Poster Abstracts (morning session)

Poster WeAM1:
Road-Marking Based Loop Closure Using a Monocular Camera

Jeong, Jinyong	KAIST
Kim, Ayoung	Korea Advanced Institute of Science Technology

Abstracts:
In this paper, we propose an algorithm that leverages road markings obtained from monocular camera images to estimate accurate vehicle position. Our method generates sub-maps containing only road markings that increase the confidence of the matching to improve the accuracy of the loop detection. The cumulative error is compensated by the detected loop, thereby increasing the overall global accuracy. This method achieved an average global accuracy of 1.098 m over 4.7 km travel distance.

Poster WeAM2:
Practical Control of Tendon-Driven Multi-DOF Robot Mechanism for Precision Operation

Jeong, Hyunhwan	Korea University
Kang, Bong ki	Korea University
Cheong, Joono	Korea University

Abstracts:
This paper addresses a practical control method for a human-like multi-DOF tendon-driven joint (TDJ) robot mechanism aimed at precision operation. The proposed control method can produce high precision accuracy by compensating for uncertainties of TDJ. The proposed controller is applied to our multi-DOF TDJ mechanism. We show experimental results to validate the performance of control method.

Poster WeAM3:
Real-time Hierarchical Fusion System for Semantic Segmentation in Offroad Scenes

KANG, DANG	Nanyang Technological University
Hoy, Michael	The University of New South Wales
Dauwels, Justin	Nanyang Technological University
YUAN, JUNSONG	NTU,Singapore

Abstracts:
Semantic segmentation is an important task for autonomous vehicle navigation in offroad environments. However, several natural factors make this problem uniquely challenging. For example, road segmentation is often difficult under heavy shadow or steep terrain, and dangerous muddy water puddles may have the similar visual appearance to dirt road surfaces (and thus are hard to identify). To tackle these challenges, we present a semantic segmentation system based on a two-stage hierarchical fusion pipeline. The first stage improves the road segmentation by effectively fusing information from camera and 3D Lidar point cloud. The second stage is dedicated to detecting water puddles, leveraging on the results from the first stage. Due to the parallelized architecture, our system can be deployed for real-time applications. We achieved an F1 score of around 93% for road segmentation and 80% for water puddle segmentation at more than 10 Hz.

Poster WeAM4:
A Novel Free Piston Linear Generator with Voice Coil Motor

Chen, Feixue	Shanghai University and Ningbo Institute of Materials Technology
Zhang, Chi	Ningbo Institute of Material Technology and Engineering,CAS
Sun, Peng	University of Chinese Academy of Sciences
Yang, Guilin	Ningbo Institute of Material Technology and Engineering, Chines

Abstracts:
Free-piston linear generator (FPLG) is a novel energy converter with advantages of high efficiency, high power density and low emissions. It normally consists of an Internal Combustion Engine (ICE), a Linear Electric Machine (LEM) and a rebounding device. The crankshaft and flywheel mechanism of ICE are eliminated, the piston is directly connected to the mover of LEM or the rebounding device. Due to the elimination of the crankshaft and flywheel, the compression ratio of FPLG is variable. This brings the advantages of high efficiency and the capability of accommodating multiple fuels without modifying the mechanical configuration of the combustion engine. Therefore, the FPLG is regarded as a promising alternative hybrid power system for hybrid electrical vehicles (HEVs). This paper presents a novel FPLG with a 15kW Voice Coil Motor (VCM) which not only functions as a starting motor but also a linear generator. Compared with the other FPLGs reported in previous literatures that mostly employed three-phase generator, the utilization of the VCM can not only improves the mechanical-electrical response, but also decreases the control difficulty. Four mechanical springs in parallel are assembled between the ICE and linear generator (VCM). They serve as the rebounding device and provide effective thermal insulation for the generator.

Poster WeAM5:
Development of the Inspection Robot FURO for the Characterisation of Radiologically Contaminated Pipework

Brown, Liam	The University of Manchester
Carrasco, Joaquin	The University of Manchester
Watson, Simon	University of Manchester
Lennox, Barry	The University of Manchester

Abstracts:
The decommissioning of contaminated facilities is a long and expensive process. The aim of this research is to develop a low-cost, sacrificial robotic system that is able to autonomously navigate through 50 mm pipework, whilst recording its geometric position and radiological data, then produce a map of the information. This can be used to reduce the cost of decommissioning by identifying the areas of radiation so that only these areas have to be disposed of as contaminated waste. This paper presents the pipe inspection vehicle FURO and the mechanical feelers developed for autonomous corner navigation.

Poster WeAM6:

Acoustic Sensing from Multi-Rotor Drones

Wang, Lin	Queen Mary University of London
Cavallaro, Andrea	Queen Mary University of London

Abstracts:
When an MAV captures sounds emitted by a ground or aerial source, its motors and propellers are much closer to the microphones than the sound source, thus leading to extremely low signal-to-noise ratios (SNR). The ego-noise will mask the target sound and degrades the sound recording quality significantly. Appropriate sound enhancement techniques are therefore necessary for MAV-based acoustic sensing. We implement three types of microphone-array algorithms to enhance the target sound captured by an MAV, and conduct a comparative evaluation with real-recorded MAV sounds.

Poster WeAM7:
Learning Robot Activities from First-Person Human Videos Using Convolutional Future Regression

Lee, Jangwon	Indiana University
Ryoo, Michael S.	Indiana University Bloomington

Abstracts:
Given unlabeled human activity videos from a human's viewpoint, our objective is to make the robot learn the temporal structure of the activity as its future regression network, and learn to transfer such model for its own motor execution. We newly introduce the concept of using a fully convolutional network to regress the intermediate scene representation corresponding to the future frame for achieving the goal.

Poster WeAM8:
Measuring Engagement in Autism Therapy with Social Robots: A Cross-Cultural Study

Rudovic, Ognjen	MIT Media Lab
Lee, Jaeryoung	Chubu University

Abstracts:
Eliciting and maintaining engagement during occupational therapy for children with autism is critical for increasing their learning opportunities. Social robots have been used to this aim, yet, they lack the ability to autonomously measure the child's engagement – something necessary to attain the naturalistic interaction. To this end, we investigate relationships between levels (defined on a 0-5 Likert scale) of children's behavioural (task-driven) and affective (valence, arousal) engagement, as these are important for optimizing the social robots for autism therapy. We perform our analysis on children diagnosed with autism (age 3-13) and with diverse cultural backgrounds, Asia (Japan, n=17) and Eastern Europe (Serbia, n=19), who participated in one daily occupational therapy lasting 25' on average. Our results indicate significant differences in engagement expression between the two cultures. Accounting for these differences may facilitate the design of the child- and culture-adaptive social/affective robots for autism.

Poster WeAM9:
Precise Motion Control of Metallic Miniaturized Grippers in Dynamic and Cluttered Environments

Scheggi, Stefano Denasi, Alper Ghosh, Arijit Ongaro, Federico Gracias, David H. Misra, Sarthak	University of Twente University of Twente Johns Hopkins University University of Twente Department of Chemical and Biomolecular Engineering, The Johns H University of Twente

Abstracts:
We demonstrate precise closed-loop control of metallic miniaturized grippers under the influence of the magnetic fields. A challenging Pac-Man-like scenario, composed of virtual dynamic and static obstacles, is used to evaluate the proposed approach. The combination of path planning algorithms and closed-loop control allows to precisely move the metallic miniaturized grippers and perform accurate and fast manipulation and transportation tasks. The controlled grippers safely navigate the environment at an average speed of 219 μm/s and maximal speed of 706 μm/s.

Poster WeAM10:
Human-Robot Collaboration During Polishing Operations

Gaz, Claudio Roberto Magrini, Emanuele De Luca, Alessandro	Sapienza University of Rome Sapienza University of Rome Sapienza University of Rome

Abstracts:
During polishing operations performed by a robot, it may be desirable for a human operator to change the orientation of the end-effector by simply pushing the robot structure. We propose an algorithm that separates the external force in two components, one due to the end-effector pushing the surface while working, and the other due to the voluntary action of the operator. This latter component drives the control law, which allows the robot to reconfigure its structure performing a self-motion, exploiting redundancy.

Poster WeAM11:
AirSim: High-Fidelity Visual and Physical Simulation for Autonomous Vehicles

Shah, Shital Dey, Debadeepta Lovett, Chris Kapoor, Ashish	Microsoft Research Microsoft Microsoft Corporation MicroSoft

Abstracts:
Training data collection, ability to develop and test algorithms for autonomous vehicles in real world is an expensive and time consuming process. Consequently, it is becoming increasingly important to be able to accurately simulate the physical environment that autonomous vehicles/robots would operate in. We present a new, easy-to-use, open-source simulator that combines advances in rendering technologies with more accurate models of physical world for physically and visually realistic simulations. Such realism can enable efficient training and testing of machine learned models by generating vast quantity of ground truth data. Our simulator includes

a fast physics engine that can operate at high frequency to enable support for hardware-in-the-loop (HIL) as well as software-in-the-loop (SIL) with widely supported protocols (e.g. MavLink). Our architecture is cross-platform (Linux, OS X and Windows) and open-source with focus on extensibility to accommodate new types of autonomous vehicles, hardware platforms and supports existing open source protocols. We use quadrotors as our first autonomous vehicle showcase.

Poster WeAM12:
Robotman: A Security Robot for Human-Robot Interaction

Lopez Manrique, Jose Alexander	Pontificia Universidad Catolica del Peru
Paredes, Renato	Pontificia Universidad Católica del Perú
Trovato, Gabriele	Waseda University
Cuellar, Francisco	Pontificia Universidad Catolica del Peru

Abstracts:
The aim of this project is to present the research and development of a security robot (Robotman) for indoor spaces where there are people moving. The robot is able to perform activities as security guard, and at the same time interact with humans to welcome and provide information of the location. The robot was designed using industrial design methodology for the aspect and functionality combined with mechatronics design methodology for the practical electronics, mechanics and software. The project provides insightful information of the interaction of this type of robot in a real case scenario with humans. Our results suggest that Robotman is user friendly and pleasing to the people, and it can perform security tasks and interact with them inside a mall.

Poster WeAM13:
A Hazard Map Generating System for Personal Mobility Users on Sidewalks

Sawabe, Taishi	Nara Institute of Science and Technology
Nishikawa, Naoki	Nara Institute of Science and Technology
Kanbara, Masayuki	Nara Institute of Science and Technology
Hagita, Norihiro	ATR

Abstracts:
Personal mobility device has been developed as a new compact vehicle. Especially, a personal mobility device that runs on sidewalks in every life attracts much attention. However, there are many dangerous factors which cause accidents by using personal mobility device on the sidewalk, such as steps, slopes and crowded sidewalks with many pedestrians and bicycles. Due to these dangerous factors, personal mobility device users may not always move safety. This paper proposes a system that detects the dangerous spot on sidewalks using smartphones attached with the mobility and generates hazard map displaying dangerous spots for the personal mobility device. In the proposed method, when the personal mobility device travels on a sidewalk, information on dangerous spots is detected by sensors of the smartphone that is attached to the device. After that, a hazard map is created based on the collected dangerous information. The proposal hazard map specifies and displays the dangerous parts existing on the sidewalk.

Poster WeAM14:
Empathetic Speech Synthesis Applied to a Chat Robot to Obtain the User's Confidence

Nishimura, Shogo Kawanami, Hiromichi Kanbara, Masayuki Hagita, Norihiro	Nara Institute of Science and Technology Nara Institute of Science and Technology Nara Institute of Science and Technology ATR

Abstracts:
This paper describes chatting robots aiming at getting confidence with a user by Empathetic Speech Synthesis which imitates one of social skill “pacing”. In general, there are two factors that people want to have interaction. One is sociality which means a high level of social skills and humanity of communication. The other one is novelty which means providing unexpectedness or new information. Conventional researches have realized an interaction between user and a robot with novelty. However, there is a problem that it is difficult to interact with the robot because the study of sociality is not sufficient. In this research, the authors try to improve the communication robot which has sociality and novelty for a long-term interaction.

Poster WeAM15:
Smart Algorithms for Safe Physical Human-Robotic Care

Krishnaswamy, Kavita Tim Oates, Tim Oates Thippur Sreenivas, Thippur Sreenivas	University of Maryland Baltimore County (UMBC) University of Maryland Baltimore County (UMBC) Indian Institute of Science (IISc.)

Abstracts:
A promising and challenging application of human-robot interaction is technology that assists individuals with repositioning, transferring, and personal care tasks. Although these systems have the potential to significantly improve quality of life for people with disabilities and seniors, there remain significant gaps in enforcing human safety. Our goal is to explore the intersection between caregiving and assistive robotics, and how it is possible to translate safe patient handling and mobility guidelines into smart human-robotic interaction (HRI) algorithms for development of HRI safety standards in the process of repositioning human arms and legs with a robotic arm.

Poster WeAM16:
Extracting Grasping and Contact Points from Assembly Demonstration

Petit, Damien Ramirez-Alpizar, Ixchel Georgina Harada, Kensuke Yamanobe, Natsuki Wan, Weiwei Nagata, Kazuyuki	Osaka University Osaka University Osaka University Advanced Industrial Science and Technology National Inst. of AIST National Inst. of AIST

Abstracts:
This work presents a framework to extract the grasping and contact points of object parts being assembled. With this framework the parts are recognized and tracked using markers. The data of the user's hands assembling the parts are acquired with a data-glove. The grasping and contact points are determined with the motion capture data, the model of the parts and point cloud based algorithms. The functionality of the framework is demonstrated with an experiment where the user realizes an assembly demonstration.

Poster WeAM17:
Smart Microsurgical Robot Based on High-Speed 4D Optical Coherence Tomography

Park, Taiwoo	Michigan State University
Im, JIntaek	DGIST
song, cheol	DGIST

Abstracts:
We present an interactive and assisted microsurgical system featuring a graphical processing unit (GPU)-accelerated 4D target area real time visualization as well as guided SMART micro-forceps for active tremor cancellation, which are enabled by common path swept source optical coherence tomography (CP SS-OCT). The visualization and active tremor cancellation are implemented in one integrated system, while sharing one OCT source as well as multiple GPU cores. The system aims to assist micro surgeons to accurately and rapidly locate a surgical target at the desired position and thereby accomplishing given surgical tasks with enhanced interactivity.

Poster WeAM18:
Model-Based Design of a 3D Haptic Shape Display

Koehler, Margaret	Stanford University
Usevitch, Nathan	Stanford
Okamura, Allison M.	Stanford University

Abstracts:
Haptic shape displays provide compelling interactions by allowing users to freely touch a rendered surface. Building on previous work in haptic jamming, we developed a novel 3D shape display. We present the design of the display, a dynamic model of the device, and a computational model-based algorithm for the automatic design of the display to reach a set of target shapes.

Poster WeAM19:
Entropy-Weighted Particle Filter-Based Vehicle Localization Using Vertical and Road Intensity Information

Kim, Hyungjin	KAIST(Korea Advanced Insititute of Science and Technology)
Liu, Bingbing	I2R, A*Star
Goh, Chi Yuan	Institute For Infocomm Research
Lee, Serin	Institute for Infocomm Research (I2R)
Myung, Hyun	KAIST (Korea Adv. Inst. Sci. & Tech.)

Abstracts:
This paper proposes a robust vehicle localization method based on a prior point cloud in urban area. Since the prior point cloud has many changed aspects of environment due to outdated data, the proposed method estimates vehicle pose using a particle filter by considering the reliability of extracted features from the prior map. In this paper, multi-layer vertical and road intensity information are utilized as the extracted features. The proposed method is demonstrated by an autonomous vehicle in Singapore.

Poster WeAM20:
Sensor Data-Driven Urban Site Analysis Using Point Cloud from Urban Mapping System (UMS)

Kim, Giseop	KAIST(Korea Advanced Institute of Science and Technology)
roh, hyunchul	KAIST
Kim, Youngchul	Korea Advanced Institute of Science and Technology
Kim, Ayoung	Korea Advanced Institute of Science Technology

Abstracts:
Understanding and analyzing urban environment have been of focus by many researchers [1]. While conventional approaches rely on survey and/or manual 3D modeling, this paper introduces a new approach that allows direct and fast urban analysis using sensor data from Urban Mapping System(UMS). We focus on a concept of 3D isovist as the urban analysis metric, and present a pipeline to calculate a 3D isovist using Light Detection and Ranging (LiDAR) data for large and complex urban sites. Each point has 3D global coordinates after applying localization algorithms and is merged to a voxel for efficiency representing the 3D isovist. Our method is capable of handling a a 3D isovist precisely while automatically generating its distribution following urban roads. The results produced by the proposed pipeline could be important evidence to study the utility of the notion of 3D isovists in real space.

Poster WeAM21:
New Class of Compliant Modular Earthworm-Like Robot Using Novel Scissor Mechanisms

LUO, yudong	university of nevada,reno
Zhao, Na	University of Nevada, Reno
Shen, Yantao	University of Nevada, Reno
Kim, Kwang	University of Nevada Reno

Abstracts:
Earthworms are the soft, tube-shaped, segmented worms who move with waves of muscular contractions. This paper presents our recently developed compliant modular earthworm-like robot with the novel segmental muscle-mimetic design unit that efficiently mimics earthworm's segmental circular and longitudinal muscles for contractions and extensions. The new class of segmental muscle-mimetic design unit relied on curvature of scissor mechanisms that can be extended and contracted smoothly through controlled servo motors. By connecting number of the units through the transmission mechanisms, a new class of multi-segment earthworm-like robot is developed and tested. Extensive results demonstrate the advanced design unit mimicking functions, the relationship between segmental phase shift and locomotion speed, and the excellent peristaltic locomotion performance of the robot.

Poster WeAM22:
Robust Connectivity-Preserving Rendezvous of Mobile Multi-Robot Systems

Feng, Zhi	Nanyang Technological University
Sun, Chao	NTU
Hu, Guoqiang	Nanyang Technological University,

Abstracts: This project studies a robust connectivity preserving rendezvous problem for a mobile multi-robot system. It aims to develop efficient distributed algorithms for heterogeneous mobile multi-robot systems to achieve robust rendezvous and meanwhile to maintain network connectivity in the presence of sensing and communication constraints and model complexity and uncertainties. A gradient-based distributed framework is proposed to solve this problem. Although the robot network has a dynamic network topology, the proposed distributed PID controller with the model-free and finite-time features can maintain the connectivity of an initially connected communication network. Numerical example and results are presented to show the effectiveness of the methods.	
Poster WeAM23: A SDRE-Based Near Optimal Control Scheme for Quadrotor	
Yoon, Seongwon Han, Soohee	Pohang University of Science and Technology Pohang University of Science and Technology (POSTECH)
Abstracts: In this paper, a SDRE based near optimal control scheme for quadrotor is present. SDRE control scheme is systematic near optimal approach for nonlinear system and has gained much popularity among researchers since early 00s. In order to verify the effectiveness of the proposed control scheme, simulation is conducted using Simulink.	
Poster WeAM24: A Novel Omnidirectional Depth Perception Method for Multi-Rotor Micro Aerial Vehicles	
Son, Youngbin Kwak, Inveom Lee, Hakjun Oh, Se-Young Han, Soohee	POSTECH POSTECH Pohang University of Science and Technology POSTECH Pohang University of Science and Technology (POSTECH)
Abstracts: Understanding the 3D structure of surrounding environment is one of the most important tasks for autonomous multi-rotor MAVs. Various approaches have been explored in an attempt to perceive the 3D structure of the environment efficiently. However, most of them are based on the methods which use limited viewing angle, i.e. non-omnidirectional depth sensing. Such a sensing method produces blind spots around a MAV, and hence limits the autonomy of multi-rotor MAVs by prohibiting them from obtaining the full information around the surrounding environment and then computing an optimal path. To touch this problem, this paper proposes a novel omnidirectional depth perception method which can be applied to few-hundred-grams class MAVs. By using a line laser scanner (LLS), and exploiting the ability to change the direction of movement independently of the yaw-rotation of the multi-rotor MAVs, this paper proposes a novel omnidirectional 3D structure sensing system of small size and lightweight design. As a pilot research, we concentrated on assessing feasibility of the proposed sensing system. We have implemented a lightweight, wide-angle view LLS and attached it on a customized MAV testbed	

platform. Furthermore, a specialized attitude controller is designed to mitigate undesirable effects arising from continuous yaw rotation.

Poster WeAM25:
Tubular Jamming – a Form of Expansion Jamming Toward High Force Actuation with Soft Pneumatic Actuators

Miller-Jackson, Tiana	National University of Singapore
Yeow, Chen-Hua	National University of Singapore

Abstracts:
Expansion jamming, a novel form of granular jamming, is a method for increasing the stiffness of soft pneumatic actuator (SPA) beam segments, in order to withstand buckling at high loads, while maintaining their inherently compliant features. In this work, tubular jamming is presented. The bending stiffness of a traditional fabric-based SPA beam is compared with that of a tubule-jammed beam (TJB). Additionally, the jam volume (volume of tubules installed in the TJB) is varied and the resultant bending stiffness from each configuration is compared. The TJB showed a bending stiffness of nearly two times that of the traditional SPA beam of equivalent dimension. A distinct decrease in efficacy of the TJB below a jamming ratio of 67% was observed. Tubular jamming is a promising and easily implemented method for increasing the stiffness of traditional fabric SPAs.

Poster WeAM26:
An Investigation into the Upper Extremity Motion During Trip-Induced Forward Falls

Abdolshah, Saeed	University of Padova
Akiyama, Yasuhiro	Nagoya-University
Mitsuoka, Kento	Nagoya University
Yamada, Yoji	Nagoya University
Okamoto, Shogo	Nagoya University

Abstracts:
Elbow extension and impact velocity are the most important parameters influencing impact force and injuries in forward falls. We carried out a tripping experiment to determine natural upper extremity motion such as elbow extension during the fall process. Moreover, the fall motion was simulated using a 12-DOF model to obtain a realistic evaluation of the impact velocity. The related impact force was estimated using a sagittal 3-segment model.