Open Invited Track

22nd IFAC World Congress, Yokohama, Japan, July $9 - 14$, 2023

"Asymptotic and Non-Asymptotic Estimation Methods for Nonlinear Systems"

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Abstract

This invited session is proposed for inclusion in The International Federation of Automatic Control (IFAC) which will be held in Yokohama, Japan, from July 09 to 14, 2023. This session aims to present recent advances in the design of asymptotic and non-asymptotic estimation algorithms and state observers for nonlinear systems and their applications. The development of fundamental and theoretical estimation methods with different techniques and real-world applications is considered.

Brief description

The proposed open invited session track focuses on fundamental issues in asymptotic and non-asymptotic state estimation approaches and their applications. It provides systematic asymptotic and non-asymptotic estimation synthesis techniques and analysis tools for establishing stability. Further, this session is designed to serve researchers. It allows the conference attendees and researchers to be aware of the state-of-the-art and new design methods developed in nonlinear estimation techniques in general and their role in control design systems.

Estimation problems become the heart of a general control problem and are crucial in theory and practice. Indeed, estimating the internal information or current state of a dynamic system is essential for deriving a controller or obtaining real-time information on the system for monitoring or decision-making. Several powerful techniques for asymptotic estimation and observer design methods for nonlinear systems have been developed and explored in the last few years. Unlike linear time-invariant systems, where the state estimation problem is analogous to the control design problem, the design of asymptotic and non-asymptotic estimation methods remains a significant and challenging field in nonlinear systems. In asymptotic estimation, one of the challenges comes from the need to invert a change of coordinates that transforms the dynamics into one of the "normal" forms in which the observer design is available. Additionally, several breakthroughs for tuning the observer gain in stability analysis arise from the Lyapunov-based methods and the introduction of linear matrix inequalities (LMI)-based approaches through some locally and globally Lipschitz properties. In the non-asymptotic estimation, most of the challenges in **finite and fixed time estimation (sliding mode, interval observers)** lie in the Lyapunov-based method for stability analysis of the system dynamics and the need for **algebraic representation (Volterra integral transformation and modulating functions)** to put the system dynamics in a linear regression form. Still, many fundamental non-asymptotic estimation problems for nonlinear systems remain unsolved. Further, the need for nonlinear filters and observers, in general, has been felt and pursued in many new, modern, and essential applications.

This special session will report on new "**asymptotic and non-asymptotic estimation techniques**" and emerging applications.

The topics covered in this session lie in the "**Design Methods: TC2.3 Nonlinear control**" research areas, and we look forward to receiving contributions to this track.

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