

IROS 2020 Workshop on New Advances in Soft Robots Control

Main Organizer

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Sponsorship

The Journal Frontiers in Robotics and AI strongly support this workshop proposal.

Elements of the workshop could result in a potential article collection around themes that fall within the scope of the Journal.

2020 IEEE/RSJ

International Conference on Intelligent Robots and Systems(IROS)

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



Objectives

Introduction:

The emerging field of soft robotics is nowadays looking at innovative ways to create and apply robotic technology in our lives. It is a relatively new domain in the field of robotics, but one that has a lot of potential to change how we relate with robots and also how they are used. The term "soft robot" describes a system that is inherently soft yielding a complex dynamics and a passive compliance similar to the biological counterpart. As this was a new design paradigm for the hardware, methods or algorithms to prescribe the robotic system a certain dynamics changed as well.

Motivation:

Classical control approaches in robotics are nonlinear model based. However, the highly complex and nonlinear models necessary for a soft robotic system make this approach a difficult task and therefore seem to come to a limit in the presence of a soft robot. Therefore, other methods have been applied seemingly being more useful in this context, such as learning-based control algorithms, model-free approaches like bang bang control, control algorithms motivated by neuroscience, or morphological computation. These methods add new perspectives to the well known model-based approach. We want to provide an inter- and cross-disciplinary platform to discuss techniques, conventional as well as novel, that are currently applied and developed and discuss limitations, potentials and future directions.

Contribution:

The workshop will bring together experts in the above mentioned control methods as well as people with neuro-scientific and biology background in order to discuss the following issues:

- How are control loops set up in biology (from a biological and neuroscientifical point of view)?
- Requirements of each method in order to apply them on a real system.
- Is there a theoretical background, proving that the method works?; passivity, robustness, Lyapynov stability, others.
- Limitation of the control approaches.
- Are there specific tasks / trajectories / applications for which each method is applicable?

Goals of the workshop:

- Answer the question: "Do we have to rethink the basic approach in robot control, which is model based, when it comes to controlling soft robotic systems?".
- Identify the best experimental testbeds for soft robot control evaluation.
- Contribute to the field by giving the audience a structured review of existing control methods for these systems, including the above-mentioned bullets.
- A Special Issue in the Journal Frontiers in Robotics and AI will be published as an outcome of the workshop summarizing and categorizing the presented methods.

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Topics of interest

- Soft robotics concepts and foundations/ Keywords: Soft robot materials and design; Soft sensors and actuators;
- Modeling of soft robots / Keywords: modeling for soft robots
- Model-based control of soft robotic systems / Keywords: control for soft robots
- Model-free control approaches of soft robotic systems / Keywords: control for soft robots
- Main soft robotic applications and testbed platforms for experimental validation / Keywords: Soft robot applications

Invited Speakers (Both confirmed and/or tentative)

- 1. Cecilia Laschi (BioRobotics Institute of Pisa, Italy). Soft robotics and morphological computation.
- 2. Concepción A. Monje (RoboticsLab, University Carlos III of Madrid, Spain). Fractional order control of a soft robotic neck.
- 3. Lars Schiller (University of Technology of Hamburg, Germany). A gait pattern generator for closed-loop position control of a soft walking robot.
- 4. Kohei Nakajima (University of Tokyo). Soft body meets chaos.
- 5. Akira Fukuhara (Tohoku University, Japan). Towards understanding design principle underlying versatile animal behanviors.
- 6. Seppe Terryn (Vrije Universiteit Brussel, Belgium). Self-healing soft robots.
- 7. Dorin Copaci (RoboticsLab, University Carlos III of Madrid, Spain). Soft upper limb exoskeletons.
- 8. Thomas Thuruthel (University of Cambridge, United Kingdom). Closing the loop with embedded soft sensors.
- 9. Michele Pierallini (Research Center "E. Piaggio", Università di Pisa, Italy). Trajectory tracking of a one-link flexible arm via iterative learning control.
- 10. Egidio Falotico (BioRobotics Institute Pisa, Italy). Machine learning controllers for continuum and soft manipulators.

The invited speakers work in a wide variety of areas in soft robotics, from modeling to control, which contributes to a significant representation of the state of the art in this field.

Endorsement

The organizers have the support of the IEEE RAS Technical Committee on Soft Robotics.

On-Demand format

The talk videos of our invited speakers will be available from October 25th in the IROS On-Demand platform.