Special Session Proposal for the Polish Control Conference 2026

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Proposed Session Title: "Cognition, Communication, and Coordination in Autonomous Multi-Robot and Swarm Systems"

Abstract:

This special session will explore recent advances in the design, analysis, and application of autonomous multi-robot systems and swarm robotics, with a focus on the interrelated aspects of cognition, communication, and coordination. The session invites contributions in areas such as distributed perception and learning, communication architectures for autonomous teams, decentralized control and task allocation, cognitive modeling, swarm intelligence, and AI-based methods for mapping, localization, and adaptation. Applications of interest include autonomous transport, search and rescue, environmental monitoring, precision agriculture, and logistics.

Detailed Description of the Topic:

The special session will focus on recent advances in the design, analysis, and application of autonomous multi-robot systems and swarm robotics, with particular emphasis on the interrelated aspects of cognition, communication, and coordination. As robotic systems increasingly operate in dynamic, uncertain, and large-scale environments, their ability to perceive, interpret, and reason about the world – that is, their cognitive capabilities – becomes critical. This includes processes such as perception, decision-making, learning, planning, and adaptation, both at the level of individual robots and within groups acting collectively. At the same time, the performance of multi-robot systems depends heavily on robust inter-robot communication, whether through explicit messages or implicit mechanisms such as stigmergy or local sensing. Effective coordination - in task allocation, motion planning, mapping, or exploration – is essential for achieving scalable, efficient, and fault-tolerant behavior in decentralized settings.

The session welcomes contributions on topics including (but not limited to):

- distributed perception and learning in robot collectives,
- communication architectures for autonomous teams,
- decentralized control and task coordination,
- cognitive modeling and decision-making in robotic systems,
- swarm-level behaviors and emergent phenomena,
- AI-based methods for mapping, localization, and adaptation.