

# AMC 2020

IEEE 16<sup>th</sup> International Workshop  
on Advanced Motion Control

September 14-16



IEEE



UiA University  
of Agder

## Welcome Message from AMC2020 General Co-Chairs

On behalf of the Organizing Committees and Industrial Electronics Society of the IEEE, it is our pleasure to welcome you to the IEEE International Workshop on Advanced Motion Control (AMC2020) on September 14-16, 2020 (postponed from April 20-22, 2020 due to COVID-19), at the University of Agder, Campus Kristiansand, in Norway. AMC2020 is 16th in a series of biennial international workshops on Advanced Motion Control, started in 1990 in Yokohama, Japan, and since there uniting an always young and enthusiastic research community grown around the omnipresent motion control technologies and applications. Following to the previous AMC2018 in Tokyo, Japan, our wish is to continue bringing together the researchers from both academia and industry and to maintain a highest scientific conference level, with enriching meetings and discussions and interesting and memorable events and experiences.

Kristiansand is chosen to host AMC2020 as the most southern part of Norway, with its beautiful nature, high integration of local industries, and the University of Agder as an important host for academic and applied research in the Agder region. Kristiansand down-town area is attractive and pleasant to discover for visitors, and the well-connected University Campus Kristiansand provides convenient and modern facilities for hosting the scientific workshops and conferences.

For preparing this event and bringing it to success, we would like to thank all volunteering members of the Organizing Committees for their readiness to serve and continuous contribution to AMC2020. We want to gratefully acknowledge the sponsoring societies and organizations: The Institute of Electrical and Electronics Engineers (IEEE), the IEEE Industrial Electronics Society (IES), and the University of Agder. We also deeply thank to the technical co-sponsors: Industry Applications Society of IEEE, Measurement & Automatic Control Society of VDI/VDE, and Mechatronics Innovation Lab.

The Technical Program Committee selected 57 papers from 17 countries worldwide, after a thorough review process of the all received manuscripts submitted to technical tracks and organized special sessions. Three invited plenary sessions and a frontier lecture will provide additional opportunities for stimulating and developing ideas and exciting scientific exchange in the motion control, its theories and applications.

Due to COVID-19 developments in August, we had, unfortunately, to change AMC2020 to a fully virtual online event. Despite this drastic change-over and being no longer able to warmly welcome our authors and guests in person in Kristiansand, all originally planned sessions of AMC2020 have been converted into digital space. We much value keeping same traditions of the chaired, moderated, and interactive sessions of AMC and organize the digital conference as life and online as possible, this way providing forum for discussions and active attendance of the presenters and auditorium. The digital AMC2020 is also accompanied by the social events and ceremonies, with speeches and announcements and, above all, original recorded music performances and tours.

We hope that the workshop will satisfy your highest intellectual and cultural expectations and wish you to enjoy all technical and social aspects of AMC2020.

Michael Ruderman  
University of Agder

Makoto Iwasaki  
Nagoya Institute of Technology

## AMC2020 Organizing Committees

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### Local arrangements Committee:

Anne Augland, University of Agder  
Leif Arne Løhaugen, University of Agder  
Morten Kjeld Ebbesen, University of Agder





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Alexey Pavlov  
Andrea Tilli  
Andreas Rauh  
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Andrew Fleming  
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Stanislav Aranovskiy  
Takahiro Nozaki  
Taro Takahashi  
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Tomoyuki Shimono  
Toshiaki Tsuji  
Toshimasa Miyazaki  
Valentin Ivanov  
Wataru Ohnishi  
Wen-Hua Chen  
Yasutaka Fujimoto  
Yoshiyuki Urakawa  
Yuki Yokokura  
Yutaka Uchimura

## General Information

### Conference Venue

University of Agder, Campus Kristiansand  
Universitetsveien 25, 4630 Kristiansand, Norway

### Registration Desk

Time: (initially 20-22.04.2020 from 08:00-16:00)  
Place: (initially University of Agder, Campus Kristiansand, B-building, in front of the main entrance)

### Wi-Fi connection

During the conference the free of charge internet Wi-Fi connection is available.

### Coffee breaks

All coffee breaks take place at the conference area, on the first floor close to Registration Desk.

### Lunch breaks

Lunches will be served in the Canteen, on the ground floor of main building.

### Welcome Reception

Time: Monday September 14th, 15:20-16:00 (initially April 20th, 18:00-20:00)  
Place: Digital Room A (initially Scandic Bystranda hotel)  
If you have signed up for Welcome Reception, please bring the ticket "Welcome Reception" given in your Participant Letter.  
One drinking unit and snacks are included. Additional drinks are at your own cost.

### Conference Social Event (initially Conference Dinner)

Time: Tuesday September 15th, 15:50-17:00 (initially April 21st, 19:00-23:00)  
Place: Digital Room A (initially Christiansholm Fortress)  
If you have signed up for Welcome Reception, please bring the ticket "Conference Dinner" given in your Participant Letter.  
Three-course dinner and 2 drinking units plus aperitif at the entrance are included. Additional drinks are at your own cost.

### Virtual tour (initially Cultural tour: Hunsfos Brewery)

Time: Wednesday September 16th, 12:50-13:30 (initially April 22nd, 13:10-16:00)  
Place: Digital Room B (initially Hunsfos Brewery, Vennesla)  
Bus from and back to the Campus Kristiansand; stops at the conference hotels on return.  
Guided tour at the brewery, beer tasting, and food.

### Technical tour: Mechatronics Innovation Lab

Time: Wednesday September 16th, 12:50-13:30 (initially April 22nd, 13:10-16:00)  
Place: Digital Room C (initially Campus Grimstad)  
Bus from and back to the Campus Kristiansand; stops at the conference hotels on return.  
Guided tour at the Mechatronics Innovation Lab in Campus Grimstad.

### Conference participants policies

All presentation and conference activities are conducted in the English language. The participants are obligated to carry the name badge. The participants are not expected to take pictures of or record the presentations, since it can violate consent from the presenters.

## Access to Campus Kristiansand

### Buses to/from Campus Kristiansand

There are several buses between the city center and Campus Kristiansand:

M1, M2, M3, M4, 12, 15, 19, 35, 36, 59.

Schedule of AKT public buses can be found: <https://www.akt.no/english/info-in-english/travel/>

We suggest taking a bus from "Kristiansand rutebilstasjon" to "Universitetet (Kristiansand)".

"Kristiansand rutebilstasjon" is about 5-10 min walking distance from the conference hotels.

You get off at Universitetet/Spicheren bus stop and walk about 3 min to the Campus B-building.

### Bus pass/tickets

You will find the valid period ticket for buses for all three conference days in the conference bag. Period ticket is not valid for the night bus, airport bus, and commercial express buses. The bus cards are touchless smart cards; you must hold the bus card over the card reader, upon the entrance to the bus, until the reader screen lights up green.

### On foot

If the weather permits, it is possible to walk to Campus from the city center; this would take about 40-45 minutes.

## Taxi

Taxi can be ordered on the following numbers:

Taxi Sør +47 38 02 80 00

Agder Taxi +47 07000

## Emergency

In case of emergency, following numbers are to be used:

Fire 110

Police 112

Ambulance 113

## Insurance

Participants of AMC2020 are advised to take out their own insurance in case of emergency illness or lost baggage. The conference registration fees DO NOT include any provisions for the insurance of participants against personal injuries, sickness, and theft or property damage.

## Currency

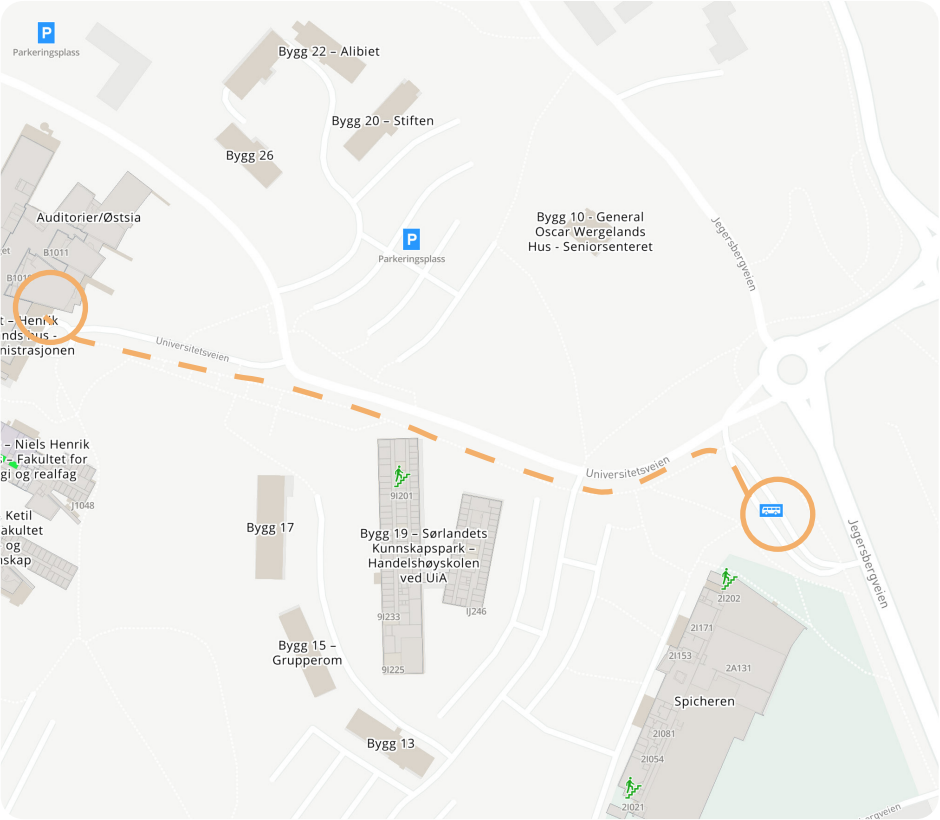
The official currency is Norwegian Krone (NOK).

All major credit cards are accepted in the most hotels, stores, and restaurants.

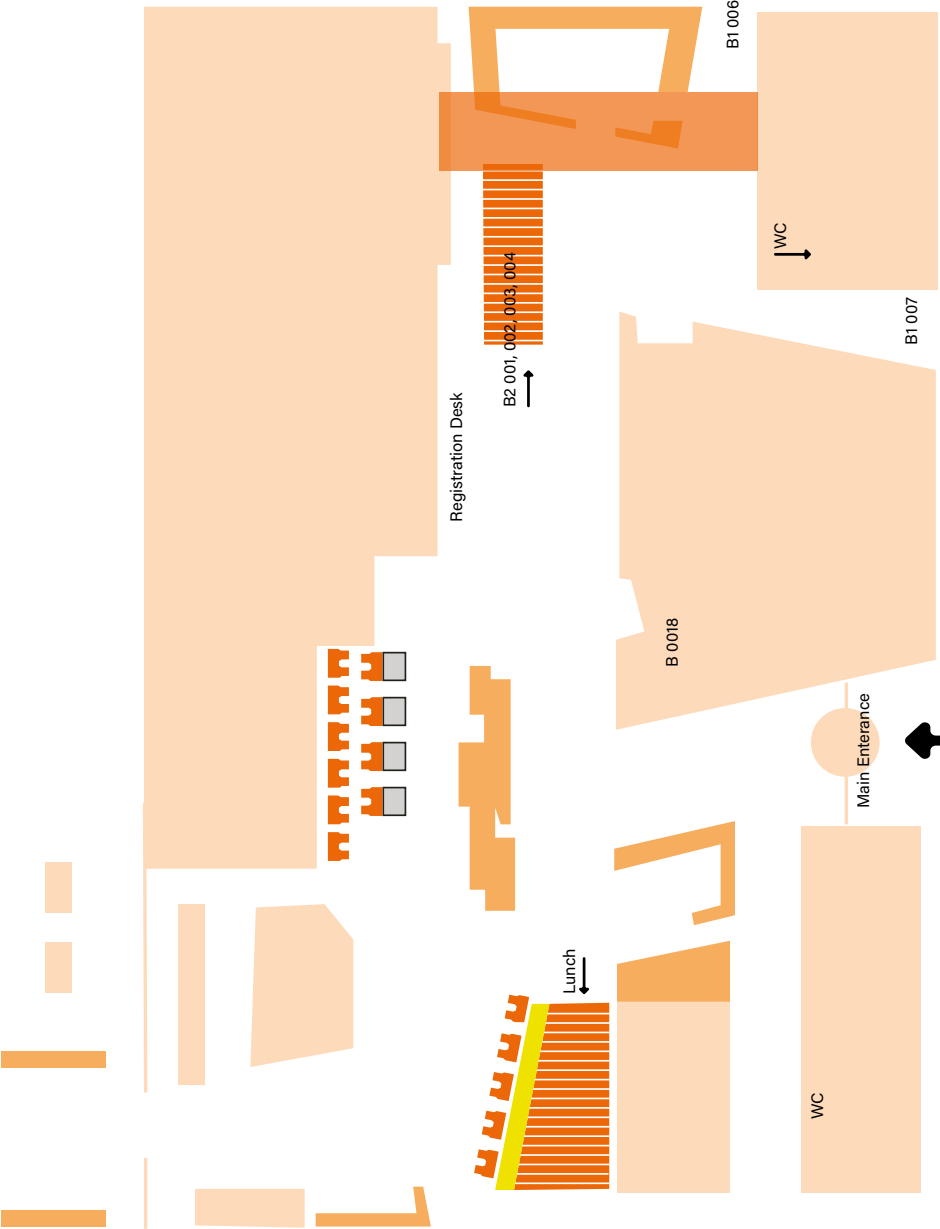
## Power Supply

230V AC, 50 Hz

Busstop to main entrance



Orientation and Campus



## Workshop Program Overview

### Monday, September 14, 2020

9:00-9:10, Room A Opening Ceremony	
9:10-10:00, Room A Plenary Session I	
10:00-10:10, Coffee break (individual)	
10:10-11:50, Room B TT – Robotics and mechatronics	10:10-11:50, Room C SS – Soft motion for advanced human-robot- interaction – I
11:50-12:30, Lunch break (individual)	
12:30-13:20, Room A Frontier Lecture	
13:20-13:30, Coffee break (individual)	
13:30-15:10, Room B TT – Complex dynamics and nonlinear control	13:30-15:10, Room C SS – Soft motion for advanced human-robot- interaction – II
15:10-15:20, Coffee break (individual)	
15:20-16:00, Room A Welcome Reception	

### Tuesday, September 15, 2020

09:00-10:40, Room B TT – Motion control – I	09:00-10:40, Room C SS – Smart precision motion control in mechatronic systems
10:40-10:50, Coffee break (individual)	
10:50-12:30, Room B TT – Motion control – II	10:50-12:30, Room C TT – Force control, haptics, and HMI – I
12:30-13:10, Lunch break (individual)	
13:10-14:50, Room B TT – Motion control – III	13:10-14:50, Room C TT – Force control, haptics, and HMI – II
14:50-15:00, Coffee break (individual)	
15:00-15:50, Room A Plenary session II	
15:50-17:00, Room A Conference Social Event	

### Wednesday, September 16, 2020

9:00-9:50, Room A Plenary session III	
9:50-10:00, Coffee break (individual)	
10:00-11:40, Room B TT – Automotive and vehicular motion systems	10:00-11:40, Room C SS – Intelligent sensing applications for human assistive systems
11:40-12:10, Room A Closing Ceremony	
12:10-12:50, Lunch break (individual)	
12:50-13:30, Virtual Tour	12:50-13:30, Technical Tour

### Attending digital AMC2020

Virtual online AMC2020 takes place in a digital space, in the scheduled Rooms A, B, and C. All registered AMC2020 participants receive access to the digital space for all conference sessions. The scheduled Coffee and Lunch breaks are individual, and there are no activities in the digital rooms. All AMC2020 sessions are chaired and moderated. During the presentations, the microphones are on mute for auditorium, while during the questions and discussions round the session chairs give word to audience and moderate the digital podium. Each digital room has a technical assistance for broadcasting the pre-recorded presentations on time. All presentations in the technical track and special sessions are scheduled for 20 min timeslot each, and the plenary sessions and frontier lecture are scheduled for 50 min timeslot each. The auditorium can also use chat functionality to pass questions to the presenters. The digital sessions will be recorded and made available online after the conference.



# Invited Speakers

## Plenary Session I

### Discussion on sensing and actuating to support human activities from a view point of intelligent space



**Prof Hideki Hashimoto**  
Chuo University

#### Abstract:

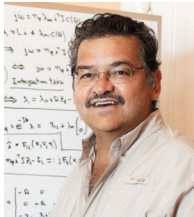
When I started my research works with a name of Intelligent Space, the main idea was "We should use our technologies to support our human activities with keeping good health conditions." It means that the intelligent space should understand human behaviors and to provide proper physical support by using robotics. The Intelligent Space is focusing to fuse IT and Robotics in our daily life. I believe that such research direction is still important even if actual state of ongoing intelligent space is remaining in lower stages. In this talk I will show some current results of monitoring human health conditions, assisting human mobilities and elementary technologies for actuators from a view point of Intelligent Space to discuss our important research issues.

#### Biography:

Hideki Hashimoto (IEEE Fellow, SICE Fellow, RSJ Fellow) received the B.S., M.S. and Dr. of Engineering from the Department of Electrical Engineering, University of Tokyo in 1981, 1984 and 1987 respectively. He joined the Institute of Industrial Science of the University of Tokyo as a lecturer in April of 1987. He was an associate professor from July of 1990 until March of 2011. He has been a professor at Dept. of Electrical, Electronics and Communication Engineering, Chuo University, Tokyo, Japan since April of 2011. He was a visiting scientist at LIDS (Laboratory for Information and Decision System) and LEES (Laboratory for Electromagnetic and Electronic Systems) of MIT from September of 1989 to August of 1990. He was an Invited Distinguished Professor at Seoul National University from 2009 to 2012, and a Visiting Professor at Budapest University of Technology and Economics from 2009 to 2011. He is a visiting professor at Budapest University of Technology and Economics from 2014. He was the founding general chair of 1997 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM). He was a program chair of IEEE/RSJ IROS in 1988 and 2000, and a general chair of IEEE ITS Conference in 2002 and IECON 2015. His research topics are Intelligent Space, Intelligent Systems, Mechatronics, Robotics and Control.

## Penary Session II

### Parameter estimation and gradient descent-based observers: application to mechanical and electromechanical systems



**Prof  
Romeo Ortega**  
Department of  
Digital Systems,  
ITAM

#### Abstract:

In the first part of the talk we present a new approach to state observation, called Parameter Estimation-based Observers (PEBO) whose main idea is to translate the state estimation problem into one of estimation of constant, unknown parameters. The class of systems for which is applicable is identified via two assumptions related to the transformability of the system into a suitable cascaded form and our ability to estimate the unknown parameters. The first condition involves the solvability of a partial differential equation while the second one requires some persistency of excitation-like conditions. We present also PEBO in a unified framework together with the – by-now classical – Kasantzis-Kravaris-Luenberger and Immersion and Invariance observers. In the second part we show that, for systems for which a linear regression-like relation is available, it is possible to combine PEBO with a new estimation technique called Dynamic Regressor Extension and Mixing (DREM). This new technique, called DREMBAO, is used to generate adaptive observers. PEBO and DREMBAO are shown to be applicable to position estimation of a class of electromechanical systems – including motors and MagLev systems – and for speed observation of a class of mechanical systems. The performance of these observers is compared with high-gain and sliding mode observers. As expected, it is shown that – in the presence of noise – the performance of the two latter designs is significantly below par with respect to the other techniques.

#### Biography:

Romeo Ortega was born in Mexico. He obtained his BSc in Electrical and Mechanical Engineering from the National University of Mexico, Master of Engineering from Polytechnical Institute of Leningrad, USSR, and the Docteur D`Etat from the Polytechnical Institute of Grenoble, France in 1974, 1978 and 1984 respectively. He then joined the National University of Mexico, where he worked until 1989. He was a Visiting Professor at the University of Illinois in 1987-88 and at McGill University in 1991-1992, and a Fellow of the Japan Society for Promotion of Science in 1990-1991. He was a member of the French National Research Council (CNRS) from June 1992 to July 2020, where he was a "Directeur de Recherche" in the Laboratoire de Signaux et Systemes (CentraleSupélec) in Gif-sur-Yvette, France. Currently, he is a full time Professor at ITAM in Mexico City, Mexico. His research interests are in the fields of nonlinear and adaptive control, with special emphasis on applications. Dr Ortega has published five books and more than 350 scientific papers in international journals, with an h-index of 84. He has supervised more than 35 PhD thesis. He is a (Life) Fellow Member of the IEEE since 1999 (Life 2020) and an IFAC Fellow since 2016. He has served as chairman in several IFAC and IEEE committees and participated in various editorial boards of international journals. He is currently Editor in Chief of Int. J. Adaptive Control and Signal Processing and Senior Editor of Asian Journal of Control.

## Plenary Session III

### Vision for robotics



**Prof  
Annette Stahl**  
Norwegian  
University of  
Science and  
Technology  
(NTNU)

#### Abstract:

Reproducing the capabilities of visual sensing that one can find in nature would provide a very powerful and highly desired tool for robots. Ideally this enables a robot to perceive and interpret its surrounding so that it can use this information to execute different tasks within a real world environment. As robots operate in various environments (indoors, in space, in air, underwater) equipped with different sets of visual sensing devices (standard cameras, time-of-flight cameras, structured light cameras, hyperspectral imager) this makes the generic "interpretation of the world around a robot" very challenging. In this presentation I wish to introduce you to certain aspects within the world of "robotic vision" - where we try to teach machines to understand, plan and act in an intelligent way. In particular we will be concerned with how robots might build concepts about objects, understand relations between objects and understand the 3D structure of the surrounding world. The analysis of motion in the world of a robot is also an integral part of this understanding and important for many robotic control tasks.

#### Biography:

Annette Stahl is Head of the Robotic Vision Group at the Department of Engineering Cybernetics at the Norwegian University of Science and Technology – NTNU, Norway. She is also an Affiliated Scientist of the Center of Excellence for Autonomous Marine Operations and Systems – NTNU AMOS. She received her PhD degree from the University of Heidelberg, Germany in applied mathematics with the main focus on computer vision applications in relation to variational methods for motion estimation using physical prior knowledge. She spent two years as a postdoc at the School of Computing, Dublin City University – DCU, Ireland and three years at the Department of Mathematical Sciences, NTNU, Norway, where she worked on isogeometric analysis based methods for graphics and visualization. After this period she worked as a researcher at the High Performance Computing Group at NTNU and at SINTEF Ocean, Norway, where she was concerned with computer vision based aquaculture applications. In 2016, her was awarded an Onsager Fellowship from NTNU's Research Excellence. She is currently working within the field of robotic vision targeting underwater, on sea surface, on land, in air and space as well as indoor and industrial related robotic applications.

## Frontier Lecture

### Learning for advanced motion control



**Prof  
Tom Oomen**  
Eindhoven  
University of  
Technology

#### Summary:

Do you also have a motion system that has the same error in each task? Iterative Learning Control (ILC) can achieve perfect performance for your system. A general learning framework is presented that exploits measured error signals from previous tasks. By employing very simple models, both fast and safe learning is achieved, guaranteeing a reduction of the error in each experiment. Typically, perfect performance is achieved in only five to ten iterations. A complete design framework for motion systems is provided, while at the same time touching upon the essential theoretical foundations, including non-causality of the optimal design and the connection to traditional feedback and feedforward designs. Finally, recent approaches are explored that facilitate the implementation on industrial systems, including flexibility for a large class of tasks and multivariable systems.

#### Biography:

Tom Oomen received the M.Sc. degree (cum laude) and Ph.D. degree from the Eindhoven University of Technology, Eindhoven, The Netherlands. He held visiting positions at KTH, Stockholm, Sweden, and at The University of Newcastle, Australia. Presently, he is associate professor with the Department of Mechanical Engineering at the Eindhoven University of Technology. He is a recipient of the Corus Young Talent Graduation Award, the IFAC 2019 TC 4.2 Mechatronics Young Research Award, the 2015 IEEE Transactions on Control Systems Technology Outstanding Paper Award, the 2017 IFAC Mechatronics Best Paper Award, the 2019 IEEE Journal of Industry Applications Best Paper Award, and recipient of a Veni and Vidi personal grant. He is Associate Editor of the IEEE Control Systems Letters (L-CSS), IFAC Mechatronics, and IEEE Transactions on Control Systems Technology. He is a member of the Eindhoven Young Academy of Engineering. His research interests are in the field of data-driven modeling, learning, and control, with applications in precision mechatronics.

# Technical Program

## Monday 14 September

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### Opening Ceremony: Opening Ceremony

Room: Room A  
Day: Monday 14 September  
Time: 09:00  
Duration: 10 minutes

#### Chair

Michael Ruderman

### Plenary Session I

Room: Room A  
Day: Monday 14 September  
Time: 09:10  
Duration: 50 minutes

#### Discussion on sensing and actuating to support human activities from a view point of intelligent space

#### Speaker

Prof Hideki Hashimoto, Chuo University, Japan

#### Chair

Makoto Iwasaki

### Oral Session: TT – Robotics and mechatronics

Room: Room B  
Day: Monday 14 September  
Time: 10:10  
Duration: 80 minutes

#### Chairs

Arne Wahrburg and Kenta Seki

### Papers

#### Time:10:10

**Title:** ND-000353. Extending Dynamic Movement Primitives towards High-Performance Robot Motion

#### Authors:

Dr. Arne Wahrburg, ABB Corporate Research, Germany  
Mr. Simone Guida, Politecnico di Milano, Italy  
Dr. Nima Enayati, ABB Corporate Research, Germany  
Prof. Andrea M. Zanchettin, Politecnico di Milano, Italy  
Prof. Paolo Rocco, Politecnico di Milano, Italy

#### Time:10:30

**Title:** ND-000035. Development of Pushing Control Mechanisms for Generator Inspection Robot

#### Authors:

Mr. Hiroaki Kuwahara, TOSHIBA Corporation, Japan  
Mr. Kazuma Hiraguri, TOSHIBA Corporation, Japan  
Dr. Fujio Terai, TOSHIBA Energy Systems and Solutions Corporation, Japan

#### Time:10:50

**Title:** ND-000345. Distributed Interpolation: Synchronization of motion-controlled axes with coordination vector and decentralized segment controllers

#### Authors:

Ms. Caren Dripke, Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW), University of Stuttgart, Germany  
Mr. Daniel Schoebel, Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW), University of Stuttgart, Germany  
Prof. Alexander Verl, Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW), University of Stuttgart, Germany

#### Time:11:10

**Title:** ND-000957. Collaborative Transport by Mecanum Mobile Robots using Reaction Torque Observer

#### Authors:

Mr. Maximilien Tsuji, Keio University, Japan  
Prof. Toshiyuki Murakami, Keio University, Japan



## Oral Session: SS

### – Soft motion for advanced human-robot-interaction – I

Room: Room C  
Day: Monday 14 September  
Time: 10:10  
Duration: 100 minutes

#### Chairs

Tomoyuki Shimono and Sehoon Oh

#### Papers

##### Time:10:10

**Title:** ND-001023. Development of Compact Linear Actuator Combining DC motor and Cylindrical Cam for Tactile Display

##### Authors:

Dr. Sakahisa Nagai, The University of Tokyo, Japan  
Prof. Atsuo Kawamura, Yokohama National University, Japan

##### Time:10:30

**Title:** ND-000698. A High-Torque Density Compliant Actuator Design for Physical Robot Environment Interaction

##### Authors:

Mr. Evan Dunwoodie, Uow, Australia  
Dr. Rahim Mutlu, Uow, Australia  
Dr. Barkan Ugurlu, Ozu, Turkey  
Mr. Mehmet Yildirim, Ozu, Turkey  
Dr. Tarik Uzunovic, Uos, Bosnia and Herzegovina  
Dr. Emre Sariyildiz, Uow, Australia

##### Time:10:50

**Title:** ND-000477. Human-Adaptive Impedance Control Using Recurrent Neural Network for Stability Recovery in Human-Robot Cooperation

##### Authors:

Ms. Misaki Hanafusa, Tokyo Denki University, Japan  
Prof. Jun Ishikawa, Tokyo Denki University, Japan

##### Time:11:10

**Title:** ND-001163. Novel Algorithm for Position/Force Control of Multi-DOF Robotic Systems

##### Authors:

Prof. Tarik Uzunovic, University of Sarajevo - Faculty of Electrical Engineering, Bosnia and Herzegovina  
Prof. Asif Sabanovic, International University of Sarajevo, Bosnia and Herzegovina  
Mr. Minoru Yokoyama, Yokohama National University, Japan  
Prof. Tomoyuki Shimono, Yokohama National University, Japan

##### Time:11:30

**Title:** ND-001279. Transparent Torque Sensor-less Impedance Rendering for Low-cost Direct Drive Motor

##### Authors:

Mr. Chan Lee, Dgist, Korea (South)  
Mr. Sangjin Bae, Dgist, Korea (South)  
Mr. Woosong Kang, Dgist, Korea (South)  
Prof. Sehoon Oh, Dgist, Korea (South)

## Frontier Lecture

Room: Room A  
Day: Monday 14 September  
Time: 12:30  
Duration: 50 minutes

### Learning for Advanced Motion Control

#### Speaker

Prof. Tom Oomen, Eindhoven University of Technology, Netherlands

#### Chair

Alexey Pavlov

## Oral Session: TT – Complex dynamics and nonlinear control

Room: Room B  
Day: Monday 14 September  
Time: 13:30  
Duration: 100 minutes

### Chair

Christian Fredrik Sætre

### Papers

#### Time:13:30

**Title:** ND-000515. Event-Triggered Sliding Mode Control Strategies for Positioning Systems: An Experimental Assessment

#### Authors:

Dr. Andrej Sarjaš, University of Maribor, Slovenia  
Prof. Martin Steinberger, Graz University of Technology, Austria  
Prof. Dušan Gleich, University of Maribor, Slovenia  
Prof. Martin Horn, Graz University of Technology, Austria

#### Time:13:50

**Title:** ND-000906. Fractional-Order System Identification of Viscoelastic Behavior: A Frequency Domain Based Experimental Study

#### Authors:

Ms. Daniela Kapp, TU Ilmenau, Germany  
Mr. Christoph Weise, TU Ilmenau, Germany  
Prof. Michael Ruderman, University of Agder, Norway  
Prof. Johann Reger, TU Ilmenau, Germany

#### Time:14:10

**Title:** ND-000728. On Orbital Stabilization as an alternative to Reference Tracking Control

#### Authors:

Mr. Christian Fredrik Sætre, NTNU, Norway  
Prof. Anton Shiriaev, NTNU, Norway

#### Time:14:30

**Title:** ND-001309. A Fractional-Order Control Approach to Ramp Tracking with Memory-Efficient Implementation

#### Authors:

Mr. Christoph Weise, TU Ilmenau, Germany  
Mr. Rafael Tavares, University of Agder, Norway  
Dr. Kai Wulff, TU Ilmenau, Germany  
Prof. Michael Ruderman, University of Agder, Norway  
Prof. Johann Reger, TU Ilmenau, Germany

#### Time:14:50

**Title:** ND-000892. Regulation of Penetration Rate and Drilling Power in Rotary Drilling Systems

#### Authors:

Mr. Maksim V. Faronov, Western University, Canada  
Dr. Ilia G. Polushin, Western University, Canada

### Oral Session: SS

#### - Soft motion for advanced human-robot-interaction - II

Room: Room C  
Day: Monday 14 September  
Time: 13:30  
Duration: 100 minutes

#### Chairs

Sehoon Oh and Tarik Uzunovic

### Papers

#### Time:13:30

**Title:** ND-001171. Development and Basic Analysis of Novel Flexible Linear Motor

#### Authors:

Mr. Hiroshi Asai, Kanagawa Institute of Industrial Science and Technology, Japan  
Prof. Tomoyuki Shimono, Yokohama National University, Kanagawa Institute of Industrial Science and Technology, Japan  
Ms. Tomoe Deguchi, KRI Incorporated, Japan  
Mr. Yasuhisa Fujii, KRI Incorporated, Japan  
Mr. Hitoshi Yamamoto, KRI Incorporated, Japan  
Prof. Kouhei Ohnishi, Haptics Research Center, Kanagawa Institute of Industrial Science and Technology, Japan

#### Time:13:50

**Title:** ND-000205. Soft Boom Cylinder Control Using Disturbance-Observer-Based Equivalent Hydraulic System for Electric Excavator

#### Authors:

Mr. Rintaro Nakano, Nagaoka University of Technology, Japan  
Prof. Kiyoshi Ohishi, Nagaoka University of Technology, Japan  
Prof. Yuki Yokokura, Nagaoka University of Technology, Japan

**Time:14:10**

**Title:** ND-000604. An Approach to Force Control by Model Predictive Velocity Control with Constraints

**Authors:**

Mr. Takashi Ohhira, Keio University, Japan  
Prof. Toshiyuki Murakami, Keio University, Japan

**Time:14:30**

**Title:** ND-000752. A Method to Make a Robot Understand What was a Target Object in Motion Copying System

**Authors:**

Mr. Xiaobai Sun, Keio University, Japan  
Dr. Takahiro Nozaki, Keio University, Japan  
Prof. Toshiyuki Murakami, Keio University, Japan  
Prof. Kouhei Ohnishi, Keio University, Japan

**Time:14:50**

**Title:** ND-001295. Ripple Minimization for Harmonic-gear Series Elastic Actuator under Force Control

**Authors:**

Mr. Woosong Kang, Dgist, Korea (South)  
Mr. Chan Lee, Dgist, Korea (South)  
Mr. Sangin Bae, Dgist, Korea (South)  
Prof. Sehoon Oh, Dgist, Korea (South)

**Welcome Reception: Welcome Reception**

Room: Room A  
Day: Monday 14 September  
Time: 15:20  
Duration: 40 minutes

## Tuesday 15 September

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**Oral Session: TT - Motion control - I**

Room: Room B  
Day: Tuesday 15 September  
Time: 09:00  
Duration: 100 minutes

**Chairs**

Tomoyuki Shimono and Enzo Evers

**Papers**

**Time:09:00**

**Title:** ND-001147. Feedback Controller Design Based on H-infinity Control Theory in Dynamically Substructured System

**Authors:**

Mr. Ryo Ishibashi, Nagoya Institute of Technology, Japan  
Prof. Kenta Seki, Nagoya Institute of Technology, Japan  
Prof. Makoto Iwasaki, Nagoya Institute of Technology, Japan

**Time:09:20**

**Title:** ND-000175. Experimental comparison of velocity estimators for a control moment gyroscope inverted pendulum

**Authors:**

Dr. Dmitry Sokolov, Université de Lorraine, France  
Dr. Stanislav Aranovskiy, CentraleSupélec - IETR, France  
Mr. Alexander Gusev, Kuban State University, Russian Federation  
Dr. Igor Ryadchikov, Kuban State University, Russian Federation

**Time:09:40**

**Title:** ND-000531. Controller design of mass flow rate loop for high-precision pneumatic actuator

**Authors:**

Ms. Shirato Yui, The University of Tokyo, Japan  
Prof. Ohnishi Wataru, The University of Tokyo, Japan  
Prof. Fujimoto Hiroshi, The University of Tokyo, Japan  
Prof. Koseki Takafumi, The University of Tokyo, Japan  
Prof. Hori Yoichi, The University of Tokyo, Japan

**Time:10:00**

**Title:** ND-000442. A simple quasi-LPV approach to control design of an industrial wind turbine

**Authors:**

Mr. Ali Poureh, Niroo Research Institute, Iran  
Mr. Omid Bazzaz, Niroo Research Institute, Iran

**Time:10:20**

**Title:** ND-001015. Multi-System Iterative Learning Control: an Extension of ILC for Interconnected Systems.

**Authors:**

Mr. Daniele Ronzani, Department of Mechanical Engineering, KU Leuven - DMMS lab, Flanders Make, Belgium  
Dr. Armin Steinhauser, Department of Mechanical Engineering, KU Leuven - DMMS lab, Flanders Make, Belgium  
Prof. Jan Swevers, Department of Mechanical Engineering, KU Leuven - DMMS lab, Flanders Make, Belgium

**Oral Session: SS****- Smart precision motion control in mechatronic systems**

Room: Room C  
Day: Tuesday 15 September  
Time: 09:00  
Duration: 80 minutes

**Chairs**

Kenta Seki and Tom Oomen

**Papers****Time:09:00**

**Title:** ND-000744. On Frequency Response Function Identification for Advanced Motion Control

**Authors:**

Mr. Enzo Evers, Eindhoven University of Technology, Netherlands  
Dr. Robbert Voorhoeve, Eindhoven University of Technology, Netherlands  
Dr. Tom Oomen, Eindhoven University of Technology, Netherlands

**Time:09:20**

**Title:** ND-000124. Resonant Frequency Damping Disturbance Observer based Robot Servo System

**Authors:**

Mr. Akinori Yabuki, National Institute of Technology, Ishikawa College, Japan  
Prof. Toshiyuki Kanmachi, National Institute of Technology, Ishikawa College, Japan  
Prof. Kiyoshi Ohishi, Nagaoka University of Technology, Japan  
Prof. Toshimasa Miyazaki, Nagaoka University of Technology, Japan  
Prof. Yuki Yokokura, Nagaoka University of Technology, Japan  
Prof. Itaru Ando, National Institute of Technology, Akita College, Japan

**Time:09:40**

**Title:** ND-000701. Suppressing Position-Dependent Disturbances in Repetitive Control: With Application to a Substrate Carrier System

**Authors:**

Mr. Noud Mooren, Eindhoven University of Technology, Netherlands  
Dr. Gert Witvoet, Eindhoven University of Technology, Netherlands  
Mr. Ibrahim Acan, Sioux CCM B.V., Netherlands  
Mr. Joep Kooijman, Sioux CCM B.V., Netherlands  
Dr. Tom Oomen, Eindhoven University of Technology, Netherlands

**Time:10:00**

**Title:** ND-000558. Vibration Amplitude Suppression Control of Industrial Machine Driven at Resonance Frequency

**Authors:**

Mr. Hikaru Sato, Nagaoka University of Technology, Japan  
Mr. Toshimasa Miyazaki, Nagaoka University of Technology, Japan  
Mr. Yoshihisa Hojo, Toyo Denki Seizo K.K., Japan

**Oral Session: TT - Motion control - II**

Room: Room B  
Day: Tuesday 15 September  
Time: 10:50  
Duration: 60 minutes

**Chairs**

Andrej Sarjas and Bastiaan Vandewal



## Papers

### Time:10:50

**Title:** ND-001155. Proposal of Automatic Power Plug Insertion Control for Electric Vehicle with In-Wheel-Motors

### Authors:

Mr. Daiki Kusuyama, The University of Tokyo, Japan  
Mr. Tomoki Emmei, The University of Tokyo, Japan  
Prof. Hiroshi Fujimoto, The University of Tokyo, Japan  
Prof. Yoichi Hori, The University of Tokyo, Japan

### Time:11:10

**Title:** ND-001112. 3K Compound Planetary Reduction Gearbox With Non-backlash Mechanism

### Authors:

Mr. Satoru Oba, Yokohama National University, Japan  
Prof. Yasutaka Fujimoto, Yokohama National University, Japan

### Time:11:30

**Title:** ND-001198. Basic Study on Regenerative Air Brake Using Observer-based Thrust Control for Electric Airplane

### Authors:

Mr. Kentaro Yokota, The University of Tokyo, Japan  
Prof. Hiroshi Fujimoto, The University of Tokyo, Japan  
Prof. Yoichi Hori, The University of Tokyo, Japan

## Oral Session: TT – Force control, haptics, and HMI – I

Room: Room C  
Day: Tuesday 15 September  
Time: 10:50  
Duration: 100 minutes

### Chairs

Toshiaki Tsuji and Gudmundur Gunnarsson

## Papers

### Time:10:50

**Title:** ND-001139. Contact Force Control Based on Force Estimation in Bimorph-type Piezoelectric Actuators

### Authors:

Prof. Kenta Seki, Nagoya Institute of Technology, Japan  
Mr. Yuya Sakuragi, Nagoya Institute of Technology, Japan  
Prof. Makoto Iwasaki, Nagoya Institute of Technology, Japan

### Time:11:10

**Title:** ND-001236. Verification of Double Hand Teleoperation System Using Haptic Forceps Robots and LCLM Platform

### Authors:

Dr. Takuya Matsunaga, Kanagawa Institute of Industrial Science and Technology, Japan  
Prof. Tomoyuki Shimono, Yokohama National University, Japan  
Prof. Kouhei Ohnishi, Keio University, Japan

### Time:11:30

**Title:** ND-001252. Experimental Setup for a Novel Mechanical Force Generator

### Authors:

Mr. Mehmet Burak Ekinci, Tubitak, Turkey  
Prof. Ulas Yaman, Middle East Technical University, Turkey  
Prof. Reşit Soylu, Middle East Technical University, Turkey

### Time:11:50

**Title:** ND-000655. Coactivation Method of Antagonistic Muscle Pairs Using Common and Differential Modes for Functional Electrical Stimulation Control

### Authors:

Ms. Akari Takada, Keio University, Japan  
Mr. Akira Hirata, Keio University, Japan  
Prof. Seiichiro Katsura, Keio University, Japan

### Time:12:10

**Title:** ND-000574. Minimum-Energy State Determination of an Underactuated Suction Cup Gripper Grid

### Authors:

Mr. Gudmundur G. Gunnarsson, University of Southern Denmark, Denmark  
Prof. Henrik G. Petersen, University of Southern Denmark, Denmark

### Oral Session: TT – Motion control – III

Room: Room B

Day: Tuesday 15 September

Time: 13:10

Duration: 100 minutes

#### Chairs

Daniele Ronzani and Seiichiro Katsura

#### Papers

##### Time:13:10

**Title:** ND-000213. Path Planning for Perception-Driven Obstacle-Aided Snake Robot Locomotion

#### Authors:

Dr. Kristian G. Hanssen, Sintef Digital, Norway

Dr. Aksel A. Transeth, Sintef Digital, Norway

Dr. Filippo Sanfilippo, University of Agder, Norway

Dr. Pål Liljebäck, Eelume AS, Norway

Prof. Øyvind Stavdahl, Norwegian University of Science and Technology, Norway

##### Time:13:30

**Title:** ND-000736. Basic Idea of Quadrant Dynamic Programming for Adaptive Cruise Control to Create Energy Efficient Velocity Trajectory of Electric Vehicle

#### Authors:

Mr. Mitsuhiro Hattori, The University of Tokyo, Japan

Prof. Hiroshi Fujimoto, The University of Tokyo, Japan

##### Time:13:50

**Title:** ND-000418. Motion Control of Large Inertia Loads Using Electrohydrostatic Actuation

#### Authors:

Mr. Petter Goytil, University of Agder, Norway

Dr. Damiano Padovani, University of Agder, Norway

##### Time:14:10

**Title:** ND-001244. Obstacle Avoidance in Path Following using Local Spline Relaxation

#### Authors:

Mr. Bastiaan Vandewal, MECO Research Team, Department of Mechanical Engineering, KU Leuven and DMMS lab, Flanders Make, Leuven, Belgium

Dr. Joris Gillis, MECO Research Team, Department of Mechanical Engineering, KU Leuven and DMMS lab, Flanders Make, Leuven, Belgium

Mr. Erwin Rademakers, Core Lab MotionS, Flanders Make, Lommel, Belgium

Prof. Goele Pipeleers, MECO Research Team, Department of Mechanical Engineering, KU Leuven and DMMS lab, Flanders Make, Leuven, Belgium

Prof. Jan Swevers, MECO Research Team, Department of Mechanical Engineering, KU Leuven and DMMS lab, Flanders Make, Leuven, Belgium

##### Time:14:30

**Title:** ND-000116. Robust Controller Design for Ball Screw Drives with Varying Resonant Mode via  $\mu$ -synthesis

#### Authors:

Mr. Tiancheng Zhong, Southeast University, China

Dr. Wencheng Tang, Southeast University, China

### Oral Session: TT – Force control, haptics, and HMI – II

Room: Room C

Day: Tuesday 15 September

Time: 13:10

Duration: 60 minutes

#### Chair

Toshimasa Miyazaki

#### Papers

##### Time:13:10

**Title:** ND-000566. Feature Extraction and Generation of Robot Writing Motion Using Encoder-Decoder Based Deep Neural Network

#### Authors:

Mr. Masahiro Kamigaki, Keio University, Japan

Prof. Seiichiro Katsura, Keio University, Japan

**Time:13:30**

**Title:** ND-000612. Admittance Control Based on a Stiffness Ellipse for Rapid Trajectory Deformation

**Authors:**

Mr. Masahide Oikawa, Saitama University, Japan  
Mr. Kyo Kutsuzawa, Saitama University, Japan  
Prof. Sho Sakaino, University of Tsukuba, Japan  
Prof. Toshiaki Tsuji, Saitama University, Japan

**Time:13:50**

**Title:** ND-001201. Standing Assistance Control based on Voluntary Body Movement within Safety Tolerance

**Authors:**

Prof. Daisuke Chugo, Kwansei Gakuin University, Japan  
Mr. Masahiro Yokota, Kwansei Gakuin University, Japan  
Prof. Satoshi Muramatsu, Tokai University, Japan  
Prof. Sho Yokota, Toyo University, Japan  
Prof. Jin-Hua She, Tokyo University of Technology, Japan  
Prof. Hiroshi Hashimoto, Advanced Institute of Industrial Technology, Japan  
Mr. Takahiro Katayama, Rt.Works Co., Ltd, Japan  
Dr. Yasuhide Mizuta, Rt.Works Co., Ltd, Japan  
Mr. Atsushi Koujina, Rt.Works Co., Ltd, Japan

**Plenary Session II**

Room: Room A  
Day: Tuesday 15 September  
Time: 15:00  
Duration: 50 minutes

**Parameter estimation and gradient descent-based observers:  
application to mechanical and electromechanical systems**

**Speaker**

Prof Romeo Ortega

**Chair**

Michael Ruderman

**Reunion: Conference Social Event**

Room: Room A  
Day: Tuesday 15 September  
Time: 15:50  
Duration: 70 minutes

**Organizer**

Elisabeth Rasmussen

## Wednesday 16 September

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**Plenary Session III**

Room: Room A  
Day: Wednesday 16 September  
Time: 09:00  
Duration: 50 minutes

Vision for robotics

**Speaker**

Prof Annette Stahl

**Chair**

Hiroshi Fujimoto

**Oral Session: TT – Automotive and vehicular motion systems**

Room: Room B  
Day: Wednesday 16 September  
Time: 10:00  
Duration: 80 minutes

**Chair**

Jan Swevers

## Papers

**Time:10:00**

**Title:** ND-001317. Offline and Online Tyre Model Reconstruction by Locally Weighted Projection Regression

### Authors:

Mr. Kunal Iyer, Delft University of Technology, Netherlands  
Dr. Barys Shyrokau, Delft University of Technology, Netherlands  
Dr. Valentin Ivanov, Technische Universitaet Ilmenau, Germany

**Time:10:20**

**Title:** ND-000469. Cooperative Adaptive Cruise Control Algorithms for Vehicular Platoons Based on Distributed Model Predictive Control

### Authors:

Ms. Tugba Tapli, AVL Research and Engineering, Turkey  
Prof. Mehmet Akar, Bogazici University, Turkey

**Time:10:40**

**Title:** ND-000779. Modeling and field-experiments identification of vertical dynamics of vehicle with active anti-roll bar

### Authors:

Mr. Rafael Tavares, University of Agder, Norway  
Prof. Michael Ruderman, University of Agder, Norway  
Mr. Daan Menjoie, DRiV Tenneco Automotive BVBA, Belgium  
Dr. Joan Vazquez Molina, DRiV Tenneco Automotive BVBA, Belgium  
Mr. Miguel Dhaens, DRiV Tenneco Automotive BVBA, Belgium

**Time:11:00**

**Title:** ND-000647. Real-Time Model Predictive Control for a Parallel Hybrid Electric Vehicle using Outer Approximation and Semi-Convex Cut Generation

### Authors:

Mr. Massimo De Mauri, KU Leuven, Belgium  
Dr. Joris Gillis, KU Leuven, Belgium  
Prof. Jan Swevers, KU Leuven, Belgium  
Prof. Goele Pipeleers, KU Leuven, Belgium

## Oral Session: SS

### - Intelligent sensing applications for human assistive systems

Room: Room C

Day: Wednesday 16 September

Time: 10:00

Duration: 100 minutes

### Chairs

Hiroshi Igarashi and Sota Shimizu

## Papers

**Time:10:00**

**Title:** ND-000264. Energy Analysis Method and Walking Simulation with Exoskeleton Assistive Devices

### Authors:

Mr. Kaiki Fukutoku, Keio University, Japan  
Mr. Kentaro Ominato, Keio University, Japan  
Mr. Atsushi Hiraoka, Keio University, Japan  
Mr. Maximilien Tsuji, Keio University, Japan  
Prof. Toshiyuki Murakami, Keio University, Japan

**Time:10:20**

**Title:** ND-000027. Remote Control Method with Tactile Sensation for Underwater Robot with Magnetic Coupling

### Authors:

Prof. Naoki Motoi, Kobe University, Japan  
Mr. Shoki Nakamura, Kobe University, Japan

**Time:10:40**

**Title:** ND-000582. Space-variant Color Point Cloud Measurement System - Enormous Data Reduction using Saliency Map -

### Authors:

Prof. Sota Shimizu, Shibaura Institute of Technology, Japan  
Ms. Yu Fujita, Shibaura Institute of Technology, Japan  
Mr. Naoaki Kameyama, Shibaura Institute of Technology, Japan  
Prof. Nobuyuki Hasebe, Waseda University, Japan



**Time:11:00**

**Title:** ND-001228. Road and Intersection Detection Using Convolutional Neural Network

**Authors:**

Mr. Ryuki Higuchi, Yokohama National University, Japan  
Prof. Yasutaka Fujimoto, Yokohama National University, Japan

**Time:11:20**

**Title:** ND-000981. Haptic Interface for Virtual Reality based on Hybrid Cable-Driven Parallel Robot

**Authors:**

Mr. Bastien Poitrimol, Tokyo Denki University, Japan  
Prof. Hiroshi Igarashi, Tokyo Denki University, Japan

---

**Closing Ceremony**

Room: Room A  
Day: Wednesday 16  
September  
Time: 11:40  
Duration: 30 minutes

**Chair**

Michael Ruderman

**Reunion:  
Virtual Tour**

Room: Room B  
Day: Wednesday 16  
September  
Time: 12:50  
Duration: 40 minutes

**Organizer**

Elisabeth Rasmussen

**Reunion:  
Technical Tour**

Room: Room C  
Day: Wednesday 16  
September  
Time: 12:50  
Duration: 40 minutes

**Organizer**

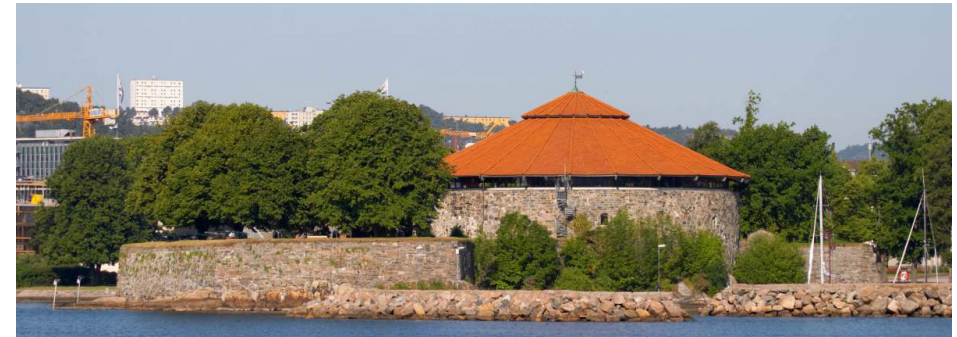
Michael Ruderman

## Social Program (initial)



### Welcome reception

will be held at Scandic Bystranda hotel, on Monday 20 April from 18:00 to 20:00. All registered participants are welcome to a drink and snack in a pleasant atmosphere of get together. The welcome reception will be accompanied by life music and greeting words.



### Conference banquet

will be held at Christiansholm Fortress, on Tuesday 21 April from 19:00 to 23:00. The historical Christiansholm fortress is located middle in the downtown area of Kristiansand, with a beautiful seaside view on the bay, and opens with interior and courtyard for the event. All registered participants are welcome to enjoy the evening and authentic Norwegian food, in a relaxed agreeable atmosphere accompanied by a music performance, also by conference awards ceremony and announcements.

## Technical Tour (changed to digital)



The registered participants are welcome to the guided tour through the facilities of Mechatronics Innovation Lab (MIL) on Wednesday afternoon, 22 April. The bus will take the participants from Campus Kristiansand and, afterwards, bring you back while also stopping at the AMC2020 conference hotels.

MIL is a technology catapult for innovation, piloting and technology qualification within mechatronics and related areas. It offers access to technologies, competence and connection to a broad network of partners.

## Cultural Tour (initial, substituted by Virtual Tour)



The registered participants are welcome to a guided tour at Hunsfos Business Park followed by a historical view of Hunsfos Factories and beer tasting at the Hunsfos Brewery in Vennesla on Wednesday afternoon, 22 April. The bus will take the participants from Campus Kristiansand and, afterwards, bring you back while also stopping at the AMC2020 conference hotels.

“Beer tasting with a touch of history” – behind the old walls of Hunsfos Paper Factory participants are invited to taste various local beer with a sense of the old atmosphere.





# AMC 2020

IEEE 16<sup>th</sup> International Workshop  
on Advanced Motion Control



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