powerful tool for solving complex PDEs and has broad implications for a wide range of scientific and engineering applications.

Biography: Prof. Seungchul Lee is an associate professor at the Department of Mechanical Engineering at Pohang University of Science and Technology (POSTECH), Korea. His research focuses on Industrial Artificial Intelligence for Mechanical Systems, Smart Manufacturing, Materials, and Healthcare. He extends his research work to both knowledge-guided AI and AI-driven knowledge discovery at POSTECH.

Workshop 1

Tuesday 4-Jul, 16:30 – 18:30 @ Room #304

Development of High-strength Highspeed and Ultrathin Robot Simulator with Compound Planetary GearBased Sensor quarterly seminar-workshop

Organizer: Prof. JongWoo Kim, Kyung Hee University, Korea

Description: Currently, domestic technology related to robot gearboxes is in the early stages of technology development, and securing core technologies is somewhat insufficient. Therefore, to stably revitalize the domestic robot market, R&D is necessary to reduce the technology gap with technology-leading countries. It is necessary to secure the originality and competitiveness of design, processing, and heat treatment technologies, which are vulnerable parts of Korea, by additionally securing basic technologies that are the core of gearboxes through R&D. Currently, the robot gearbox market is monopolized by Japan and has a problem that it is difficult to find a replacement. For the stable growth of the domestic robot industry market, research and development to localization are essential. For the quarterly inspection of the project to develop compound planetary gears for robots under research by localizing gears under the supervision of Kyung Hee University, I would like to apply for a workshop at the IAS 18 Society. A workshop will be held on mid-term inspection of research projects conducted in the first half of 2023, a review of the prototype of the gearbox developed, and the development of a robot control system using compound planetary gear. The 200:1 ratio gearbox prototype developed in the first half of the year can be shared by the institution and modified gearbox development can be carried out according to the expert's opinion. The development of a motor-embedded gearbox and application to a three-axis manipulator robot demonstrate the feasibility of the gearbox, and the development of robot design and control algorithms scheduled for the second half of the year will be discussed in collaboration. This project is expected to significantly impact the robot gearbox development market in the future by developing an all-in-one gearbox that is cheaper than conventional robot gearboxes and has built-in ultra-thin sensors.

- **List of Workshop Speakers**
  - Soon Geul Lee, Kyung Hee Univ.
  - Bum Joo Lee, Myong Ji Univ.
  - Chi Kyeung Jun, Tech Co. Ltd
  - Jung Ho Park, Seoul National Univ.

Workshop 2

Thursday 6-Jul, 08:30 – 11:30 @ Convention Hall #3

Workshop on Human-Device Symbiosis: State of the Art and Future Directions

Organizer: Prof. Myunghee Kim and Dr. Ashutosh Tiwari
University of Illinois, Chicago, United States

Description: Wearable devices have progressed significantly in the integration with humans, particularly in rehabilitation and augmentation. This requires an interdisciplinary approach and integration of knowledge from fields such as robotics, human-factors, soft electronics, biomechanics, and neuroscience. The workplace is a promising area for device integration, but personalizing wearable robot control parameters is a challenge. A potential solution is a personalized lower-limb wearable robot that senses a user's physical effort using soft-wearable electronics. Another example is the use of wearable sensors to improve AR devices. To address these challenges and opportunities, a workshop has been planned to bring together researchers from diverse disciplines related to human-device symbiosis. The workshop aims to present the state of the art, identify open problems, and foster collaboration through invited talks, poster presentations, and panel discussions. Emphasis will be placed on encouraging participation from students and researchers from underrepresented groups.

- **List of Workshop Speakers**
  - Heejin Jeong, Arizona State University, US
  - Woonhong Yeo, Georgia Institute of Technology, US
  - Myunghee Kim, University of Illinois, Chicago, US
  - Matthew J. Major, Northwestern University, US
  - Giuk Lee, Chung-Ang University, Korea

List of Special Sessions

<W2BS> Digital Twinning for Robots and Artificial Intelligence

10:30-11:30, Wednesday 05-Jul @ Room #304

Organizers: Alessandro Carfì, University of Genoa. Italy
Anany Dwivedi, Friedrich-Alexander-Universitat, Germany
Philipp Beckerle, Friedrich-Alexander-Universitat, Germany
Fulvio Mastrogiovanni, University of Genoa, Italy

<W2CS> Digital Twin and Haptic Interface

10:30-11:45, Wednesday 05-Jul @ Room #305

Organizers: Ki-Uk Kyung, KAIST, Korea
Sang-Youn Kim, Korea University of Technology and Education, Korea

<W4BS> Rehabilitation Robots for Upper Extremity

14:50-15:50, Wednesday 05-Jul @ Room #304

Organizer: Won-Kyung Song, National Rehabilitation Center, Korea

<W4CS> SLAM for Robotics Digital Twin in Challenging Environment

14:50-16:05, Wednesday 05-Jul @ Room #305

Organizer: Ayoung Kim, Seoul National University, Korea

<T2DS> Smart Haptics & Teleoperation

10:30-11:30 Thursday 06-Jul @ Room #306

Organizer: Gi-Hun Yang, KITECH, Korea

<T4AS> Metaverse and XR Applications in Intelligent Autonomous Systems

14:50-15:50 Thursday 06-Jul @ Convention Hall #3

Organizer: Heejin Jeong, Arizona State University, United States

<F2AS> Autonomous Vehicle in Adverse Weather: Challenges and Opportunities

10:30-11:30, Friday 07-Jul @ Convention Hall #3

Organizers: Gyeungho Choi, DGIST, Korea
Yongseob Lim, DGIST, Korea

<F3DS> Field Robots and Intelligent Autonomous Systems

13:30-15:15, Friday 07-Jul @ Room #306

Organizer: Hyun-Joon Chung, Korea Institute of Robotics and Technology Convergence, Korea

Technical Program Details

D-2, Wednesday, July 5th

D-3, Thursday, July 6th

D-4, Friday, July 7th

<W2A> Autonomous Navigation

10:30-11:45, Wednesday 05-Jul @ Convention Hall #3

Chair: Marcelo H. ANG Jr, National University of Singapore, Singapore

W2A.1
10:30-10:45
Nonlinear Programming-Based Robot Motion Planning for Gait Measurement When Passing Pedestrians
Hayashide, Kazuyuki; Takahashi, Masaki
Keio University, Japan

W2A.2
10:45-11:00
MOVRO: Loosely Coupled EKF-Based Monocular Visual Radar Odometry
Štironja, Vlaho-Josip; Persic, Juraj; Markovic, Ivan; Petrovic, Ivan
Faculty of Electrical Engineering and Computing, Croatia

W2A.3
11:00-11:15
Give Pedestrian More Choice: Socially Aware Navigation Using Reinforcement Learning with Human Action Entropy Maximization
Wu, Jiaxu; Asama, Hajime; An, Qi; Yamashita, Atsushi
Tokyo University, Japan

W2A.4
11:15-11:30
Automatic Lane Change Using Adaptive Grid Map
Woo, SooHo; Choi, Jaehwan; Hong, Junki; Kim, Jaehyeong; Ryu, Jaekwan; Kim, JaeJun; Lee, Soon-Geul
Kyung Hee University, Korea, South

W2A.5
11:30-11:45
Enhancing Navigational Performance with Holistic Deep-Reinforcement-Learning
Meusel, Marvin; Kästner, Linh; Buiyan, Teham; Lambrecht, Jens
T-Mobile, TU Berlin, Germany

<W2BS> Digital Twinning for Robots and Artificial Intelligence

10:30-11:30, Wednesday 05-Jul @ Room #304

Chair: Alessandro Carfì, University of Genoa, Italy

W2BS.1 **10:30-10:45**	**Sim2Real When Data Is Scarce: Image Transformation for Industrial Applications** Weisenböhler, Moritz; Augenstein, Philipp; Hein, Björn; Wurll, Christian; Furmans, Kai *Karlsruhe University of Applied Sciences, Germany*
W2BS.2 **10:45-11:00**	**Estimation of Kidney's Blood Vessels Deformations for Robot-Assisted Surgery** Lastrico, Riccardo; Macciò, Simone; Carfì, Alessandro; Traverso, Paolo; Mastrogiovanni, Fulvio *University of Genoa, Italy*
W2BS.3 **11:00-11:15**	**Digital Twins for Human-Robot Collaboration: A Future Perspective** MOHAMAD, SHAABAN; Carfì, Alessandro; Mastrogiovanni, Fulvio *University of Genova, Italy*
W2BS.4 **11:15-11:30**	**A Cognitive Digital Twin for Intention Anticipation in Human-Aware AI** Russwinkel, Nele *Universität zu Lübeck, Germany*

<W2CS> Digital Twin and Haptic Interface

10:30-11:45, Wednesday 05-Jul @ Room #305

Chair: Ki-Uk Kyung, KAIST, KoreaTech, Korea, South

W2CS.1
10:30-10:45
Soft Haptic Interface Interacting with Touch Gesture
Jang, Seung-Yeon; Kim, Hyunwoo; Kyung, Ki-Uk
Korea Advanced Institute of Science & Technology (KAIST), Korea, South

W2CS.2
10:45-11:00
Providing Localized Surface Haptic Feedback on a Thin-Transparent Vibrating Panel
Park, Jihwan; Han, Jaeseung; Kyung, Ki-Uk
Korea Advanced Institute of Science & Technology (KAIST), Korea, South

W2CS.3
11:00-11:15
Multi-Mode Simultaneous Tactile Feedback Using Soft Pneumatic Fingertip Actuator with Dual Air Chamber
Hashem, Mohammad Shadman; Joolee, Joolekha Bibi; Hassan, Waseem; Jeon, Seokhee
Kyung Hee University, Korea, South

W2CS.4
11:15-11:30
Thin and Soft Haptic Thimble Interface for Digital Twin
Heo, Yong Hae; Jeon, Seokhee; Kim, Sang-Youn
Korea Univ. Technology & Education, Korea, South

W2CS.5
11:30-11:45
Learning Mechanical Impulse Response for Understanding Surface Characteristics
Lee, Joohyun; Ryu, Semin; Kim, Seung-Chan
SUNGKYUNKWAN UNIVERSITY, Korea, South

<W2D> Object Detection

10:30-11:45, Wednesday 05-Jul @ Room #306

Chair: Jun Miura, Toyohashi University of Technology, Japan

W2D.1 **10:30-10:45**	**Improving Multi-Object Re-Identification at Night with GAN Data Augmentation** Amersfoort, Midas; Dubbeldam, Michael; Visser, Arnoud *Universiteit van Amsterdam, Netherlands*
W2D.2 **10:45-11:00**	**LTS-NET: End-To-End Unsupervised Learning of Long-Term 3D Stable Objects** Hroob, Ibrahim; Molina, Sergi; Polvara, Riccardo; Cielniak, Grzegorz; Hanheide, Marc *University of Lincoln, United Kingdom*
W2D.3 **11:00-11:15**	**Autonomous Model-Based Inspection Planning for 3D Visual Coverage Tasks** Türk, Nehemia; Strand, Marcus; Rettig, Oliver *Baden-Wuerttemberg Cooperative State University Karlsruhe, Germany*
W2D.4 **11:15-11:30**	**RPC-Pillars: Radar Point Correction with Radar-PointPillars** Lee, Min Young; Lee, Christina Dao Wen; Shen, Lyuyu; Ang Jr, Marcelo H *National University of Singapore, Singapore*
W2D.5 **11:30-11:45**	**Post-Processing Using Spatial Relationships for Button Recognition** Pyo, Jeongwon; Lee, Kwang Hee; Kuc, Tae-Yong *Korea Institute of Industrial Technology, Korea, South*

<W4A> Pose Estimation

14:50-16:05, Wednesday 05-Jul @ Convention Hall #3

Chair: Fulvio Mastrogiovanni, University of Genoa, Italy

W4A.1
14:50-15:05
EA-Repose: Efficient and Accurate Feature-Metric-Based 6D Object Pose Refinement Via Deep Reinforcement Learning
Ni, Peiyuan; Liu, Zhiyang; Wang, Haozhe; Zhou, Lei; Ang Jr, Marcelo H
National University of Singapore, Singapore

W4A.2
15:05-15:20
Human Emergency Detection During Autonomous Hospital Transports
Zachariae, Andreas; Widera, Julia; Hein, Björn; Wurll, Christian
Hochschule Karlsruhe, Germany

W4A.3
15:20-15:35
Gradient Based Grasp Pose Optimization on a NeRF That Approximates Grasp Success
Sóti, Gergely; Hein, Björn; Wurll, Christian
Karlsruhe University of Applied Sciences, Germany

W4A.4
15:35-15:50
Determining Grasp Positions with 4-Finger Gripper Manipulator Using Reinforcement Learning
Kim, Myunghyun; Kang, Sumin; Yang, Sungwoo; Jargalbaatar, Yura; Kim, Donghan
Kyung Hee University, Korea, South

W4A.5
15:50-16:05
Workspace-Based Precision Grasp Pose Generator for Multi-Fingered Robotic Hands
Wu, Liqi; Kawaharazuka, Kento; Hasegawa, Shun; Okada, Kei; Inaba, Masayuki
the University of Tokyo, Japan

<W4BS> Rehabilitation Robots for Upper Extremity

14:50-15:50, Wednesday 05-Jul @ Room #304

Chair: Won-Kyung Song, National Rehabilitation Center, Korea, South

W4BS.1
14:50-15:05
Toward Upper-Body Posture Monitoring for Upper-Limb Rehabilitation Robot
Hwang, Yeji; Kim, Jonghyun
Sungkyunkwan University, Korea, South

W4BS.2
15:05-15:20
Upper Extremity Rehabilitation Robot Platform: From Unilateral Toward Bimanual
Song, Won-Kyung
National Rehabilitation Center, Korea, South

W4BS.3
15:20-15:35
A Device for the Verification of Reliability and Accuracy of Post-Stroke Upper Limb Mechanical Impedance Estimation
Kang, Hyunah; Kang, Sang Hoon
Ulsan National Institute of Science and Technology(UNIST) / U. of Maryland, Korea, South

W4BS.4
15:35-15:50
Clinical applications of rehabilitation robots among patients with stroke
Shin, Joon-Ho
National Rehabilitation Center of Korea, Korea, South

<W4CS> SLAM for Robotics Digital Twin in Challenging Environment

14:50-16:05, Wednesday 05-Jul @ Room #305

Chair: Ayoung Kim, Seoul National University, Korea, South

W4CS.1
14:50-15:05
Radar Image Retrieval and Localization
Jang, Hyesu; Kim, Ayoung
Seoul National University, Korea, South

W4CS.2
15:05-15:20
Performance Comparison of SAC Methods for Radar Dynamic Object Classification
Park, Yeong Sang; Choi, Dooseop; Min, Kyoung-Wook
Electronics and Telecommunications Research Institute, Korea (ETRI), Korea, South

W4CS.3
15:20-15:35
LiDAR Localization Using Crowd-Sourced Building Information
Cho, Younghun; Ryu, Jee-Hwan
KAIST, Korea, South

W4CS.4
15:35-15:50
Simultaneous Image Enhancement and Depth Estimation in Underwater Environments
Yang, Geonmo; Cho, Younggun
Inha University, Korea, South

W4CS.5
15:50-16:05
Efficient Traversability Mapping Based on Single Camera and 3D LiDAR
Youn, Chanmin; Youn, Wonkeun; Kim, Sanghyun; Park, Jinseong; Shin, Young-Sik
KIMM, Korea, South

<W4D> Smart Sensors in Autonomous Agents

14:50-16:05, Wednesday 05-Jul @ Room #306

Chair: Chun-Hsing Ho, University of Nebraska-Lincoln, United States of America

W4D.1
14:50-15:05
State-Of-The-Art Pavement Sensing Technology to Evaluate the Effect of Climate Change on Resilient Performance of Highway Infrastructure Systems: A Pilot Study in the Phoenix Region
Ho, Chun-Hsing; Zhang, Dada; Snyder, Matt
University of Nebraska-Lincoln, United States of America

W4D.2
15:05-15:20
RCBEVD: Radar-Camera Fusion in Bird's Eye View for Detection with Velocity Estimation
Jia, Yansong; Lee, Christina Dao Wen; Ang Jr, Marcelo H
National University of Singapore, Singapore

W4D.3
15:20-15:35
Investigating Augmentation Techniques for Camera-Radar Object Detection
Park, Jinah; Lee, Christina Dao Wen; Ang Jr, Marcelo H
National University of Singapore, Singapore

W4D.4
15:35-15:50
Automated Accessibility Map Construction with Two-Level Viewpoint Planning Strategy
Saito, Ryo; Miura, Jun
Toyohashi University of Technology, Japan

W4S.5
15:50-16:05
Improvement of Position Error Rate of Docking of Autonomous Mobile Robot with Object Recognition and Ultrasonic Sensor
LEE, SANG-MIN; JOO, KYEONG-JIN; IN, GUN-GYO; KUC, TAE-YONG
Sungkyunkwan University, Korea, South

<T1B> HRI (Social Robotics)

08:45-10:00, Thursday 06-Jul @ Room #304

Chair: Arnoud Visser, Universiteit van Amsterdam, Netherlands

T1B.1
08:45-09:00
System for Teaching Robot Action Instructions and Responding to Situations Using a Chat Application
Obinata, Yoshiki; Yanokura, Iori; Tsukamoto, Naoto; Yamaguchi, Naoya; Kitagawa, Shingo; Shinjo, Koki; Okada, Kei; Inaba, Masayuki
The University of Tokyo, Japan

T1B.2
09:00-09:15
Affecta-Context: The Context-Guided Behavior Adaptation Framework
Frederiksen, Morten Roed; Stoy, Kasper
IT-University of Copenhagen, Denmark

T1B.3
09:15-09:30
A Multi-Modal Robotic Blackjack Dealer: Design, Implementation, and Reliability Analysis
Fiedler, Niklas; Güldenstein, Jasper; Naß, Theresa Alexandra Aurelia; Görner, Michael; Hendrich, Norman; Zhang, Jianwei
University of Hamburg, Germany

T1B.4
09:30-09:45
A Persuasive Chatbot in an Aging-In-Place Environment
Chua, Alicia; Liu, Siyuan; Zhang, Huiguo; Fan, Xiuyi
Nanyang Technological University, Singapore

T1B.5
09:45-10:00
Automatic Diary Generation System Including Information on Joint Experiences between Humans and Robots
Ichikura, Aiko; Kawaharazuka, Kento; Obinata, Yoshiki; Shinjo, Koki; Okada, Kei; Inaba, Masayuki
University of Tokyo, Japan

<T1C> Robot Dynamics & Kinematics

08:45-10:00, Thursday 06-Jul @ Room #305

Chair: Atsushi Yamashita, The University of Tokyo, Japan

T1C.1
08:45-09:00
Application of Conformal Geometric Algebra in Robotics: DH-Parameters Extraction from Joint Axes Poses
Rettig, Oliver; Strand, Marcus; Hinderer, Fabian
DHBW Karlsruhe, Germany

T1C.2
09:00-09:15
Optimal Number and Positioning of Inertial Measurement Units in Spherical Robots
Bösch, Carolin; Zevering, Jasper; Nuechter, Andreas
Julius-Maximilians-University Würzburg, Germany

T1C.3
09:15-09:30
Contact-Implicit Trajectory Optimization Using Conditional Constraints
Peng, William; Song, Hyunjong; Kim, Joo H.
New York University, United States of America

T1C.4
09:30-09:45
A Study on the Structure of a Three-Finger Gripper for Intelligence Verification for Edge Computer Systems
Lee, Jae Yong; SON, Minseok; Kim, Gi-Seong; Jeong, Sunghun
KOTMI, Korea, South

T1C.5
09:45-10:00
Development of 3-Finger Gripper with Suction Units for Various Grasping Strategies
Jeong, Heeyeon; Um, Seunghwan; Yoon, Jimin; Choi, Hyouk Ryeol
Sungkyunkwan University, Korea, South

<T1D> Robot Manipulation

08:45-09:45, Thursday 06-Jul @ Room #306

Chair: Dongjun Lee, Seoul National University, Korea

T1D.1
08:45-09:00
Multi-Stage Book Perception and Bimanual Manipulation for Rearranging Book Shelves
Sygo, Björn; Liu, Shang-Ching; Wieczorek, Fabian; Koshil, Mykhailo; Görner, Michael; Hendrich, Norman; Zhang, Jianwei
University of Hamburg, Germany

T1D.2
09:00-09:15
Reactive Correction of Object Placement Errors for Robotic Arrangement Tasks
Kreis, Benedikt; Menon, Rohit; Adinarayan, Bharath Kumar; de Heuvel, Jorge; Bennewitz, Maren
University of Bonn, Germany

T1D.3
09:15-09:30
Target Acquisition by Reinforcement Learning-Based Bin Tilting with a Robotic Arm
Li, Qiuyang; GAO, ZIYAN; Elibol, Armagan; Chong, Nak Young
Japan Advanced Institute of Science and Technology, Japan

T1D.4
09:30-09:45
Out-Of-Distribution Detection in Hand Gesture Recognition Using Image Augmentation
Lee, Hyeonji; Yu, Yeonguk; Lee, Kyoobin
Gwangju Institute of Science and Technology, Korea, South

<T2B> Digital Health

10:30-11:45, Thursday 06-Jul @ Room #304
Chair: Joo Hyun Kim, New York University, USA

T2B.1
10:30-10:45
Evaluation of Ballistocardiogram Based on Short-Time Energy and Dynamic Time Warping
Yang, Tianyi; Yuan, Haihang; Zhou, Zhongchao; Yu, Wenwei
Chiba University, Japan

T2B.2
10:45-11:00
Automatic Corona Discharge Detection for Cable Safety Inspection
Maeng, Jemo; Heo, Yunjae; Lee, Kyoobin
Gwangju Institute of Science and Technology, Korea, South

T2B.3
11:00-11:15
A Machine Learning-Based Blood Volume Classification Model for Cardiopulmonary Resuscitation Robot Feedback System
Kim, Byung Jun; Shin, Dong Ah; Sim, Jaehoon; Cho, Woo Sang; Kwon, Soyoon; Suh, Gil Joon; Kim, KyungSu; Kim, Taegyun; Lee, Jung Chan
Seoul National University College of Medicine, Korea, South

T2B.4
11:15-11:30
A Study on the Effect of Measurement Distance on the Accuracy of Millimeter-Wave Radar Sensing for Heartbeat Measurement
Yuan, Haihang; Lu, Yuxi; Yang, Tianyi; Yu, Wenwei
Chiba University, Japan

T2B.5
11:30-11:45
A Comparison of Global Explanations Given on Electronic Health Records
Duell, Jamie; Seisenberger, Monika; Fan, Xiuyi
Swansea University, United Kingdom

<T2C> Humanoid Robotics

10:30-11:15, Thursday 06-Jul @ Room #305

Chair: Thomas Henderson, University of Utah, United States of America

T2C.1
10:30-10:45
Walking State Estimation for Biped Robot Using Foot Contact Information
Lee, Haeseong; Kim, Myeong-Ju; Sung, Eunho; Park, Jaeheung
Seoul National University, Korea, South

T2C.2
10:45-11:00
Fault Mitigation and Fault Tolerant Humanoid System against Contact Impact
Hiraoka, Takuma; Sato, Shimpei; Hiraoka, Naoki; Miki, Akihiro; Kojima, Kunio; Okada, Kei; Inaba, Masayuki; Kawasaki, Koji
The University of Tokyo, Japan

T2C.3
11:00-11:15
System Architecture and Real-World Task Realization of Musculoskeletal Wheeled Robot Musashi-W with Various Hardware Components
Miki, Akihiro; Kawaharazuka, Kento; Bando, Masahiro; Okada, Kei; Kawasaki, Koji; Inaba, Masayuki
the University of Tokyo, Japan

<T2DS> Smart Haptics & Teleoperation

10:30-11:30, Thursday 06-Jul @ Room #306

Chair: Gi-Hun Yang, KITECH, Korea, South

T2DS.1
10:30-10:45
Preliminary Implementation of Human-Swarm-Interaction Methodology with Hand-Gesture
Heo, Jinuk; Lee, Yongseok; Lee, Dongjun
Seoul National University, Korea, South

T2DS.2
10:45-11:00
On the Development of a Motor Driver for Physical Human-Robot Interactions
Cho, Jang Ho; Sin, MinKi; Lee, Hyuk-Jin; An, Bohyeon; Kim, Ki-Young
Korea Institute of Machinery & Materials, Korea, South

T2DS.3
11:00-11:15
Haptic Field and Force Feedback Generation for Wheeled Vehicle Teleoperation on 2.5D Environments
Kim, Yongjun; Kim, Donghyeon; Ryu, Jee-Hwan
KAIST, Korea, South

T2DS.4
11:15-11:30
A Novel Force Sensing Biopsy Needle for MR-Compatible Robotic Biopsy System: Performance Evaluation
Liu, Rongrong; Ko, Seong Young
Chonnam National University, Korea, South

<T4AS> Metaverse and XR Applications in Intelligent Autonomous Systems

14:50-15:50, Thursday 06-JulJul @ Convention Hall #3

Chair: Heejin Jeong, Arizona State University, United States of America

T4AS.1
14:50-15:05
Intelligent and Smart Manufacturing Metaverse System Using Industrial AI in an XR Environment
Choi, Sung Ho; Moon, Hongju; Yu, Seunghyeon; Lee, Jae Yeol
Chonnam National University, Korea, South

T4AS.2
15:05-15:20
Approaches of Safe and Efficient 3D UAM Traffic Management Using VR, AR, and MR with AI; HCI Requirements for Digital Twin Application
Oh, Chang-Geun; Lee, Mikyoung
Hanseo University, Korea, South

T4AS.3
15:20-15:35
Extended Reality in Intelligent Occupational and Rehabilitation Training Systems
Jeong, Heejin
Arizona State University, United States of America

T4AS.4
15:35-15:50
The Effect of Visual Guidance on the Squat Posture
Kim, Daehyun; Lee, Sangeun; TIWARI, ASHUTOSH; Ko, Minsam; Kim, Myunghee
University of Illinois at Chicago, United States of America

<T5I> Interactive Session

16:10-17:30, Thursday 06-Jul, @ Convention Hall #3

T5I.1 **Development of Autonomous Driving for Passenger Boarding Bridge (PBB) through Aircraft Door Detection Based on YOLO Object Detection Algorithm**
Weon, Ihnsik; Park, Beomchan; Kim, Hyunjoong; Jong-Hyuk, Park
Incheon International Airport Corporation, Korea, South

T5I.2 **Development of Incheon Airport Indoor AR Wayfinding Based on 3D Spatial Information**
Jung, Jooik; Weon, Ihnsik; Son, Seokhyun; Cha, Heejune; Jong-Hyuk, Park
Incheon International Airport Corporation, Korea, South

T5I.3 **MPC Based Four Wheel Independent Steering Vehicle Path Tracking Using LSTM Estimator under various road condition**
Lim, Sungjin; Sadiq, Bilal; Lim, Yongseob; An, Jinung
DGIST, Korea, South

T5I.4 **Design and Dynamic Analysis of a Quadcopter Capable of Tilting Its Body Frame**
Tao, Xiaodi; Ko, Seong Young
Chonnam National University, Korea, South

T5I.5 **Autonomous Surface Grinding of Wind Turbine Blades**
Stoeckl, Florian; Strand, Marcus; Müller, Silvan; Huber, Marco; Raible, Julian; Braun, Christopher; Katic, Darko; Alt, Benjamin; Merkt, Holger
DHBW Karlsruhe, Germany

T5I.6 **Target Orientation Inclusive Push Planning for Robotic Manipulations**
Elibol, Armagan; Chong, Nak Young
Japan Advanced Institute of Science and Technology, Japan

T5I.7 **An Uncertainty Estimation Model for Algorithmic Trading Agent**
Wang, Li Rong; Henderson, Thomas C.; Fan, Xiuyi
Nanyang Technological University, Singapore

T5I.8 **Robot End-Effector Trajectory Tracking Enhancement Using Force Tracking Impedance Control for Non-Contact Cutting Tasks**
Khan, Muhammad Hamza; Lee, Min Cheol
Pusan National University, Korea, South

T5I.9 **Development of a Mobile Robot with Minimum Number of D&S modules for Omnidirectional Drive**
Son, Soeun; Cho, Gun Rae; Jung, Eui-Jung; Park, Sungho; Shin, Hyunseok; Choi, Yong
KIRO (KOREA INSTITUTE OF ROBOT CONVERGENCE), Korea, South

<T5I> Interactive Session

16:10-17:30, Thursday 06-Jul, @ Convention Hall #3

T5I.10 **Information-Based Patrol Speed Control Method for Rail-Guided Robot System Using Deep Deterministic Policy Gradient Algorithm**
LEE, HOSUN; Kwon, Jaesung; Lee, Sungon; Chong, Nak Young; Yang, Woosung
JAIST, Japan

T5I.11 **The Application of Continual Learning to Instance Segmentation**
Zhou, Heng; Kim, Sang-Cheol
Jeonbuk National University, Korea, South

T5I.12 **A Learning-Based Finger Joint Stiffness Self-Sensing Scheme for Soft Robot-Assisted Rehabilitation**
Zhou, Zhongchao; Tortós, Pablo; Lu, Yuxi; Kokubu, Shota; Qin, Ruian; Matsunaga, Fuko; Yu, Wenwei
Chiba University, Japan

T5I.13 **Behavior Trees Design for Swarm Robotics SLAM**
Beom-Joon, Park; Kang, Jeon-Seong; Chung, Hyun-Joon
Korea Institute of Robotics and Technology Convergence, Korea, South

T5I.14 **Human Detection in Thermal Images using Transfer Learning**
Kang, Jeon-Seong; Beom-Joon, Park; Chung, Hyun-Joon
Korea Institute of Robotics and Technology Convergence, Korea, South

T5I.15 **Disparity Estimation of Remote Sensing Images Using Cost Volume Guide of Variance-based Disparity Range Uncertainty**
Jeong, wonje; Park, Soon-Yong
Kyungpook National University, Korea, South

T5I.16 **Reinforcement Learning based algorithm to HVAC Control for next generation Smart Farm**
KIM, SUNG HOON; Kim, Sang-Cheol
Jeonbuk National University, Korea, South

T5I.17 **The Application for Pig Face Recognition Using Transformer Model**
RUIHAN, MA; Kim, Sang-Cheol
Jeobuk National University, Korea, South

T5I.18 **Leveraging Computer Vision for Autonomous Local Navigation**
Ali, Hassan; Kim, Sang-Cheol
Jeobuk National University, Korea, South

<T5I> Interactive Session

16:10-17:30, Thursday 06-Jul, @ Convention Hall #3

T5I.19 **Outlier Detection Via Autoencoder on Real-Time Series Data**
KAKAR, JUNAID KHAN; Kim, Sang-Cheol
Jeobuk National University, Korea, South

T5I.20 **Evaluation of Joint Module Soft Actuator for Personalized Soft Rehabilitation Gloves**
Kokubu, Shota; Yu, Wenwei
Chiba university, Japan

T5I.21 **Development of Industrial robot utilization model for flat-plate drilling process automation**
Kim, SeungWoo; Jee, Sung Chul; LEE, mangi; Kim, Jungjun; KIM, JONG CHAN; Chung, Hyun-Joon
Korea Institute of Robot and Convergence, Korea, South

T5I.22 **Modernised Reduction: Adapting the ROT Tree**
Harrigan, Shane Patrick; Coleman, Sonya; Kerr, Dermot; Quinn, Justin
Ulster University, United Kingdom

T5I.23 **Design of Compound Planetary Gear and Evaluation through Dynamometer System**
BONG, Sung Jun; LEE, JAE-HONG; Hong, Junki; Woo, SooHo; Lee, Soon-Geul
Kyung Hee University, Korea, South

T5I.24 **Design and Hybrid Control of Soft Material-Based Concentric Tube Robot**
Choi, Juhyeong; Kim, Jongwoo
Kyung Hee University, Korea, South

T5I.25 **Adaptive Model Predictive Controller Design for Vehicle Motion with Laguerre Function with Computationally Inexpensive Method**
Sadiq, Bilal; Lim, Sungjin; Lim, Yongseob
DGIST, Korea, South

T5I.26 **Semantic Knowledge-Based Mission Planning Method According to Robot Characteristics in Outdoor Environment**
SangHyeon, Bae; choi, junhyeon; Kuc, Tae-Yong; Park, Hyunjin; Lee, Kwang
HeeKorea Institute of Industrial Technology, Korea, South

T5I.27 **YOLO Algorithm Based Pig Face detection**
jeong, seyeon; Kim, Sang-Cheol
Jeobuk National University, Korea, South

<F2AS> Autonomous Vehicle in Adverse Weather: Challenges and Opportunities

10:30-11:30, Friday 07-Jul @ Convention Hall #3

Chair: Yongseob Lim, DGIST, Korea

F2AS.1
10:30-10:45
Challenges of Lane Detection using Deep Neural Network in Extremely Heavy Rain: CARLA Simulator-based Synthetic Evaluation Dataset
Jeon, Hyeonjae; Kim, Yaeohn; Kim, Taesoo; Son, Sungho; Lee, Jungki; Choi, GyeungHo; Lim, Yongseob
DGIST, Korea, South

F2AS.2
10:45-11:00
Enhancing Lane Detection with a Lightweight Collaborative Late Fusion Model
Jahn, Lennart Lorenz Freimuth; Park, Seongjeong; Lim, Yongseob; An, Jinung; Choi, GyeungHo
Daegu Gyeongbuk Institute of Science and Technology, Korea, South

F2AS.3
11:00-11:15
A Study on Quantifying Sim2Real Image Gap in Autonomous Driving Simulations Using Lane Segmentation Attention Map Similarity
Park, Seongjeong; Pahk, Jinu; Jahn, Lennart Lorenz Freimuth; Lim, Yongseob; An, Jinung; Choi, GyeungHo
Daegu Gyeongbuk Institute of Science and Technology, Korea, South

F2AS.4
11:15-11:30
A Study on LiDAR Sensor Cleaning Through Vision Obstruction Reproduction
Jung, HyunGi
Korea Automotive Testing & Research Institute, Korea Transportation Safety Authority, Korea, South

<F2B> HRI (Collaborative Robotics)

10:30-11:45, Friday 07-Jul @ Room #304

Chair: Marc Hanheide, University of Lincoln, United Kingdom

F2B.1
10:30-10:45
Mid-turbinate Swab Sampling Using a 6-DOF Collaborative Robot and Cameras
Leung, Michael; Ortiz, Ricardo; Jo, Bruce
Tennessee Technological University, United States of America

F2B.2
10:45-11:00
Role Adaptation of Human-Robot Physical Interaction Based on the Distribution of Learned Belief
Lu, Weifeng; Zhao, Longfei; Hu, Zhe; Pan, Jia
City University of Hong Kong, China

F2B.3
11:00-11:15
Holistic Assembly Planning Framework for Dynamic Human-Robot Collaboration
Schirmer, Fabian; Kranz, Philipp; Rose, Chad; Schmitt, Jan; Kaupp, Tobias
University of Applied Sciences Würzburg-Schweinfurt, Germany

F2B.4
11:15-11:30
Robot-Facilitated Human-Robot Interaction with Integrated Tracking, Re-Identification and Gesture Recognition
Lee, Sukhan; Lee, Soojin; Kim, Seunghwan; Kim, Areum
Sungkyunkwan University, Korea, South

F2B.5
11:30-11:45
A Step towards a Finite Element Model for an Impact Situation in Human-Robot Interaction
Hornung, Luisa; Wurll, Christian; Sóti, Gergely
Hochschule Karlsruhe - University of Applied Sciences, Germany

<F2C> Intelligent Autonomous Mobility

10:30-11:45, Friday 07-Jul @ Room #305

Chair: Rok Vrabic, University of Ljubljana, Slovenia

F2C.1
10:30-10:45
Proposition of Augmenting V2X Roadside Unit to Enhance Cooperative Awareness of Heterogeneously Connected Road Users
Ansari, Keyvan; Hasan, Khondokar Fida
Murdoch University, Australia

F2C.2
10:45-11:00
Global Map Generation Using Local Feature Grid Maps for Autonomous Vehicles in Frequently Changing Off-Road Environments
Kremer, Matthias; Wolf, Patrick; Meckel, Dennis; Berns, Karsten
RPTU Kaiserslautern Landau, Germany

F2C.3
11:00-11:15
Reverse-Engineering of Behavior-Based Robot Components
Meckel, Dennis; Wolf, Patrick; Berns, Karsten
RPTU Kaiserslautern-Landau, Germany

F2C.4
11:15-11:30
Revisiting the Minimum Constraint Removal Problem in Mobile Robotics
Thomas, Antony; Mastrogiovanni, Fulvio; Baglietto, Marco
University of Genoa, Italy

F2C.5
11:30-11:45
Accelerated Video Annotation Driven by Deep Detector and Tracker
Price, Eric; Ahmad, Aamir
Universität Stuttgart, Germany

<F2D> Knowledge Inference, Software Modeling

10:30-11:45, Friday 07-Jul @ Room #306

Chair: Armagan Elibol, JAIST, Japan

F2D.1
10:30-10:45
Chop-SAT: A New Method for Knowledge-Based Agent Decision Making
Henderson, Thomas C.; Lessen, Amelia; Rajan, Ishaan; Nishida, Tessa; Eken, Kutay
University of Utah, United States of America

F2D.2
10:45-11:00
Data Aggregation (DAgger) Algorithm Using Adversarial Agent Policy for Dynamic Situations
Ahn, Joonwoo; Shin, Seho; Koo, Jahoo; Kim, Minsoo; Park, Jaeheung
Seoul National University, Korea, South

F2D.3
11:00-11:15
Recognition of Heat-Induced Food State Changes by Time-Series Use of Vision-Language Model for Cooking Robot
Kanazawa, Naoaki; Kawaharazuka, Kento; Obinata, Yoshiki; Okada, Kei; Inaba, Masayuki
The University of Tokyo, Japan

F2D.4
11:15-11:30
VGG-16 Neural Network-Based Visual Artificial Potential Field for Autonomous Navigation of Ground Robots
Galiza Cerdeira Gonzalez, Antonio; Venture, Gentiane; Mizuuchi, Ikuo
Tokyo University of Agriculture and Technology, Japan

F2D.5
11:30-11:45
Trajectory Planning of Mobile Robot for Obstacle Avoidance Considering Time and Path Length
Yorozu, Ayanori; Zou, Yushu; Ohya, Akihisa
University of Tsukuba, Japan

<F3A> Smart Factory, Digital Twin, VR

13:30-14:45, Friday 07-Jul @ Convention Hall #3

Chair: Ivan Petrović, University of Zagreb, Croatia

F3A.1
13:30-13:45
Improving Digital Twin Fidelity through Contextual Surface Plot Modelling
Laurence, Alexander; Muro, Keiro
Hitachi Ltd, Japan

F3A.2
13:45-14:00
Digital Twin Simulation for Automated Aerobridge Docking System
LEE, JAE-HONG; Weon, Ihnsik; Lee, Soon-Geul
Kyung Hee University, Korea, South

F3A.3
14:00-14:15
A Virtual Reality Escape Room Game for Learning Computer Architecture Concepts
Tan Rong Hui, Mark; Liu, Siyuan; Qiu, Yang; Zhu, Gaoxia; Fan, Xiuyi
Nanyang Technological University, Singapore

F3A.4
14:15-14:30
2-DOF Modular Suction Gripper with Revolute and Multi-Stage Prismatic Joint
Kim, Chun Soo; Rhee, Issac; Um, Seunghwan; Jung, Hosang; Choi, Hyouk Ryeol
Sungkyunkwan University, Korea, South

F3A.5
14:30-14:45
A New Local Planner Based on Pedestrian Model and Its Safety Guarantee with Collision Arc
Han, Jeong-woo; Kwon, Hyock-Ju; Jeon, Soo
University of Waterloo, Canada

<F3B> Autonomous Aerial Vehicle

13:30-14:45, Friday 07-Jul @ Room #304

Chair: Linh Kaestner, T-Mobile, TU Berlin, Germany

F3B.1
13:30-13:45
Multi-Modal Air Trajectory Traffic Management
Henderson, Thomas C.; Marston, Vista; Sacharny, David
University of Utah, United States of America

F3B.2
13:45-14:00
Aggressive Trajectory Tracking for Autonomous MAV Using Embedded Model Predictive Control
Kazim, Muhammad; Sim, Hyunjae; Shin, Gihun; Hwang, Hwancheol; Kim, Kwangki
Inha University, Korea, South

F3B.3
14:00-14:15
Optimal Piecewise Polynomial Function-Approximation for Computing Cost Minimization by Using Constrained Least Squares
Lee, Bumjoo
Myongji University, Korea, South

F3B.4
14:15-14:30
HoLLiE C - A Multifunctional Bimanual Mobile Robot Supporting Versatile Care Applications
Steffen, Lea; Schulze, Martin Asghar; Eichmann, Christian; Koch, Robin; Hermann, Andreas; Wilbrandt, Robert; Frietsch Musulin, Rosa; Graaf, Friedrich; Grosse Besselmann, Marvin; Roennau, Arne; Dillmann, Rüdiger
FZI Research Center for Information Technology, 76131 Karlsruhe, Germany

F3B.5
14:30-14:45
Action Transition Recognition Using Principal Component Analysis for Agricultural Robot Following
Ooka, Chihiro; Ohya, Akihisa; Yorozu, Ayanori
University of Tsukuba, Japan

<F3C> Multi Agent System

13:30-14:45, Friday 07-Jul @ Room #305

Chair: Keyvan Ansari, Murdoch University, Australia

F3C.1
13:30-13:45
On Optimising Topology of Agricultural Fields for Efficient Robotic Fleet Deployment
Zhu, Zuyuan; Das, Gautham; Hanheide, Marc
University of Lincoln, United Kingdom

F3C.2
13:45-14:00
A Multi-Expert Agent for Efficient Learning from Demonstrations
Chen, Yiwen; Zhang, Zedong; LIU, HAOFENG; Tan, Jiayi; Chew, Chee Meng; Ang Jr, Marcelo H
National University of Singapore, Singapore

F3C.3
14:00-14:15
Factor Graph-based Dense Mapping for Mobile Robot Teams using VDB-Submaps
Hagmanns, Raphael; Emter, Thomas; Garbe, Leo; Beyerer, Jürgen
Karlsruhe Institute of Technology, Germany

F3C.4
14:15-14:30
Ant-Colony-Inspired Grid Graph Optimization for Improving Logistic Performance of Multi-AMR Systems
Zuzek, Tena; Vrabic, Rok; Malus, Andreja; Zdesar, Andrej; Klancar, Gregor
University of Ljubljana, Slovenia

F3C.5
14:30-14:45
Analysing the Effects of Congestion on Hybrid Order Picking Systems using a Discrete-Event Simulator
Street, Charlie; Jujjavarapu, Sri Sadhan; Chen, Michael Nai-An; Paul, Sanjoy; Hawes, Nick
University of Oxford, United Kingdom

<F3DS> Field Robots and Intelligent Autonomous Systems

13:30-15:15, Friday 07-Jul @ Room #306

Chair: Hyun-Joon Chung, Korea Institute of Robotics and Technology Convergence, Korea

F3DS.1
13:30-13:45
Autonomous Landing Using Convex Formulation and Line Search Algorithm
Kim, Chaehyeon; Lee, Sang-Don; Choi, Han-Lim; Lee, Chang-Hun
KAIST, Korea, South

F3DS.2
13:45-14:00
Real-Time Road Surface Classification Based on Intelligent Tire for Autonomous Vehicle
Kim, Seokchan; Lee, Hanmin
Korea Institute of Machinery & Materials, Korea, South

F3DS.3
14:00-14:15
Reinforcement Learning-Based Autonomous Task Scheduling with Time Windows
Kim, Sung Jun; Kim, Yeowon; Shin, Min Kyu; Choi, Han-Lim
KAIST, Korea, South

F3DS.4
14:15-14:30
Navigating the Unknown: Autonomous Exploration in Extreme Underground Tunnel Environments
Park, Gyuhyun; Lee, Wonsuk; Lee, Jung-Suk; Shim, Inwook; Kwak, Kiho
Agency for Defense Development(ADD), Korea, South

F3DS.5
14:30-14:45
Development of In-Pipe Inspection Robot for Large-Diameter Water Pipe
Jeon, Kwang Woo; Chung, Hyun-Joon; Chung, Goobong; Jung, Eui-Jung; Park, Sungho; Bae, Jongho; Son, Soeun; HAK, YI
Korea Institute of Robotics and Technology Convergence, Korea, South

F3DS.6
14:45-15:00
Use of LiDAR and GNSS for Collision Avoidance-based Adaptive Path Tracking of a Racing Robot
Kim, Yong-Hyun; Yun, Changho; Kim, Hak-Jin
Seoul National University, Korea, South

F3DS.7
15:00-15:15
Hydraulic Quadruped Robot JINPOONG II: Toward Qualified Platform for Mobile Manipulation in Field Environment
Seo, Jaehong; Park, Sangshin; Kim, Jin Tak; Kim, Jinhyeon; Cho, Jungsan
KITECH (Korea Institute of Industrial Technology), Korea, South

Author Index

A

Adinarayan, Bharath Kumar T1D.3
Ahmad, Aamir F2C.5
Ahn, Joonwoo F2D.2
Ali, Hassan T5I.18
Alt, Benjamin T5I.5
Amersfoort, Midas W2D.1
An, Bohyeon T2DS.2
An, Jinung T5I.3
F2AS.2
F2AS.3
An, Qi W2A.3
Ang Jr, Marcelo H W4A.1
W4D.2
F3C.2
W2D.4
W4D.3
Ansari, Keyvan F2C.1
Asama, Hajime W2A.3
Augenstein, Philipp W2BS.1

B

Bae, Jongho F3DS.5
Baglietto, Marco F2C.4
Bando, Masahiro T2C.3
Bennewitz, Maren T1D.3
Beom-Joon, Park T5I.13
T5I.14
Berns, Karsten F2C.2
F2C.3
Beyerer, Jürgen F3C.3
BONG, Sung Jun T5I.23
Bösch, Carolin T1C.2
Braun, Christopher T5I.5
Buiyan, Teham W2A.5

C

Carfì, Alessandro W2BS.2
W2BS.3
Cha, Heejune T5I.2
Chen, Michael Nai-An T1D.1
Chen, Yiwen F3C.2
Chew, Chee Meng F3C.2
Cho, Gun Rae T5I.9
Cho, Jang Ho T2DS.2
Cho, Jungsan F3DS.7
Cho, Woo Sang T2B.3
Cho, Younggun W4CS.4
W4CS.3
Choi, Dooseop W4CS.2
Choi, GyeungHo F2AS.1
F2AS.2
F2AS.3
Choi, Han-Lim F3DS.1
F3DS.3
Choi, Hyouk Ryeol T1C.5
F3A.4
Choi, Jaehwan W2A.4
Choi, Juhyeong T5I.24
choi, junhyeon T5I.26
Choi, Sung Ho T4AS.1
Choi, Yong T5I.9
Chong, Nak Young T1D.4
T5I.6
T5I.10
Chua, Alicia T1B.4
Chung, Goobong F3DS.5
Chung, Hyun-Joon F3DS.5
T5I.13
T5I.14
T5I.21
Cielniak, Grzegorz W2D.2
Coleman, Sonya T5I.22

D

Das, Gautham F3C.1
de Heuvel, Jorge T1D.3
Dillmann, Rüdiger F3B.4
Dubbeldam, Michael W2D.1
Duell, Jamie T2B.5

E

Eichmann, Christian F3B.4
Eken, Kutay F2D.1
Elibol, Armagan T1D.4
T5I.6
Emter, Thomas F3C.3

Author Index

F

Fan, Xiuyi T1B.4, F3A.3, T2B.5, T5I.7
Fiedler, Niklas T1B.3
Frederiksen, Morten Roed T1B.2
Frietsch Musulin, Rosa F3B.4
Furmans, Kai W2BS.1

G

Galiza Cerdeira Gonzalez, Antonio F2D.4
GAO, ZIYAN T1D.4
Garbe, Leo F3C.3
Görner, Michael T1D.2, T1B.3
Graaf, Friedrich F3B.4
Grosse Besselmann, Marvin F3B.4
Güldenstein, Jasper T1B.3

H

Hagmanns, Raphael F3C.3
HAK, YI F3DS.5
Han, Jaeseung W2CS.2
Han, Jeong-woo F3A.5
Hanheide, Marc W2D.2, F3C.1
Harrigan, Shane Patrick T5I.22
Hasan, Khondokar Fida F2C.1
Hasegawa, Shun W4A.5
Hashem, Mohammad Shadman W2CS.3
Hassan, Waseem W2CS.3
Hawes, Nick T1D.1
Hayashide, Kazuyuki W2A.1
Hein, Björn W4A.2, W2BS.1, W4A.3
Henderson, Thomas C. F3B.1, F2D.1, T5I.7
Hendrich, Norman T1D.2, T1B.3
Heo, Jinuk T2DS.1
Heo, Yong Hae W2CS.4
Heo, Yunjae T2B.2
Hermann, Andreas F3B.4
Hinderer, Fabian T1C.1
Hiraoka, Naoki T2C.2
Hiraoka, Takuma T2C.2
Ho, Chun-Hsing W4D.1
Hong, Junki W2A.4, T5I.23
Hornung, Luisa F2B.5
Hroob, Ibrahim W2D.2
Hu, Zhe F2B.2
Huber, Marco T5I.5
Hwang, Hwancheol F3B.2
Hwang, Yeji W4BS.1

I

Ichikura, Aiko T1B.5
IN, GUN-GYO W4D.5
Inaba, Masayuki T2C.2, T2C.3, W4A.5, F2D.3, T1B.1, T1B.5

J

Jahn, Lennart Lorenz Freimuth F2AS.2, F2AS.3
Jang, Hyesu W4CS.1
Jang, Seung-Yeon W2CS.1
Jargalbaatar, Yura W4A.4
Jee, Sung Chul T5I.21
Jeon, Hyeonjae F2AS.1
Jeon, Kwang Woo F3DS.5
Jeon, Seokhee W2CS.3, W2CS.4
Jeon, Soo F3A.5
Jeong, Heejin T4AS.3
Jeong, Heeyeon T1C.5
JEONG, SEYEON T5I.27
Jeong, Sunghun T1C.4
Jeong, wonje T5I.15
Jia, Yansong W4D.2
Jo, Bruce F2B.1

Author Index

Jong-Hyuk, Park T5I.1
T5I.2
JOO, KYEONG-JIN W4D.5
Joolee, Joolekha Bibi W2CS.3
Jujjavarapu, Sri Sadhan T1D.1
Jung, Eui-Jung F3DS.5
T5I.9
Jung, Hosang F3A.4
Jung, HyunGi F2AS.4
Jung, Jooik T5I.2

K

KAKAR, JUNAID KHAN T5I.19
Kanazawa, Naoaki F2D.3
Kang, Hyunah W4BS.3
Kang, Jeon-Seong T5I.13
T5I.14
Kang, Sang Hoon W4BS.3
Kang, Sumin W4A.4
Kästner, Linh W2A.5
Katic, Darko T5I.5
Kaupp, Tobias F2B.3
Kawaharazuka, Kento T2C.3
W4A.5
F2D.3
T1B.5
Kawasaki, Koji T2C.2
T2C.3
Kazim, Muhammad F3B.2
Kerr, Dermot T5I.22
Khan, Muhammad Hamza T5I.8
Kim, Areum F2B.4
Kim, Ayoung W4CS.1
Kim, Byung Jun T2B.3
Kim, Chaehyeon F3DS.1
Kim, Chun Soo F3A.4
Kim, Daehyun T4AS.4
Kim, Donghan W4A.4
Kim, Donghyeon T2DS.3
Kim, Gi-Seong T1C.4
Kim, Hak-Jin F3DS.6
Kim, Hyunjoong T5I.1
Kim, Hyunwoo W2CS.1
Kim, Jaehyeong W2A.4
Kim, JaeJun W2A.4
Kim, Jin Tak F3DS.7
Kim, Jinhyeon F3DS.7
KIM, JONG CHAN T5I.21
Kim, Jonghyun W4BS.1
Kim, Jongwoo T5I.24
Kim, Joo H. T1C.3
Kim, Jungjun T5I.21
Kim, Ki-Young T2DS.2
Kim, Kwangki F3B.2
Kim, KyungSu T2B.3
Kim, Minsoo F2D.2
Kim, Myeong-Ju T2C.1
Kim, Myunghee T4AS.4
Kim, Myunghyun W4A.4
Kim, Sang-Cheol T5I.11
T5I.27
T5I.16
T5I.17
T5I.18
T5I.19
Kim, Sanghyun W4CS.5
Kim, Sang-Youn W2CS.4
Kim, Seokchan F3DS.2
Kim, Seung-Chan W2CS.5
Kim, Seunghwan F2B.4
Kim, SeungWoo T5I.21
KIM, SUNG HOON T5I.16
Kim, Sung Jun F3DS.3
Kim, Taegyun T2B.3
Kim, Taesoo F2AS.1
Kim, Yaeohn F2AS.1
Kim, Yeowon F3DS.3
Kim, Yong-Hyun F3DS.6
Kim, Yongjun T2DS.3
Kitagawa, Shingo T1B.1
Klancar, Gregor F3C.4
Ko, Minsam T4AS.4
Ko, Seong Young T2DS.4
T5I.4
Koch, Robin F3B.4
Kojima, Kunio T2C.2
Kokubu, Shota T5I.12
T5I.20
Koo, Jahoo F2D.2
Koshil, Mykhailo T1D.2
Kranz, Philipp F2B.3
Kreis, Benedikt T1D.3

Kremer, Matthias F2C.2
Kuc, Tae-Yong T5I.26
KUC, TAE-YONG W4D.5
Kuc, Tae-Yong W2D.5
Kwak, Kiho F3DS.4
Kwon, Hyock-Ju F3A.5
Kwon, Jaesung T5I.10
Kwon, Soyoon T2B.3
Kyung, Ki-Uk W2CS.1
W2CS.2

L

Lambrecht, Jens W2A.5
Lastrico, Riccardo W2BS.2
Laurence, Alexander F3A.1
Lee, Bumjoo F3B.3
Lee, Chang-Hun F3DS.1
Lee, Christina Dao Wen W4D.2
W2D.4
W4D.3
Lee, Dongjun T2DS.1
Lee, Haeseong T2C.1
Lee, Hanmin F3DS.2
LEE, HOSUN T5I.10
Lee, Hyeonji T1D.5
Lee, Hyuk-Jin T2DS.2
Lee, Jae Yeol T4AS.1
Lee, Jae Yong T1C.4
LEE, JAE-HONG F3A.2
T5I.23
Lee, Joohyun W2CS.5
Lee, Jung Chan T2B.3
Lee, Jungki F2AS.1
Lee, Jung-Suk F3DS.4
Lee, Kwang Hee T5I.26
W2D.5
Lee, Kyoobin T2B.2
T1D.5
LEE, mangi T5I.21
Lee, Mikyoung T4AS.2
Lee, Min Cheol T5I.8
Lee, Min Young W2D.4
Lee, Sang-Don F3DS.1
Lee, Sangeun T4AS.4
LEE, SANG-MIN W4D.5
Lee, Soojin F2B.4
Lee, Soon-Geul W2A.4
F3A.2
T5I.23
Lee, Sukhan F2B.4
Lee, Sungon T5I.10
Lee, Wonsuk F3DS.4
Lee, Yongseok T2DS.1
Lessen, Amelia F2D.1
Leung, Michael F2B.1
Li, Qiuyang T1D.4
Lim, Sungjin T5I.3
T5I.25
Lim, Yongseob F2AS.1
T5I.3
F2AS.2
F2AS.3
T5I.25
LIU, HAOFENG F3C.2
Liu, Rongrong T2DS.4
Liu, Shang-Ching T1D.2
Liu, Siyuan T1B.4
F3A.3
Liu, Zhiyang W4A.1
Lu, Weifeng F2B.2
Lu, Yuxi T2B.4
T5I.12

M

Macciò, Simone W2BS.2
Maeng, Jemo T2B.2
Malus, Andreja F3C.4
Markovic, Ivan W2A.2
Marston, Vista F3B.1
Mastrogiovanni, Fulvio F2C.4
W2BS.2
W2BS.3
Matsunaga, Fuko T5I.12
Meckel, Dennis F2C.2
F2C.3
Menon, Rohit T1D.3
Merkt, Holger T5I.5
Meusel, Marvin W2A.5
Miki, Akihiro T2C.2
T2C.3
Min, Kyoung-Wook W4CS.2
Miura, Jun W4D.4

Author Index

Mizuuchi, Ikuo F2D.4
MOHAMAD, SHAABAN W2BS.3
Molina, Sergi W2D.2
Moon, Hongju T4AS.1
Müller, Silvan T5I.5
Muro, Keiro F3A.1

N

Naß, Theresa Alexandra Aurelia T1B.3
Ni, Peiyuan W4A.1
Nishida, Tessa F2D.1
Nuechter, Andreas T1C.2

O

Obinata, Yoshiki F2D.3
T1B.1
T1B.5
Oh, Chang-Geun T4AS.2
Ohya, Akihisa F2D.5
F3B.5
Okada, Kei T2C.2
T2C.3
W4A.5
F2D.3
T1B.1
T1B.5
Ooka, Chihiro F3B.5
Ortiz, Ricardo F2B.1

P

Pahk, Jinu F2AS.3
Pan, Jia F2B.2
Park, Beomchan T5I.1
Park, Gyuhyun F3DS.4
Park, Hyunjin T5I.26
Park, Jaeheung F2D.2
T2C.1
Park, Jihwan W2CS.2
Park, Jinah W4D.3
Park, Jinseong W4CS.5
Park, Sangshin F3DS.7
Park, Seongjeong F2AS.2
F2AS.3
Park, Soon-Yong T5I.15
Park, Sungho F3DS.5
T5I.9
Park, Yeong Sang W4CS.2
Paul, Sanjoy T1D.1
Peng, William T1C.3
Persic, Juraj W2A.2
Petrovic, Ivan W2A.2
Plahl, Frederik W4A.2
Polvara, Riccardo W2D.2
Price, Eric F2C.5
Pyo, Jeongwon W2D.5

Q

Qin, Ruian T5I.12
Qiu, Yang F3A.3
Quinn, Justin T5I.22

R

Raible, Julian T5I.5
Rajan, Ishaan F2D.1
Rettig, Oliver T1C.1
W2D.3
Rhee, Issac F3A.4
Roennau, Arne F3B.4
Rose, Chad F2B.3
RUIHAN, MA T5I.17
Russwinkel, Nele W2BS.4
Ryu, Jaekwan W2A.4
Ryu, Jee-Hwan W4CS.3
T2DS.3
Ryu, Semin W2CS.5

S

Sacharny, David F3B.1
Sadiq, Bilal T5I.3
T5I.25
Saito, Ryo W4D.4
SangHyeon, Bae T5I.26
Sato, Shimpei T2C.2
Schirmer, Fabian F2B.3
Schmitt, Jan F2B.3
Schulze, Martin Asghar F3B.4
Seisenberger, Monika T2B.5
Seo, Jaehong F3DS.7

Author Index

Shen, Lyuyu W2D.4
Shim, Inwook F3DS.4
Shin, Dong Ah T2B.3
Shin, Gihun F3B.2
Shin, Hyunseok T5I.9
Shin, Joon-Ho W4BS.4
Shin, Min Kyu F3DS.3
Shin, Seho F2D.2
Shin, Young-Sik W4CS.5
Shinjo, Koki T1B.1
T1B.5
Sim, Hyunjae F3B.2
Sim, Jaehoon T2B.3
Sin, MinKi T2DS.2
Snyder, Matt W4D.1
SON, Minseok T1C.4
Son, Seokhyun T5I.2
Son, Soeun F3DS.5
T5I.9
Son, Sungho F2AS.1
Song, Hyunjong T1C.3
Song, Jieun F3B.3
Song, Won-Kyung W4BS.2
Sóti, Gergely F2B.5
W4A.3
Steffen, Lea F3B.4
Stironja, Vlaho-Josip W2A.2
Stoeckl, Florian T5I.5
Stoy, Kasper T1B.2
Strand, Marcus T1C.1
W2D.3
T5I.5
Street, Charlie T1D.1
Suh, Gil Joon T2B.3
Sung, Eunho T2C.1
Sygo, Björn T1D.2

T

Takahashi, Masaki W2A.1
Tan Rong Hui, Mark F3A.3
Tan, Jiayi F3C.2
Tao, Xiaodi T5I.4
Thomas, Antony F2C.4
TIWARI, ASHUTOSH T4AS.4
Tortós, Pablo T5I.12
Traverso, Paolo W2BS.2
Tsukamoto, Naoto T1B.1
Türk, Nehemia W2D.3

U

Um, Seunghwan T1C.5
F3A.4

V

Venture, Gentiane F2D.4
Visser, Arnoud W2D.1
Vrabic, Rok F3C.4

W

Wang, Haozhe W4A.1
Wang, Li Rong T5I.7
Weisenböhler, Moritz W2BS.1
Weon, Ihnsik F3A.2
T5I.1
T5I.2
Widera, Julia W4A.2
Wieczorek, Fabian T1D.2
Wilbrandt, Robert F3B.4
Wolf, Patrick F2C.2
F2C.3
Woo, SooHo W2A.4
T5I.23
Wu, Jiaxu W2A.3
Wu, Liqi W4A.5
Wurll, Christian W4A.2
W2BS.1
F2B.5
W4A.3

Y

Yamaguchi, Naoya T1B.1
Yamashita, Atsushi W2A.3
Yang, Geonmo W4CS.4
Yang, Sungwoo W4A.4
Yang, Tianyi T2B.1
T2B.4
Yang, Woosung T5I.10
Yanokura, Iori T1B.1
YI, HAK T5I.21
Yoon, Jimin T1C.5

Author Index

Yorozu, Ayanori F2D.5
F3B.5
Youn, Chanmin W4CS.5
Youn, Wonkeun W4CS.5
Yu, Seunghyeon T4AS.1
Yu, Wenwei T2B.1
T2B.4
T5I.12
T5I.20
Yu, Yeonguk T1D.5
Yuan, Haihang T2B.1
T2B.4
Yun, Changho F3DS.6

Z

Zachariae, Andreas W4A.2
Zdesar, Andrej F3C.4
Zevering, Jasper T1C.2
Zhang, Dada W4D.1
Zhang, Huiguo T1B.4
Zhang, Jianwei T1D.2
T1B.3
Zhang, Zedong F3C.2
Zhao, Longfei F2B.2
Zhou, Heng T5I.11
Zhou, Lei W4A.1
Zhou, Zhongchao T2B.1
T5I.12
Zhu, Gaoxia F3A.3
Zhu, Zuyuan F3C.1
Zou, Yushu F2D.5
Zuzek, Tena F3C.4

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