2020 IEEE/RSJ

International Conference on
Intelligent Robots and Systems(IROS)

October 25-29, 2020 Las Vegas, NV, USA

Sponsors

RSJ · IEEE Robotics & Automation Society · ies
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Theme: Consumer Robotics and Our Future

Ergonomic Human-Robot Collaboration: Opportunities and Challenges

Format
Online meeting, October 30, 2020

Webpage

https://hri.iit.it/news/organizations/iros2020-workshop

Main Organizer
Wansoo Kim, Post-doc (*primary contact*)

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Co-organizers
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Sponsorship (if applicable, max. 400 words)

Objectives (max. 600 words)

In many industrial countries, work-related musculoskeletal disorders (WMSD) are associated with high costs to employers such as lost productivity, worker's compensation costs, and so on. WMSD risk factors include awkward posture, repetition, mechanical compression, vibration, etc. To tackle such risk factor, a workplace ergonomics assessment comprises of intervention descriptions for WMSD and the intervention strategy for reducing, eliminating, or controlling worker exposure to the WMDS risk factor. These measures aim to ensure the workers' health and safety. Human-Robot Collaboration (HRC) a promising concept that can potentially help with maintaining and improving ergonomics and working conditions of human co-workers. However, the traditional HRC technologies mostly focus safety in terms of collision avoidance and impact safety, while ergonomics potential is largely under-exploited. Therefore, some of the major challenges and opportunities to exploit such potential are: collaborative robots have to be aware of co-worker's state and predict his/her actions; the interactive motion has to be able to reconfigure the human working conditions; the methods must operate online.

The above-mentioned challenges and opportunities present a novel research topic for the community. We previously organized two successful workshops to establish the field and to discuss this topic. First, we held a workshop at ICRA 2018 to introduce and discuss the concept in terms of collaborative robotics. Then we held a continuation workshop at IROS 2019 to review the initial research progress based on the goals set at the first workshop and identify major ongoing research problems. Now it is time to discuss those problems and come up with solutions to make progress towards robust and applicable methods for ergonomic human-robot collaboration.

The proposed workshop will first review the progress of the research and development in the new field that was achieved since the last workshop at IROS 2019. Next, we will focus on how to solve the problems that emerged during the research and development based on the goals that were set at the previous workshop. In addition, we will discuss potential novel research directions, ergonomic metric and robot control methods. Finally, we will discuss and design new validation methods that can be used for objective benchmarking within the field. Such an approach requires experts from various research fields and interdisciplinary discussion. For this purpose we assemble a diverse set of organizers and speakers, who are leading experts in their respective areas that are highly relevant to this workshop topic.

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Topics of interest

- Physical Human-Robot Collaboration
- Ergonomics
- Human Modelling
- Adaptation and Learning
- Industrial Robots
- Exoskeleton Robots
- Physical Interaction Control
- Wearable Sensors
- Feedback Devices
- Shared Control

Intended audience (max. 400 words)

One of the main topics in robotics research is physical human-robot collaboration, with broad applications in manufacturing, household and medical settings. The workshop should, therefore, be of general interest to a broad audience within the robotic community. The workshop focuses on experts in the fields of human-interaction, control and learning, human and humanoid modeling and ergonomics, as the workshop topic specifically concerns their expertise.

While the workshop topic is focused at addressing a specific line of research, it directly concerns several important fields: (1) industrial robotics, where the human-robot collaboration has an enormous potential and human working conditions are relevant (2), humanoid and service robotics, where robots are to work in human environment and should collaborate with humans in ergonomic manner, (3) wearable robotic devices, where human and robot are physically coupled and ergonomic posture and motion is important.

Expected attendance

Based on similar workshops organized by our team in the past (e.g., IROS2019, ICRA 2018, IROS 2017), we estimate around 60-80 attendants.

- "Progress in Ergonomic Physical Human-Robot Collaboration", IROS2019, by Wansoo Kim, et al., November 8, 2019, Macau, China [web: https://hri.iit.it/news/organizations/iros-2019-workshop],

- "Ergonomic Physical Human-Robot Collaboration", ICRA2018, by Luka Peternel, et al., May 21, 2018, Brisbane, Australia [web: https://hri.iit.it/news/organizations/icra-2018-workshop], and

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- "Learning for Collaborative Robotics: Enabling Flexible, Redeployable and Agile Industrial Applications" IROS 2017, Canada [web: http://www.mobilemanipulation.org/cobots-IROS-2017/].

To attract the intended audience, we will advertise the workshop through various channels. An international workshop organizing team was assembled to maximize the connections to audiences around the world. The advertisements will be sent to our partners in international projects, (e.g. H2020: SOPHIA-GA871237, etc.). The workshop will be advertised in complementary human-robot interaction workshops in the upcoming conferences. In addition, electronic media will be used for invitations, such as: E-mail (personal, "robotics-world-wide", etc.), "LinkedIn", "ResearchGate", "Facebook", etc.

Invited Speakers

All invited speakers confirmed their participation through personal correspondence by e-mail. Each speaker is an expert in their research fields that are relevant to the workshop topic.

- **Serena Ivaldi,** Tenured researcher

affiliation: National Institute for Research in Computer Science and Control (Inria), France
e-mail: serena.ivaldi@inria.fr
title: "Prediction and optimization for ergonomics movement in human-robot collaboration"

- **Bram Vanderborght,** Professor

affiliation: Vrije Universiteit Brussel, Belgium
e-mail: bram.vanderborght@vub.ac.be
title: "Improving workers' ergonomics by cobots and exoskeletons"

- **Freek Stulp,** Head of Department

affiliation: German Aerospace Center (DLR), Germany
e-mail: Freek.Stulp@dlr.de
title: "Ergonomic Task-Level Programming by Demonstration"

- **Heni Ben Amor,** Assistant Professor

affiliation: Arizona State University, USA
e-mail: hbenamor@asu.edu
title: "*to be updated*

All speaker confirmation e-mail are attached to a supplementary file.

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Relationship to the conference proper (max. 300 words)

The ergonomics in human-robot collaboration is a relatively new field and there are no regular sessions dedicated specifically to this topic. Nevertheless, ergonomics of the human worker is a very important aspect of any industrial process, therefore it should be addressed in growing research and application of collaborative robots. Regular sessions dedicated to general human-robot collaboration usually lack the contribution from experts in fields of human factors, ergonomics and medicine. Therefore, we believe that this topic is presently suited for a dedicated workshop within the conference.

Other workshops

Not applicable

Structure of the event (max. 300 words)

The organizers and invited speakers are recognized experts in the field that are relevant to the workshop and can therefore discuss the key topics of interest. Each session will begin with a presentation introducing our point of view. The organizers will give a brief introduction about the workshop topic, objectives and main points to be considered. In addition, some of the organizers will present their progress of the research that is initiated in the previous workshop. The invited speakers will present their own view on the relevant set of topics and help to complement the feasibility of potential aspects. The poster session will be scheduled additional short-form speaking by the selected contributors, to allow the workshop's participations to trigger the discussion. In the end, there will be a round table discussion where the organizers, the invited speakers and the workshop attendants will discuss on how to incorporate the potential novel ergonomic factors where is raised during the workshop that can be used within human-robot collaboration framework.

Endorsement

- IEEE-RAS TC on Human Movement Understanding
- IEEE-RAS TC on Wearable Robotics
- IEEE-RAS TC on Robot Learning
- IEEE-RAS TC on Human-Robot Interaction & Coordination

Letters of support are attached to a supplementary file.

Program

We aim for a *virtual online* workshop. During the workshop, each speaker will be given 25 minutes for the talk and subsequent 5 minutes after the talk will be allocated for questions and discussion. Each selected contributor will be given 5 minutes for promoting the interactive poster session. At the end of the talks, there will be a round table discussion (approx. 30 min.).

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Time	Description
08.00 - 08.10	Introduction by the organizers
08.10 – 08.40	Talk 1 by **Prof. Dr. Lars Fritzsche**
08.40 – 09.10	Talk 2 by **Prof. Heni Ben Amor**
09.10 – 09.40	Talk 3 by **Dr. rer. nat. Freek Stulp**
09.40 – 10.10	Talk 4 by **Prof. Luka Peternel**
10.10 – 10.20	Coffee break
10.20 – 10.40	Short paper presentation (3-5min. each)
10.40 – 11.10	Talk 5 by **Dr. Wansoo Kim and Dr. Arash Ajoudani**
11.10 – 11.40	Talk 6 by **Prof. Bram Vanderborght (Presented by Dr. ir. Ilias El Makrini)**
11.40 – 12.10	Talk 8 by **Dr. Eiichi Yoshida**
12.10 – 12.40	Talk 9 by **Dr. Serena Ivaldi**
12.40 – 13.10	Round Table Discussions

Contributions

We will welcome prospective participants to submit extended abstracts (up to 4 pages) to be presented as posters. The manuscripts should use the IEEE IROS two-column format. A PDF copy of manuscript should be submitted through our EasyChair platform. Each paper will receive a minimum of two reviews. The papers will be selected based on their originality, relevance to the workshop topics, contributions, technical clarity, and presentation. Accepted papers require that at least one of the authors register to the workshop, and has to prepare the interactive poster session, it has two components: a 3-minute spotlight pitch and a 30-minute interactive presentation.

- Submission deadline: 1st of August 2020
- Notification of acceptance: 1st of September 2020

Dissemination

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In the round-table discussion the organizers will present the conclusions and results of the workshop based on the discussed topics. Talks and posters/papers will be uploaded on the workshop website(**https://hri.iit.it/news/organizations/iros2020-workshop**). The organizers will compose an extended abstract after the workshop, which will be based on the talks, posters and input from the discussion during the workshop. The extended abstract will be published on the workshop website. A special issue based on the workshop in a relevant robotics journal will be considered.

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Supplementary file
IEEE-RAS TECHNICAL COMMITTEE LETTERS OF SUPPORT:

- **IEEE-RAS TC on Human Movement Understanding**

12th of March 2020

IEEE Robotics & Automation Society

Letter of Support

Dear Dr. Wansoo Kim,

The TC on Human Movement Understanding finds that the proposed IROS'20 workshop: "Ergonomic Human-Robot Collaboration: Opportunities and Challenges" is well-aligned with the interests and scope of the community represented by the TC and therefore supports the organization of the workshop.

We wish you a successful workshop.

Sincerely Yours,

Emel Demircan

Chair of the IEEE RAS TC on Human Movement Understanding

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- **IEEE-RAS TC on Wearable Robotics**

IEEE
**Robotics &
Automation**
Society

Paris, March 12th, 2020

Letter of support

The **IEEE/RAS Technical Committee (TC) on Wearable Robotics** fully supports the workshop proposal entitled "***Ergonomic Human-Robot Collaboration: Opportunities and Challenges*** " submitted to the IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS 2020**).

This workshop proposal attempts to bring together experts from various research and application fields to discuss potential novel research directions, ergonomic metric and robot control methods. Design and new validation methods that can be used for objective benchmarking within the field of human-Robot collaboration will be also discussed.

The TC on Wearable Robotics finds that the objectives of the workshop proposal are well aligned with the interests and scope of the TC.

We wish you a successful workshop.

Faithfully,
On behalf of the IEEE/RAS TC on Wearable Robotics

Samer Mohammed, PhD
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Web: http://www.ieee-ras.org/wearable-robotics

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- **IEEE-RAS TC on Robot Learning**

To the members of the Organizing Committee of IROS 2020

On behalf of the chairs of the IEEE RAS Technical Committee on Robot Learning, it is a great pleasure for me to recommend the workshop "Ergonomic Human-Robot Collaboration: Opportunities and Challenges" proposed by Dr. Wansoo Kim and his co-organizers to your upcoming conference. We have been aware of their research activities and sincerely recognize the importance of the proposed topic.

Robot learning recently covers many topics related to the application of machine learning methods to robotics, e.g., teaching by demonstration, reinforcement learning, navigation, and tactile manipulation. Machine learning methods and statistical models are promising frameworks for increasing the autonomy of robots. Physical collaboration with humans is one of the areas where robot learning is essential to enable robots to adapt to their human co-workers, but also faces major challenges in ensuring the safety and comfort of them, as well as having to deal with huge uncertainties inherent to human behavior. The this would be the third edition of a successful workshop, each focusing on different aspects of ergonomic human-robot collaboration.

From this point of view, the topic of the workshop, i.e., physical human-robot cooperation, is a core topic for robot learning and can be considered to be a very suitable topic for IROS 2020.

The organizers and the invited speaker are leading researchers on this subject. We believe that having this workshop in IROS 2020 must be an excellent opportunity not only for researchers related to the robot learning but also for many participants of the conference.

We wholeheartedly recommend this workshop for your favorable consideration.

Sincerely

Jens Kober

Jens Kober

Co-chair, IEEE-RAS Technical Committee on Robot Learning

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- **IEEE-RAS TC on Human-Robot Interaction & Coordination**

National Institute of
Advanced Industrial Science
and Technology
AIST

March 14th, 2020

Letter of Support for the IROS 2020 Proposed Workshop on "Ergonomic Human-Robot Collaboration: Opportunities and Challenges"

To Whom It May Concern:

As one of the Co-Chairs of the IEEE Robotics and Automation's Technical Committee on Human-Robot Interaction & Coordination, I would like to support the initiative of Wansoo Kim, Luka Peternel, Arash Ajoudani, and Eiichi Yoshida concerning their submission of the workshop proposal "Ergonomic Human-Robot Collaboration: Opportunities and Challenges" to the IEEE Intl Conference on Intelligent Robots and Systems (IROS 2020).

At this workshop, it will be explored how to solve the problems that emerged during the research and development based on the goals that were set at the previous workshop. In addition, the potential novel research directions, ergonomic metric and robot control methods, and how to design new validation methods that can be used for objective benchmarking within the field will be discussed.

A full-day workshop at IROS 2020 on this topic will provide an opportunity for interdisciplinary researchers in the field to share their ideas and present the latest research and application developments, by encouraging discussions about the ongoing and next challenges to accomplish. The organizing committee and the list of invited speakers promises a successful workshop and shows a great coverage of relevant research topics. Therefore, I strongly support this proposal.

Yours sincerely,

松本吉央

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