Human Movement Understanding for Intelligent Robots and Systems

Format
Specify the duration (half day/full day): Full-Day

Preferred date

☐ October 25, 2020
☐ October 29, 2020
☐ Either October 25 or October 29

Main Organizer

- **Emel Demircan**
  California State University Long Beach (CA), USA
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  Experience: Co-Chair of Human Movement Understanding

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  Honda R&D, Japan
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  Experience: Co-Chair of Human Movement Understanding

Sponsorship
As the workshop organizers, we consider involving CyberSens Inc. to support our workshop proposal and provide support to enhance the workshop experience. The co-organizer is the CEO of CyberSens and would like to sponsor lunch during the workshop.
Objectives

Robotics research has drawn much inspiration from humans as a system: in the design of the anthropomorphic aspects of manipulators, sensors, and actuators, the higher level strategies for coordinating complex full body motion tasks, and interacting with the external environment and other humans. Today, robotics as a field has matured to the point where methodologies developed and used in robotics may be leveraged to address research questions in many other fields, ranging from neuroscience to computer animation. Together with the tools from biomechanics, robotics enables our efforts to explore natural human motion, leading to improvements in treatments for patients with neuromusculoskeletal disorders, and facilitating development of human-inspired robots. Using robotics methods and control theory, we aim at gaining fundamental insight into natural human movement, and understanding the mechanisms that lead to improved quality of treatment and rehabilitation. Using biomechanics, we aim at exploring the relationships between muscle mechanics, form, and function, and creating subject-specific dynamics simulations to explain the causes of movement abnormalities. Through this workshop, we intend to create a focal point for this emerging interdisciplinary research field, facilitate dissemination within both the robotics and biomechanics research fields, and share it with the broader scientific community.

Our Technical Committee: Human Movement Understanding is composed of four co-chairs, each of whom is active in the US, Europe and Asia, conducting advanced research in educational institutions and in industry, and extending our community in each location. Therefore, we have access to the highest quality content such that attendees get the most out of the expected exchanges of ideas. The main objectives of the proposed TC are as follows:

1. Application of advanced computational tools to:
   a) Characterize natural human motion and the higher level strategies of its realization of complex tasks and in interacting with the external environment
   b) Develop tools for characterizing changes in human motion due to disease, aging or injury, to facilitate applications in rehabilitation and prosthesis and exoskeleton design
   c) Predict behavior and synthesize human-like motions.
2. Development of strategies for human motion reconstruction on engineered anthropomorphic systems, such as the humanoid, mobile manipulators, and simulated systems.
3. Human motion generation and task learning, including but not limited to: the strategies of generalization of learned tasks to the learning of new tasks, resolution of human motor redundancy, human strategies in handling constraints.

Topics of interest

- Natural motion generation in humanoid robotics
- Human multibody dynamics modeling
- Musculoskeletal dynamics, simulation, and control
• Motion reconstruction techniques
• Human motion analysis
• Human motion synthesis
• Kinematic modeling of the human body
• Dynamic modeling of the human body
• Whole-body dynamics identification
• Motion segmentation
• Optimal control techniques for predicting efficient movement patterns
• Motion recognition
• Computer animation/graphics
• Neuromuscular control (as affected by injury, aging, or training)
• Robotics-based motion synthesis
• Human motor control
• Subject-specific simulation in the identification and treatment of movement pathology
• Patient specific modeling of joint kinematics
• Computational modeling to understand musculoskeletal disorders
• Novel therapies for neurological disorders
• Design and simulation of assistive devices
• Understanding and manipulating neuromuscular function with electrical stimulation
• Virtual reality and character animation

Intended audience
The workshop targets researchers from rehabilitation, workplace ergonomics, sports medicine, orthopaedics, physical therapy, humanoid robotics, entertainment robotics, computer animation, and machine learning. Especially, the workshop aims to bring experts from different field together, exchange a fruitful discussion between these communities and inspire researchers to create new idea. Social network channels will be opened and used to advertise the workshop. Link to the website of this workshop will be opened in TC: Human Movement Understanding to advertise this workshop. To enhance discussion and interaction between experts and early-career researchers, we encourage experts to communicate with early-career researchers during their poster session. To increase the level of interaction between researchers, active discussion and further communication on the website will be maintained before and after the workshop.

Expected attendance
Our Technical Committee: Human Movement Understanding is composed of four co-chairs, each of whom is active in the US, Europe and Asia, conducting advanced research in educational institutions and in industry, we have enough resource to advertise this workshop all over the world through our technical committee. We will announce this workshop on our web site “https://www.ieee-ras.org/human-movement-understanding”. We expect to gather 70 listeners.
Invited Speakers (Both confirmed and/or tentative)

- Taizo Yoshikawa, Honda R&D Japan (Co-organizer)
- Viktor Losing, Honda Research Institute EU (Project member of Co-organizer Yoshikawa: confirmed)
- Martina Hasenjaeger, Honda Research Institute EU (Project member of Co-organizer Yoshikawa: confirmed)
- Tomohiro Shibata, Kyushu Institute of Technology (confirmed)
- Ko Yamamoto, University of Tokyo (confirmed)
- Honda R&D Japan Frontier Robotics Physical Assist Project (confirmed)
- Emel Demircan, California State University Long Beach (confirmed)
- Arash Ajoudani, IIT (confirmed)
- Etienne Burdet, Imperial College London (pending)
- Auke Ijspeert, EPFL (confirmed)
- Katja Mombaur, University of Waterloo (confirmed)

Relationship to the conference proper
This workshop aims to bring experts from different field together, exchange a fruitful discussion between these communities and inspire researchers to create new idea. …

Other workshops
As the co-chair of TC on Human Movement Understanding, we organized a workshop at every IEEE IROS/ICRA since 2014.

Structure of the event
Please see the program below and the confirmed speakers.
Hello Taizo,

how are you doing?

I would love to speak at the workshop. I think if the paper is declined, than the talk can be done there. Otherwise we can discuss when the decision is made whether I present another topic, or skip the talk.

Enjoy your weekend and take care

Cheers,
Viktor
Endorsement

Our workshop is supported by the IEEE RAS Technical Committee on Human Movement Understanding.
Program

<table>
<thead>
<tr>
<th>Time</th>
<th>Talk</th>
<th>Comments</th>
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<tbody>
<tr>
<td>9:00 – 9:10</td>
<td>Introduction</td>
<td>Emel Demircan</td>
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<tr>
<td>9:10 – 9:40</td>
<td>Talk 1</td>
<td>Taizo Yoshikawa</td>
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<tr>
<td>9:40 – 10:10</td>
<td>Talk 2</td>
<td>Viktor Losing</td>
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<td>10:10 – 10:30</td>
<td>Coffee break</td>
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<tr>
<td>10:30 – 11:00</td>
<td>Talk 4</td>
<td>Martina Hasenjaeger</td>
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<tr>
<td>11:00 – 11:30</td>
<td>Talk 5</td>
<td>Tomohiro Shibata</td>
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<td>11:30 – 12:00</td>
<td>Talk 6</td>
<td>Ko Yamamoto</td>
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<td>12:00 – 13:30</td>
<td>Lunch Break</td>
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<tr>
<td>13:30 – 14:00</td>
<td>Talk 7</td>
<td>Honda R&amp;D Japan Frontier Robotics</td>
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<td>Physical Assist</td>
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<td>14:00 – 14:30</td>
<td>Talk 8</td>
<td>Emel Demircan</td>
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<tr>
<td>14:30 – 15:00</td>
<td>Talk 9</td>
<td>Arash Ajoudani</td>
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<td>15:00 – 15:30</td>
<td>Coffee Break</td>
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<td>15:30 – 16:00</td>
<td>Talk 9</td>
<td>Etienne Burdet</td>
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<td>16:00 – 16:30</td>
<td>Talk 10</td>
<td>Auke Ijspeert</td>
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<td>16:30 – 17:00</td>
<td>Talk 11</td>
<td>Katja Mombaur</td>
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<tr>
<td>17:00</td>
<td>Conclusion</td>
<td>TC HMU Chairs</td>
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Equipment
In addition to the provided projector and screen, we need the following equipment during the workshop:

- One wearable microphone: for the speaker during presentations.
- Pointer
- Four portable microphones: two for the panelists during the panel discussion and two for the audience during presentations and panel discussion.