International Graduate School on Control

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Modern Sliding Mode Control

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The sliding mode methodology has been proved to be effective in dealing with complex dynamical systems affected by disturbances, uncertainties and un-modelled dynamics. These robustness properties have also been exploited in the development of nonlinear observers for state and unknown input estimation. In conventional (first-order) sliding modes a 'switching function' (typically an algebraic function of the states) is forced to zero in finite time and maintained at zero for all subsequent time. Recently, higher-order sliding modes have been developed to force the switching function and *a number of its time derivatives* to zero in finite time.

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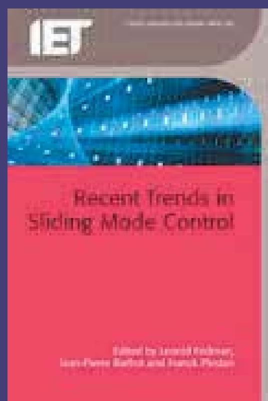
Specific features of the course

We will present a novel Lyapunov based approach for the design of first-, second- and higher-order sliding modes controllers (SMC), including sliding mode controllers producing continuous control signals, and some of its applications.

Outline of the course

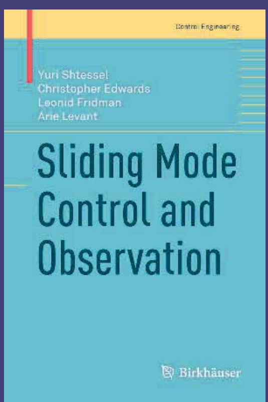
Inroduction

- Solutions of equations with discontinuous right hand sides. Finite- and fixed- time convergence.
- Lyapunov design of first-order sliding modes. Smooth and Lipschitz Lyapunov Functions. Unit Control
- Regular form. Sliding surfaces design
- Integral sliding modes



Second-Oder Sliding Modes Controllers(SOSMC)

- Lyapunov based design for SOSMC (twisting and terminal)
- Lyapunov-Based design for Super-Twisting Controller



Higher-Oder Sliding Modes Controllers (HOSMC)

- Lypunov- Based design for HOSMC (continuous and discontinuous)
- Gain Design for HOSMC: Some Alternatives: Nonlinear inequalities, Pòlya's theorem and Sum of Squares method

Sliding Mode Observation and identification

- Lyapunov-Based Design of Arbitrary-Order Exact Differentiators
- HOSM based Robust- Exact Observers
- HOSM based parameter identification
- Output Feedback HOSMC

Applications