Proposal for Workshop/Tutorial at IEEE CASE 2021

Goal:

In the automation of manufacturing industries, collaborative robotic systems have been playing a significant role, making automation adaptive and allowing human-robot cooperation and interaction. This is further boosted by cyber-physical production systems and industry 4.0 frameworks, that facilitate robot-robot, human-robot or human-systems communications. Moreover, machine learning and artificial intelligence tools, together with cognitive automation approaches, data driven industrial processes and digital twins might make robotic systems smarter for the new generation of advanced manufacturing systems. With this perspective, different scientific and technological key issues, tackled by the scientific community for smart manufacturing, will be addressed here. The objective of this workshop is to share expertise and overview scientific issues, current techniques and achievements in the domains of interaction and collaboration between humans and robots or smart systems. This workshop addresses some key aspects of industry 4.0 and smart manufacturing, such as digital, smart, human-centered and even sustainable manufacturing. Topics include, but are not limited to: Human-in-the-loop processes; human-robot / robot-robot collaboration; Human-machine interactions; Adaptive task/motion planning; Ontologies-based modeling and reasoning; Dexterous grasping / manipulation; Smart manufacturing applications.

Title: *Smart Robotic Systems for Advanced Manufacturing Industries: Planning, Interaction And Collaboration With Humans*

Organizers:

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Time: August 23, 2021

Abstract:

To achieve advanced processes involved in smart manufacturing, robots should be able to cooperate autonomously with human operators at different degrees of interaction.

Some cooperation tasks require the robots to have a high degree of autonomy, which needs: a) perception and reasoning capabilities (to perceive and understand the current state of the environment and to reason on the result of the actions); b) adaptive and dynamic task and motion planning capabilities (to adapt geometric solutions to the actual state of the environment, to allow failure identification and recovery strategies, to robustly cope with non-deterministic actions) and c) robust grasping and manipulation capabilities (to cope with uncertainty in semi-structured human environments). Robots, and more generally smart systems, may not be able to undertake complex tasks fully autonomously, i.e. they should be able to assist human operators whenever the task is difficult or dangerous, while also using the cognitive capacities of the human operators. In this line, the workshop will address the challenges and latest achievements related to interaction and collaboration between humans and robots or smart systems. This may include task planning

and motion planning (considered separately or preferably jointly), interactive and/or immersive advanced simulation, human operators in an effective collaboration with robots and smart systems. In all cases, authority sharing between humans and robots or systems, and intention detection are key challenges to be addressed. The planning and interaction features of smart robotic systems for the effective collaboration with humans may be enhanced by using knowledge. In this sense, the formal representation of knowledge using ontologies provides robots with reasoning capabilities, which can be exploited to make them adaptable to the actual situations encountered and, therefore, make them able to interact with humans at different collaboration levels. Ontologies for perception, world modeling, planning or navigation can make robots, smart systems or simulation tools context- and self-aware, and allow them to act in a smart way, and this is to be explored here in the framework of manufacturing systems. Eventually, ontologies may supply robots, smart systems or simulation tools with trade- or task-oriented information and reasoning capabilities, for a more relevant use in a given industrial context and more generally in the industry 4.0 context.

Descriptions:

In this workshop there will be several talks and discussions, and a poster and lightning talks session.

List of confirmed speakers:

1. **Véronique Perdereau**, Sorbonne University, Institut des Systèmes Intelligents et de Robotique, Paris, France, veronique.perdereau@upmc.fr - Status: confirmed
2. **Esra Erdem,** Sabanci University, Faculty of Engineering and Natural Sciences - Istanbul, Turkey esra.erdem@sabanciuniv.edu - Status: confirmed
3. **Stefano Borgo**, Laboratory for Applied Ontology (LOA) - Institute for Cognitive Sciences and Technologies (ISTC), Trento, Italy, stefano.borgo@cnr.it - Status: confirmed
4. **Michael Beetz**, Institute for Artificial Intelligence (IAI) - University of Bremen, Bremen, Germany, beetz@cs.uni-bremen.de - Status: confirmed
5. **Jean Bosco**, Dedan Kimathi Univ. of Technology, Dept Mechatronic Engineering, Director of DeKUT SIEMENS Mechatronics Certification Centre, Kenya, jean.bosco@dkut.ac.ke - Status: confirmed
6. **Ali Kanso,** ZeMA - Zentrum für Mechatronik und Automatisierungstechnik gemeinnützige GmbH, Saarbrücken, Germany, a.kanso@zema.de - Status: confirmed
7. **Thibaud Raharijaona,** ENIM, University of Lorraine, Metz, France, thibaut.raharijaona@univ-lorraine.fr - Status: confirmed
8. **Jan Rosell** and **Mohamed Diab**, Institute of Industrial an Control Engineering (IOC) - Universitat Politècnica de Catalunya (UPC), Barcelona, Spain, jan.rosell@upc.edu; Department of Electrical and Electronic Engineering, Imperial College London, UK, mohamed.diab@upc.edu - Status: confirmed
9. **Neil Dantam**, Colorado School of Mines, Golden, CO, USA, ndantam@mines.edu - Satus : confirmed
10. **Mourad Benoussaad** and **Philippe Fillatreau**, LGP-ENIT, University of Toulouse, Tarbes, France, mourad.benoussaad@enit.fr; philippe.fillatreau@enit.fr - Status: confirmed

Diversity:
We have attempted for diversity among presenters in geographic location, career stage, and gender.
Geography: We include invited speakers from France (4), Germany (2), Italy (1), Kenya (1), Spain (1), Turkey (1), UK (1), and US (1).
Gender: Two out of 10 invited talks are given by female speakers (20%). Though still far from the global population, this ratio corresponds with the US computer science ratios of female faculty members (22.6%) and Ph.D. recipients (20.3%) (https://cra.org/wp-content/uploads/2020/05/2019-Taulbee-Survey.pdf).
Career Stage: Our invited speakers include senior faculty, early career faculty, and recent Ph.D. recipients.

Event Description and Schedule:
The workshop includes invited presentations and submitted posters, with ample interaction time. The provisional program is as follows:

Morning	Afternoon
09:00-09:15: Introduction / opening remarks *Session 1: Reasoning* 09:15 - 09:45: J. ROSELL / M. DIAB 09:45 - 10:15: S. BORGO 10:15 - 10 :30: Discussion 10:30 - 10:45: coffee break *Session 2: Interaction* 10:45 - 11 :15: E. ERDEM 11:15 - 11:45: V. PERDEREAU 11:45 - 12:15: M. BENOUSSAAD / P. FILLATREAU 12:15 - 12:30: Discussion 12:30 - 13:30: Group Lunch	13:30 - 14:30: Lightning talks (1-2' per contributed abstract) and/or poster session *Session 3: Planning* 14:30 - 15:00: M. BEETZ 15:00 - 15:30: N. DANTAM 15:30 - 15:45: Discussion 15:45 - 16:00 Coffee break *Session 4: Applications* 16:00 - 16:30 J. BOSCO 16:30 - 17:00: A. KANSO 17:00 - 17:30: T. RAHARIJAONA 17:30 - 17:45: Discussion *17:45 - 18:30: Final panel discussion, conclusions and perspectives*

Format: Full day workshop

Interaction Time:
We have allocated significant interaction time in the schedule, including both slots for structured discussion such as a panel and slots for organic conversions such as a group lunch.
- *Poster Session*: We have allocated one hour for poster presentations. This slot will provide time for workshop attendees to interact directly with researchers who have submitted posters.
- *Group Lunch:* We will organize a group lunch for all workshop participants and invited speakers. This lunch will provide an opportunity for one-on-one conversations between participants in a more informal setting.
- *Panel Discussion*: We have allocated 45 minutes for a panel discussion to conclude the workshop. To add structure to the discussions, we will ask attendees to note key ideas, surprising results, or open questions during the invited talks. We will collect these notes for discussion during the panel.

Contingency Plans for a Remote Workshop:
In case continuing travel restrictions require the workshop remote, we will adjust our proposal and schedule as follows:
- Invited Speakers and participants will meet via Zoom
- Lightning talks of contributed posters will be pre-recorded and played during the scheduled workshop
- We will create separate Zoom meetings or breakout rooms for workshop participants to discuss with individual poster presenters during the scheduled workshop poster session.
- Coffee breaks will be just "Breaks"

Plan for Soliciting Participation:
We will take the following steps to encourage participation in the workshop:
- Send emails to global mailing lists for robotics, controls, formal methods, and AI planning
- Request our invited speakers to advertise the workshop within their departments
- Send personal emails to researchers in the area whom we believe would be interested, encouraging them to participate in the workshop, and send emails to encourage the participation of graduate students.

Intended Audience:
This workshop is intended for researchers and practitioners interested in interaction and collaboration between humans and robots or systems for smart manufacturing in the industry 4.0 context.
The three main target audiences for the workshop are: (1) members actively researching new methods, future trends and open questions in smart manufacturing, (2) practitioners developing innovative solutions and (3) people who are interested in learning about the current state-of-the-art in order to incorporate these methods into their own projects. We also strongly encourage the participation of graduate students.

Dear IEEE CASE 2021 Organizing Committee,

We would like to inform you that the IEEE RAS Technical Committee on Collaborative Automation for Flexible Manufacturing supports the IEEE CASE 2021 workshop proposal on "Smart Robotic Systems for Advanced Manufacturing Industries: Planning, Interaction And Collaboration With Humans".

This workshop aims to provide a platform for both senior scientists and juniors to share knowledge. It also outlines scientific issues, current technologies, and achievements in the field of interaction and collaboration between humans, robots, or intelligent systems. The workshop will discuss some key aspects of Industry 4.0 and smart manufacturing, including topics such as human/robot-robot collaboration, Dexterous manipulation, and Smart manufacturing. The proposal has already provided a list of confirmed domain specialists, who had important contributions to the state-of-the-art, to participate as speakers.

Overall, the technical committee believes that the workshop will be of interest to a good number of robotics researchers. Upon acceptance, the committee will assist in the advertising of the workshop through its mailing list and web channels. We would be happy to provide any additional information you may need.

Sincerely,

On behalf of the IEEE/RAS TC on Collaborative Automation for Flexible Manufacturing

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