Special Session Proposal for the Polish Control Conference 2026

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Proposed Session Title: "Recent developments in finite-time/fixed-time stability and stabilization"

Abstract:

Classical methods for analyzing stability and designing control strategies in dynamical systems—typically based on Lyapunov theory—have proven robust and accurate. However, in many modern engineering domains, including robotics, aerospace technology, and precision manufacturing, achieving convergence to the equilibrium point within a finite time has become a key performance requirement. This need has led to some developments in finite-time and fixed-time stability theories, which aim to achieve faster and more robust responses in dynamical systems. Recently, there has been a significant interest in finite-time stability concepts, particularly those where convergence occurs within a time bound that does not depend on the initial conditions, commonly known as fixed-time convergence. These concepts have become widespread in developing controllers, observers, differentiators, optimization methods, and multi-agent consensus strategies. A particularly relevant area of research focuses on predefined-time algorithms, where the user specifies the desired maximum settling time in advance. Despite progress, several challenges persist. Some approaches use time-varying feedback to ensure the system converges precisely within the user-defined time; however, some singularity problems remain unsolved. In contrast, others rely on time-invariant feedback and employ Lyapunov-based techniques to guarantee an upper bound on the convergence time, providing well-defined stabilizing terms; regardless, converging in a time less than or equal to the desired predefined time makes the method insufficient for applications where the convergence in exact time is required. Besides, despite some results, discretization techniques for this class of systems are still an open problem.

Description:

This special session aims to provide the researchers with insight into finite time/fixed time stability and stabilization, both from a theoretical and practical view, using classical and novel methods. This special session strives to bring together experts from various disciplines, including control engineering, applied mathematics, and computer science, to discuss the latest advancements, challenges, and opportunities in enhancing the stability and control of dynamical systems within finite/fixed-time horizons. Topics would include various aspects of finite-time and fixed-time algorithms, including but not limited to:

- Development of design methodologies for control and observation
- Implementation in discrete-time systems
- Analysis of stability and robustness under disturbances and measurement noise

- Techniques for precise estimation of convergence time to enhance tuning accuracy
- Tracking of references generated by smooth functions with compact support
- Strategies to improve transient behavior and reduce peaking phenomena
- Integration of adaptive and learning-based approaches
- Practical applications and experimental validations