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PROGRAM

Day 2

Late Breaking Results Poster Sessions

Wednesday, 31 May

IEEE

IEEE Robotics & Automation Society

Late Breaking Results Poster Sessions

Date: May 31, 2017
Venue: Sands Grand Ballroom, Level 5

Morning Session (AM): 9:30 – 12:20

Poster number	Titles of posters	Authors
1	Road-Marking Based Loop Closure Using a Monocular Camera	Jeong, Jinyong; Kim, Ayoung
2	Practical Control of Tendon-Driven Multi-DOF Robot Mechanism for Precision Operation	Jeong, Hyunhwan; Kang, Bong ki; Cheong, Joono
3	Real-time Hierarchical Fusion System for Semantic Segmentation in Offroad Scenes	KANG, DANG; Hoy, Michael; Dauwels, Justin; YUAN, JUNSONG
4	A Novel Free Piston Linear Generator with Voice Coil Motor	Chen, Feixue; Zhang, Chi; Sun, Peng; Yang, Guilin
5	Development of the Inspection Robot FURO for the Characterisation of Radiologically Contaminated Pipework	Brown, Liam; Carrasco, Joaquin; Watson, Simon; Lennox, Barry
6	Acoustic Sensing from Multi-Rotor Drones	Wang, Lin; Cavallaro, Andrea
7	Learning Robot Activities from First-Person Human Videos Using Convolutional Future Regression	Lee, Jangwon; Ryoo, Michael S.
8	Measuring Engagement in Autism Therapy with Social Robots: A Cross-Cultural Study	Rudovic, Ognjen; Lee, Jaeryoung
9	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
10	Human-Robot Collaboration During Polishing Operations	Gaz, Claudio Roberto; Magrini, Emanuele; De Luca, Alessandro
11	AirSim: High-Fidelity Visual and Physical Simulation for Autonomous Vehicles	Shah, Shital; Dey, Debadeepta; Lovett, Chris; Kapoor, Ashish
12	Robotman: A Security Robot for Human-Robot Interaction	Lopez Manrique, Jose Alexander; Paredes, Renato; Trovato, Gabriele; Cuellar, Francisco
13	A Hazard Map Generating System for Personal Mobility Users on Sidewalks	Sawabe, Taishi; Nishikawa, Naoki; Kanbara, Masayuki; Hagita, Norihiro
14	Empathetic Speech Synthesis Applied to a Chat Robot to Obtain the Users Confidence	Nishimura, Shogo; Kawanami, Hiromichi; Kanbara, Masayuki; Hagita, Norihiro

15	Smart Algorithms for Safe Physical Human-Robotic Care	Krishnaswamy, Kavita; Tim Oates, Tim Oates; Thippur Sreenivas, Thippur Sreenivas
16	Extracting Grasping and Contact Points from Assembly Demonstration	Petit, Damien; Ramirez-Alpizar, Ixchel Georgina; Harada, Kensuke; Yamanobe, Natsuki; Wan, Weiwei; Nagata, Kazuyuki
17	Smart Microsurgical Robot Based on High-Speed 4D Optical Coherence Tomography	Park, Taiwoo; Im, JIntaek; song, cheol
18	Model-Based Design of a 3D Haptic Shape Display	Koehler, Margaret; Usevitch, Nathan; Okamura, Allison M.
19	Entropy-Weighted Particle Filter-Based Vehicle Localization Using Vertical and Road Intensity Information	Kim, Hyungjin; Liu, Bingbing; Goh, Chi Yuan; Lee, Serin; Myung, Hyun
20	Sensor Data-Driven Urban Site Analysis Using Point Cloud from Urban Mapping System (UMS)	Kim, Giseop; roh, hyunchul; Kim, Youngchul; Kim, Ayoung
21	New Class of Compliant Modular Earthworm-Like Robot Using Novel Scissor Mechanisms	LUO, yudong; Zhao, Na; Shen, Yantao; Kim, Kwang
22	Robust Connectivity-Preserving Rendezvous of Mobile Multi-Robot Systems	Feng, Zhi; Sun, Chao; Hu, Guoqiang
23	A SDRE-Based Near Optimal Control Scheme for Quadrotor	Yoon, Seongwon; Han, Soohee
24	A Novel Omnidirectional Depth Perception Method for Multi-Rotor Micro Aerial Vehicles	Son, Youngbin; Kwak, Inveom; Lee, Hakjun; Oh, Se-Young; Han, Soohee
25	Tubular Jamming a Form of Expansion Jamming Toward High Force Actuation with Soft Pneumatic Actuators	Miller-Jackson, Tiana; Yeow, Chen-Hua

Afternoon Session (PM): 14:30 – 17:20

Poster number	Titles of posters	Authors
1	Crispy Disk Grabbing by an Elephant-Trunk Inspired Robot*	Wu, Jianing; Hu, David L.
2	Surface EMG-Based Evaluation of a PAM-Enabled Wrist Assist Glove	Das, Swagata; Kurita, Yuichi
3	Fabric-Based Flat Pneumatic Actuators for Soft Assistive Glove Application	Yap, Hong Kai; Yeow, Chen-Hua

4	Automatic Detection Method of Surgical Instrument and Vessel in Laparoscopic Surgery Images	Jo, Kyungmin; Choi, Bareum; Choi, Jaesoon
5	LATRO: An Electro-Hydraulically Actuated Robotic Spider for Remote Characterisation and Retrievals	Arvin, Farshad; Telford, Mark; Watson, Simon; Cheah, Wei; Green, Peter; Carrasco, Joaquin; Lennox, Barry
6	Perpetual Robotic Swarm	Arvin, Farshad; Watson, Simon; Turgut, Ali Emre; Espinosa Mendoza, Jose Luis; Krajnik, Tomas; Lennox, Barry
7	Autonomous Interactive Robot Learning	Aly, Ahmed; Dugan, Joanne
8	Model-Based Pose Tracking for 3D Shape Representation	Khin Kyu Kyu Win, Khin Kyu Kyu Win
9	Localization Method by TOF Laser Sensor for Mobile Robot	Usagawa, Daichi; Kito, Takumi; Sato, Kenjiro; Iwaki, Satoshi
10	Soft Smoothly Rolling Wheel: Principle Verification	Tian, Yang; Ma, Shugen
11	Dexclar: Dexterous, Reconfigurable, Modular Gripper for In-Hand Manipulation	Rahman, Nahian; Canali, Carlo; Caldwell, Darwin G.; Cannella, Ferdinando
12	Isolated Sensor Cluster Network Construction with UAVs	Kim, Myunggun; Son, Hungsun
13	Reducing the Number of Iterations in Pose Graph SLAM Optimisation	Harsányi, Károly; Kiss, Attila; Majdik, Andras; Sziranyi, Tamas
14	Hybrid Model for Passive Locomotion Control of a Bipedal Robot	Mondal, Soumyarka; Nandi, Gora Chand
15	An Open-Source C++ Library for Robotics and Optimal Control	Neunert, Michael; Giftthaler, Markus; Pardo, Diego; Buchli, Jonas
16	Semantic Labeling of Indoor Environments from 3D RGB Maps	Durner, Maximilian; Brucker, Manuel; Ambrus, Rares; Marton, Zoltan-Csaba; Wendt, Axel Joerg; Jensfelt, Patric; Arras, Kai Oliver; Triebel, Rudolph
17	Enhancing Situational Awareness for Teleoperation Tasks	Park, Sangsoo; Park, Sungjun; Lee, Hyunjin; Son, Hyoung Il
18	Design of an Underwater Drone for Bio-Logging	HAN, HyunTae; Hiwatashi, Masaki; Tsumaki, Yuichi
19	Attentional RGB-D Object Detection for Mobile Robot Monitoring	Imamoglu, Nevrez; Shimoda, Wataru; Zhang, Chi; Kanezaki, Asako; Fang, Yuming; Nishida, Yoshifumi

20	Evaluation of Personal Characteristic on Stress in Autonomous Driving Passengers	Sawabe, Taishi; Okajima, Tomoya; Kanbara, Masayuki; Hagita, Norihiro
21	A Delay-conscious Communication Model for Mobile Robot Navigation	Kato, Yuka; Tanaka, Mamiko
22	Real-Time Perception Meets Reactive Motion Generation	Kappler, Daniel; Meier, Franziska; Issac, Jan; Mainprice, Jim; Garcia Cifuentes, Cristina; Wüthrich, Manuel; Berenz, Vincent; Schaal, Stefan; Ratliff, Nathan; Bohg, Jeannette
23	BM-Arm: A Biologically Inspired Reconfigurable Cable Robot for the Study of Human Motion	Eden, Jonathan Paul; SONG, Chen; Tan, Ying; Oetomo, Denny; Lau, Darwin
24	An Investigation into the Upper Extremity Motion During Trip-Induced Forward Falls	Abdolshah, Saeed; Akiyama, Yasuhiro; Mitsuoka, Kento; Yamada, Yoji; Okamoto, Shogo
25	Home Social Robots Sharing Indoor Activities with Friends: Field Study	Jeong, Kwangmin; Kim, Aram; Kim, Hyemi; Lee, JeeHang; Kim, Jinwoo
26	Tacking Control of Sailboats Based on Force Polar Diagram	Sun, Qinbo; Qiao, Zhuhan; Strömbeck, Carl; Qu, Yang; QIAN, Huihuan; Xu, Yangsheng

Poster Abstracts

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. Figure 1 shows the 2D diagram of the VCM which has a single-phase moving-coil configuration. The windings are inserted into a Nylon cylinder to y

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	University of Twente
Denasi, Alper	University of Twente
Ghosh, Arijit	Johns Hopkins University
Ongaro, Federico	University of Twente
Gracias, David H.	Department of Chemical and Biomolecular Engineering, The Johns H
Misra, Sarthak	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	Sapienza University of Rome
Magrini, Emanuele	Sapienza University of Rome
De Luca, Alessandro	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	Microsoft Research
Dey, Debadeepta	Microsoft
Lovett, Chris	Microsoft Corporation
Kapoor, Ashish	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	Nara Institute of Science and Technology
Kawanami, Hiromichi	Nara Institute of Science and Technology
Kanbara, Masayuki	Nara Institute of Science and Technology
Hagita, Norihiro	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	University of Maryland Baltimore County (UMBC)
Tim Oates, Tim Oates	University of Maryland Baltimore County (UMBC)
Thippur Sreenivas, Thippur Sreenivas	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	Osaka University
Ramirez-Alpizar, Ixchel Georgina	Osaka University
Harada, Kensuke	Osaka University
Yamanobe, Natsuki	Advanced Industrial Science and Technology
Wan, Weiwei	National Inst. of AIST
Nagata, Kazuyuki	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	Pohang University of Science and Technology
Han, Soohee	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	POSTECH
Kwak, Inveom	POSTECH
Lee, Hakjun	Pohang University of Science and Technology
Oh, Se-Young	POSTECH
Han, Soohee	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 WePM1: Crispy Disk Grabbing by an Elephant-Trunk Inspired Robot*

Wu, Jianing	Georgia Institute of Technology
Hu, David L.	Georgia Institute of Technology

Abstracts: An elephant's boneless trunk is its most versatile appendage, enabling it to grab objects as heavy as a log or as a small as a peanut. However, the strategy of how the elephant can grab more fragile items such as a tortilla chip has not been revealed yet. Here we show that the elephant can grip a tortilla chip aided by air flow which is a unique feeding behavior of mammals. The elephant accurately locate, gently suck up, slightly drop the tortilla several times, and adjust the position to grab it without any damage to the food. In this experimental and theoretical investigation, we show that an elephant's great dexterity is in part to their use of suction to bring objects closer to their trunk. Elephants suck with pressures of 10 kPa, generating air speeds of over 75 miles per hour. They use suction forces to reduce the accuracy with which they must pinpoint objects. Theoretical predication indicates that the critical height is 4.8 cm considering the unevenness of the inner walls of air passages, which matches well with the experimental results. Inspired by the suction-aided gripping mechanism, we updated a general rigid gripper with a suction pipe, which can perform suction-aided grabbing. The use of aerodynamic forces can improve the success rate of grabbing by 76% compared with the original design. This work opens up a new way to fabricate robotic arms that has the capability of grabbing small fragile objects.

Poster WePM2:
Surface EMG-Based Evaluation of a PAM-Enabled Wrist Assist Glove

Das, Swagata	Hiroshima University, Higashi-Hiroshima city, Hiroshima Prefectu
Kurita, Yuichi	Hiroshima University

Abstracts: This paper demonstrates the evaluation of a proposed wrist assist glove using statistical analyses of surface EMG obtained from multiple subjects.

Poster WePM3: Fabric-Based Flat Pneumatic Actuators for Soft Assistive Glove Application

Yap, Hong Kai	National University of Singapore
Yeow, Chen-Hua	National University of Singapore

Abstracts:
We present the design of a fabric-based flat pneumatic actuators for soft assistive glove application. The soft assistive glove is designed to assist hand impaired patients in performing activities of daily living and rehabilitation. The actuators consist of flexible materials such as fabric and latex bladder. The actuators achieve bi-directional flexion and extension motions. Preliminary evaluation results show that the glove can provide both active finger flexion and extension assistance for activities of daily living and rehabilitative training.

Poster WePM4: Automatic Detection Method of Surgical Instrument and Vessel in Laparoscopic Surgery Images

Jo, Kyungmin	Asan Medical Center
Choi, Bareum	Asan Medical Center
Choi, Jaesoon	Asan Medical Center

Abstracts: In this paper, we propose a new technique to automatically detect surgical instruments and blood vessels in robot-assisted laparoscopic surgery images. The proposed method uses the concept of hessian matrix in the HSV color space to detect the edge, and the Otsu's method is used in the LAB color space to separate the surgical tool from the blood vessel. Real laparoscopic images were used and the processing speed was about 0.76 s at 1280p.	
Poster WePM5: LATRO: An Electro-Hydraulically Actuated Robotic Spider for Remote Characterisation and Retrievals	
Arvin, Farshad Telford, Mark Watson, Simon Cheah, Wei Green, Peter Carrasco, Joaquin Lennox, Barry	University of Manchester Forth University of Manchester The University of Manchester The University of Manchester The University of Manchester The University of Manchester
Abstracts: In this work, we introduce an electro-hydraulically actuated robot spider, Latro, which has been developed for remote characterisation in extreme environments. LATRO is a large, semi-autonomous mobile robot with cutting and grasping capabilities which will operate in either aboveground or underwater storage areas.	
Poster WePM6: Perpetual Robotic Swarm	
Arvin, Farshad Watson, Simon Turgut, Ali Emre Espinosa Mendoza, Jose Luis Krajnik, Tomas Lennox, Barry	University of Manchester University of Manchester University University of Manchester Faculty of Electrical Engineering, Czech TechnicalUniversity The University of Manchester
Abstracts: Swarm robotics is the study of the collective behavior of simple mobile robots resulting from long-term interactions among the members. Keeping a group of mobile robots fully functional requires a sufficient battery capacity, which is an issue for small size robots in scenarios over long durations. Various charging strategies, such as manual battery swapping or automated docking chargers have been implemented, which cause an interruption to the main task of a swarm. In this work, a low-cost on-the-fly charging system is proposed for use in swarm and multi robotic research studies. The system includes a charging pad with several individual charging cells and an inductive charging receiver attached to a mobile robot. To test the proposed system, a prototype charging pad with 12 charging cells that cover the entire arena was developed, along with a small	

mobile robot, Mona. A series of long-term, real-world robot experiments with different arenas and behavioral configurations has demonstrated the system's ability to support perpetual operation of a multi-robotic system.

Poster WePM7:
Autonomous Interactive Robot Learning

Aly, Ahmed	University of Virginia
Dugan, Joanne	University of Virginia

Abstracts:
Deep Learning techniques have been around for several years. There are many domains to which they have been applied such as Computer Vision. We present an exciting approach to combine Neural Networks and Robots. The aim is to gradually improve a robot's interaction with its environment as well as the neural net. Our approach is tested on a robot classifying everyday objects. Early results show that, under the guidance of a human coach, the robot can learn from its mistakes and improve future predictions.

Poster WePM8:
Model-Based Pose Tracking for 3D Shape Representation

Khin Kyu Kyu Win, Khin Kyu Kyu Win	Yangon Technological University

Abstracts:
With recent development in camera and sensor technology for 3D model, attentions on 3D shape representation and recognition are grater for research purpose. Efficient shape representation can be benefit in applications such as 3D search engine, robotics, CAD/CAM industry, etc. In this work, a method for finding the 3D shape from the pose of a tracked object is proposed. Assumption is that tracking and matching four non-coplanar feature points in the image can know the relative geometry on the object. The method combines three algorithms; the first algorithm, KLT track moving object in camera view; the second algorithm, POSIT use to estimate pose (in terms of rotation matrix and translation vector) of tracked object; the third algorithm, ICP use to register the shape of tracked object modeled by pose from POSIT and re-projected feature points in 3D space. Experimental test and results are illustrated and verified the results using ground truth data.

Poster WePM9:
Localization Method by TOF Laser Sensor for Mobile Robot

Usagawa, Daichi	Hiroshima city university
Kito, Takumi	Hiroshima city university
Sato, Kenjiro	Hiroshima City University
Iwaki, Satoshi	Hiroshima City University

Abstracts:
We propose a beacon method for a mobile robot navigated by a TOF laser sensor on a pan-tilt actuator in a base station, and apply the method to a motion teaching interface for a care-giver

robot. The position and orientation of the mobile robot can be estimated by measuring the pan-tilt angle, length of the laser beam as well as the laser spot position on a translucence screen equipped on the mobile robot using a camera. We built an experimental system composed of a differential wheeled robot with a Web camera, and evaluated the estimation errors.

Poster WePM10:
Soft Smoothly Rolling Wheel: Principle Verification

Tian, Yang	Ritsumeikan University
Ma, Shugen	Ritsumeikan University

Abstracts:
Soft mobile robots have several advantages except difficult to realize accurate control and low-speed motion. We propose a driving method using pneumatic actuators for soft wheel robot to archive high-speed motion without control. Furthermore, only one air bladder is utilized makes the structure of robot simple. Experiment results show that the control-less robot can achieve high speed (0.75m/s) with payload (592g).

Poster WePM11:
Dexclar: Dexterous, Reconfigurable, Modular Gripper for In-Hand Manipulation

Rahman, Nahian	Istituto Italiano Di Tecnologia
Canali, Carlo	Department of Advanced Robotics, Istituto Italiano di Tecnologia
Caldwell, Darwin G.	Istituto Italiano di Tecnologia
Cannella, Ferdinando	Istituto Italiano di Tecnologia

Abstracts:
In the last few decades, robotic grippers are developed by research community to solve grasping complexities of several objects as their primary objective. However, due to the increasing demands of industries, many issues are rising and remain unsolved such as in-hand manipulation, placing object with appropriate posture. Operations like twisting, altering orientation of object, in a hand, requires significant dexterity of the gripper that must be achieved from a compact mechanical design at the first place. This paper demonstrates kinematic analysis, validation and control method of a novel, modular, reconfigurable gripper, named Dexclar (DEXterous reConfigurable moduLAR); which is capable to change posture or orientation of plurality of object within in-hand, without an additional manipulator or external support. The gripper consists of four identical modular fingers, dexterous among all axes. Each modular finger of the gripper is conceived to the aim of satisfying efficient grasping, manipulation and also object release with accordance of desired posture. In this paper, the in-hand manipulation capabilities such as rotating, twisting, re-grasp are explained and synthesis analysis is described. A physical prototype and a control method have been developed to verify the central concept, several experiments have conducted and expected postures were achieved.

Poster WePM12:
Isolated Sensor Cluster Network Construction with UAVs

Kim, Myunggun	UNIST

Son, Hungsun	Ulsan National Institute of Science and Technology

Abstracts:
This paper presents an investigation of relayed network construction to collect data from isolated sensor cluster by using UAVs as communication relay. Static sensor cluster transmits data to distanced operating station with high data rate, and it could be easily isolated in disaster condition. Thus, the wireless network system constructed with UAVs is suggested in this research.

Poster WePM13:
Reducing the Number of Iterations in Pose Graph SLAM Optimisation

Harsányi, Károly	Hungarian Academy of Sciences Institute for Computer Science and
Kiss, Attila	Institute for Computer Science and Control of the Hungarian Acad
Majdik, Andras	Hungarian Academy of Sciences
Sziranyi, Tamas	MTA SZTAKI

Abstracts:
In this paper we propose a novel algorithm to compute the initial structure of pose graph based Simultaneous Localization and Mapping (SLAM) systems. We perform a Breadth-First Search (BFS) on the graph in order to obtain multiple votes regarding the location of a certain robot position from all of its processed neighbors. Next, we define the initial location of a pose as the average of the multiple alternatives. By adopting the proposed initialization approach the number of iteration needed for optimization is significantly reduced while the computational complexity remains lightweight. Initial results using generally accepted benchmark datasets show the advantages of the proposed method.

Poster WePM14:
Hybrid Model for Passive Locomotion Control of a Bipedal Robot

Mondal, Soumyarka	Morgan Stanley
Nandi, Gora Chand	IIIT, Allahabad

Abstracts:
The present research describes the development of a hybrid biped model using an analytical three link leg model as base model which produces approximate real-world trajectories and passive gait data have also been collected from the human subjects while walking down a slope. The pattern between the deviation of the actual trajectories and the base model generated trajectories have been found using a back propagation based artificial neural network architecture. It has been observed that this base model with learning based compensation enables the biped to better adapt in a real walking environment, showing better limit cycle behaviours.

Poster WePM15:
An Open-Source C++ Library for Robotics and Optimal Control

Neunert, Michael	ETH Zurich
Giftthaler, Markus	Swiss Federal Institute of Technology (ETH) Zurich,

	Switzerland
Pardo, Diego	ETH Zürich
Buchli, Jonas	ETH Zurich

Abstracts:
We introduce the "Robotics and Optimal Control Toolbox", an open-source C++ library developed for optimal control and trajectory optimization. The toolbox is designed for high efficiency and online control. This abstract outlines its general concept, its major building blocks and highlights selected application examples. A open-source pre-release including reference examples is provided.

Poster WePM16:
Semantic Labeling of Indoor Environments from 3D RGB Maps

Durner, Maximilian	German Aerospace Center DLR
Brucker, Manuel	German Aerospace Center
Ambrus, Rares	Royal Institute of Technology (KTH) Stockholm Sweden
	German Aerospace Center (DLR)
Marton, Zoltan-Csaba	Robert Bosch LLC, Research and Technology Center
Wendt, Axel Joerg	KTH - Royal Institute of Technology
	University of Freiburg
Jensfelt, Patric	Technical University Munich
Arras, Kai Oliver	
Triebel, Rudolph	

Abstracts:
We present an approach to automatically assign semantic labels to rooms reconstructed from 3D RGB maps of apartments. Evidence for the room types is generated using state of the art deep learning techniques for scene classification and object detection based on automatically generated virtual RGB views, as well as from a geometric analysis of the 3D structure of the map. The evidence is merged in a Conditional Random Field, using statistics mined from different datasets of indoor environments. We evaluate our approach qualitatively and quantitatively and compare to related methods. To address the lack of datasets containing complete 3D RGB maps of real-world apartments with ground truth labels, we will release the data we created and used for the experimental evaluation.

Poster WePM17:
Enhancing Situational Awareness for Teleoperation Tasks

Park, Sangsoo	Gwangju Institute of Science and Technology (GIST, Republic of K
Park, Sungjun	Gwangju Institute of Science and Technology (GIST)
	Chonnam national university
Lee, Hyunjin	Chonnam National University
Son, Hyoung Il	

Abstracts:
This paper introduced ongoing researches on situational awareness using psychophysical methodologies to improve the performance of teleoperation tasks.

Poster WePM18:
Design of an Underwater Drone for Bio-Logging

HAN, HyunTae	YAMAGATA University
Hiwatashi, Masaki	Yamagata University
Tsumaki, Yuichi	Yamagata University

Abstracts:
A research approach called bio-logging has been recently utilized in the investigation of animal behavior. Specifically, this method has been used to study the behavior of sperm whales. Zoologists have tried to observe the preying behavior of sperm whales by fixing a data logger (camera) to the whale's back. Such attempts have not been successful so far. To tackle this problem, we design an underwater drone that will be used to attach the camera to the mouth area of the sperm whale.

Poster WePM19:
Attentional RGB-D Object Detection for Mobile Robot Monitoring

Imamoglu, Nevrez	National Institute of Advanced Industrial Science and Technolgy
Shimoda, Wataru	University of Electro-Communications
Zhang, Chi	Jiangxi University of Finance and Economics
Kanezaki, Asako	National Institute of Advanced Industrial Science and Technology
Fang, Yuming	Jiangxi University of Finance and Economics
Nishida, Yoshifumi	National Institute of Advanced IndustrialScienceandTechnology

Abstracts:
Instead of processing the whole scene, previously,we demonstrated that space-based saliency (based on the changes detected) can improve CNN based semantic segmentation to focus only on novel region for robot monitoring system. Our initial evaluation for focused object detection is done on a data collected from mobile robot with an RGB-D sensor.Focusing on an area of attention can improve vision task rather than processing the whole scene. So, we can achieve improved detection and tracking for specific objects with focused CNN approach.Change based attentional cues can be successful if the environment is known. However, if the robot enters a new environment with no prior knowledge or if there is a sensory error in localization, change detection based saliency will not be reliable and change may not be the only needed attentional cues for observation. Therefore, to define focus area for CNN model, we are introducing multi-model saliency that integrates salient cues from bottom-up and top-down information from spatial and objectness based features. These bottom-up and top-down salient cues includes features obtained from color image, depth image, 3D data. And, we demonstrated that our multi-modal salient feature fusion can give very reliable attentional cues for object (e.g. human) detection and tracking in indoor environment for mobile robot monitoring. Our saliency maps resulted in better or close performance values compared to state-of-the-art models.

Poster WePM20:
Evaluation of Personal Characteristic on Stress in Autonomous Driving Passengers

Sawabe, Taishi Okajima, Tomoya Kanbara, Masayuki Hagita, Norihiro	Nara Institute of Science and Technology Nara Institute of Science and Technology Nara Institute of Science and Technology ATR

Abstracts:
Many of autonomous driving research focus on efficiency and safety. In order for the autonomous mobility to be accepted by passengers, they have to be perceived as safe and comfortable for passengers. Since perceived safety and comfort depend on each passengers' driving experience, habits, knowledge, personality, and preference. It is necessary to personalize the autonomous driving system to optimize its behavior for each passenger. But there are still few studies on personalization of autonomous driving, and there is not enough verification of what kind of difference caused by individual stress. In this study, we show the difference in individual passengers' stress objectively based on physiological measurements. By using these data to attempt classifying passengers by susceptibility to stress factors. We evaluate characteristics of passengers' stress actually obtained from experimental data using a robot wheelchair and physiological measurements.

Poster WePM21:
A Delay-conscious Communication Model for Mobile Robot Navigation

Kato, Yuka Tanaka, Mamiko	Tokyo Woman's Christian University Tokyo Woman's Christian University

Abstracts:
Recently, many studies have been made actively on robot services using computer networks, such as cloud robotics. These services are required to be conscious of uncertainty and instability of communication networks. Particularly for mobile robots, correspondence to delay in communication time and its variation is an important research topic. From these backgrounds, in this paper, we propose a delay-conscious communication model for remote navigation of mobile robots under cloud environment.

Poster WePM22:
Real-Time Perception Meets Reactive Motion Generation

Kappler, Daniel Meier, Franziska Issac, Jan Mainprice, Jim Garcia Cifuentes, Cristina Wüthrich, Manuel Berenz, Vincent Schaal, Stefan Ratliff, Nathan Bohg, Jeannette	Max-Planck Institute for Intelligent Systems Max Planck Institute for Intelligent Systems Max Planck Institute for Intelligent Systems Max Planck Institute Max Planck Institute for Intelligent Systems Max-Planck-Institute for Intelligent Systems Max Planck Institute for Intelligent Systems MPI Intelligent Systems & University of Southern California Lula Robotics Inc. Max-Planck Institute for Intelligent Systems

Abstracts:

We address the challenging problem of robotic grasping and manipulation in the presence of uncertainty. This uncertainty is due to noisy sensing, inaccurate models and hard- to-predict environment dynamics. Our approach emphasizes the importance of continuous, real-time perception and its tight integration with reactive motion generation methods. We present a fully integrated system where real-time object and robot tracking as well as ambient world modeling provides the necessary input to feedback controllers and continuous motion optimizers. Specifically, they provide attractive and repulsive potentials based on which the controllers and motion optimizer can online compute movement policies at different time intervals. We extensively evaluate the proposed system on a real robotic platform in four scenarios that exhibit either challenging workspace geometry or a dynamic environment. We compare the proposed integrated system with a more traditional sense-plan-act approach that is still widely used. In 333 experiments, we show the robustness and accuracy of the proposed system.

Poster WePM23:
BM-Arm: A Biologically Inspired Reconfigurable Cable Robot for the Study of Human Motion

Eden, Jonathan Paul	The University of Melbourne
SONG, Chen	The Chinese University of Hong Kong
Tan, Ying	The University of Melbourne
Oetomo, Denny	The University of Melbourne
Lau, Darwin	The Chinese University of Hong Kong

Abstracts:
Multi-link cable driven robots (MCDRs) have found increased application in the study of human motion due to the strong parallels between cable and muscle actuation. Existing MCDRs are typically limited in their capability to study a range of human-like motions, due to their use of fixed mechanism and cable structures and a lack of software compatibility. This poster presents the Bio-Muscular Arm (BM-Arm) as a reconfigurable bio-inspired MCDR that can be used in benchmarking different algorithms for the study of human motion. It is shown that the robot allows for reconfigurability through the use of 96 different possible base attachment locations as well as custom built arm sleeves which provide 28 different attachment locations on each link. Using the author's recently presented cable-robot analysis and simulation platform for research (CASPR), it is also shown that the BM-Arm can be simulated using a range of different algorithms for inverse dynamics, forward kinematics and control. Furthermore, online hardware implementation is also supported using a ROS-based extension of CASPR (CASPR-ROS) that can allow for hardware based benchmarking.

Poster WePM24:
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.

Poster WePM25:
Home Social Robots Sharing Indoor Activities with Friends: Field Study

Jeong, Kwangmin	Yonsei University
Kim, Aram	Yonsei University
Kim, Hyemi	Yonsei University
Lee, JeeHang	KAIST
Kim, Jinwoo	Yonsei University

Abstracts:
Population living alone has been rapidly increasing worldwide, resulting in the spread of social isolation and loneliness among these people. This study aimed to provide a solution to such predicament by home social robots designed to boost perceived social connectedness of users. We conducted the field study with 12 participants, building a smart home in their house with a few sensors and prototype robots to find whether these robots can mitigate social isolation and loneliness problems. The result exhibits participants experienced the increase of social interactions with friends while having little fatigue from communication or privacy concerns. It also shows robot interactions helped lower perceived distances to friends and silence in the house eventually lowering loneliness.

Poster WePM26:
Tacking Control of Sailboats Based on Force Polar Diagram

Sun, Qinbo	Central South University
Qiao, Zhuhan	Chinese University of Hong Kong(Shenzhen)
Strömbeck, Carl	Lund University, Faculty of Engineering
Qu, Yang	Wuhan University of Technology
QIAN, Huihuan	The Chinese University of Hong Kong, Shenzhen
Xu, Yangsheng	The Chinese University of Hong Kong

Abstracts:
Compared with past researches based on acquiring wind speed and direction by a wind sensor and controlling the system using a velocity polar diagram, an alternative way based on Force Polar Diagram (FPD) is proposed. The sail angle that produces the maximum forward force along the boat's heading is computed. The method is validated based on experiments in a wind controlled water pool. The maximum speed is increased by 56%, the time is shortened by 44%, and the motion agility is improved in an autonomous tacking motion.