

Special Session Proposal for the Polish Control Conference 2026

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Proposed Session Title: "Sensing and control in soft robotics"

Abstract:

Soft robotics has advanced rapidly in recent years, propelled by innovations in novel materials, actuation modalities, integrated sensing technologies, advanced design strategies, and control techniques. The design of soft robotic systems requires a multipronged approach involving geometric optimization, sensor integration, fabrication methods, and tailored control strategies. Holistic development across these domains will unlock challenging applications in medicine, rehabilitation, and agriculture. This special session highlights recent trends in design, sensing integration, and control in soft robotics, with emphasis on methodologies for multidisciplinary integration.

Description:

Soft robots design and control presents multiple multifaceted challenges including material nonlinearities, infinite degrees of freedom, complex sensor integration. These challenges create opportunities for developing novel sensing technologies, advanced control methodologies, and innovative fabrication approaches that address the unique requirements of compliant robotic systems.

This session provides a forum for discussing fundamental problems and cutting-edge solutions related to sensing integration and control design in soft robotics. Key challenges include optimal sensor placement strategies, fabrication and integration techniques, perception from multi-modal sensor data and control techniques. Control approaches encompass both direct methods that focus on developing new control laws and algorithms that explicitly account for the system's compliance and nonlinear dynamics, and indirect methods based on morphological computation and design strategies to simplify the control problem by exploiting the robot's inherent mechanical properties for desired behaviors.

We welcome contributions related to sensing techniques, sensor design and placement, fabrication and integration, control methodologies such as Lyapunov-based approaches, optimal control, data-driven and reinforcement learning strategies. Contributions demonstrating applications of sensing and control advances in soft robotic systems are also encouraged.