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Constructions of strict Lyapunov functions. (English)

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Lyapunov functions are a widely accepted tool for the investigation of stability of dynamical systems in numerous applications. Strict Lyapunov functions are characterized by having negative definite time derivatives along all trajectories of the system, while non-strict Lyapunov functions have negative semi-definite derivatives along trajectories. To construct explicit strict Lyapunov functions the so-called strictification method is used which allows to transform given non-strict Lyapunov functions into strict Lyapunov functions. This monograph covers a wide range of nonlinear dynamical systems, including Jurdjevic-Quinn systems, time-varying systems satisfying LaSalle or Matrosov conditions, adaptively controlled dynamics, slowly and rapidly time-varying systems, and hybrid time-varying systems. The simplicity of construction of strict Lyapunov functions is illustrated in applications that are of compelling engineering interest including the adaptive control of chemostats and the stabilization of underactuated ships.

The book will be useful to researchers and graduate students in various areas of applied mathematics and control theory and engineering.

Table of Contents: Part I, Background: Background of nonlinear systems; Review of Lyapunov functions. Part II, Time-invariant case: Matrosov conditions: Simple case; Jurdjevic-Quinn conditions; Systems satisfying the conditions of LaSalle. Part III, Time-varying case: Strictification: Basic results; Backstepping for time-varying systems; Matrosov conditions: General case; Adaptively controlled systems. Part IV, Systems with multiple-time scales: Rapidly time-varying systems; Slowly time-varying systems; Hybrid time-varying systems. Part V, Appendices: Some lemmas; Converse theory.

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Keywords : stability; Lyapunov functions; discrete time systems; time-scale analysis; hybrid systems

Classification :

- *93-02 Research monographs (systems and control)
- 34D20 Lyapunov stability of ODE
- 70K20 Stability of nonlinear oscillations (general mechanics)
- 93D30 Scalar and vector Lyapunov functions