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The construction of strict Lyapunov functions is a challenging problem that is of significant ongoing research interest. Although converse Lyapunov function theory guarantees the existence of strict Lyapunov functions in many situations, the Lyapunov functions that converse theory provides are often abstract and nonexplicit, and therefore may not lend themselves to engineering applications. Often, even when a system is known to be stable, one still needs explicit Lyapunov functions; however, once an appropriate strict Lyapunov function has been constructed, many robustness and stabilization problems can be solved almost immediately through standard feedback designs or robustness arguments. By contrast, non-strict Lyapunov functions are often readily constructed, e.g., from passivity, backstepping, or forwarding (especially in the time varying context), or by using the Hamiltonian in Euler-Lagrange systems.

Constructions of Strict Lyapunov Functions contains a broad repertoire of Lyapunov constructions for nonlinear systems, focusing on methods for transforming non-strict Lyapunov functions into strict ones. Many important classes of dynamics are covered: Jurdjevic-Quinn systems; time-varying systems satisfying LaSalle or Matrosov conditions; slowly and rapidly time-varying systems; adaptively controlled dynamics; and hybrid systems. The explicitness and simplicity of the constructions make them suitable for feedback design, and for quantifying the effects of uncertainty. Readers will benefit from the authors' mathematical rigor and unifying, design-oriented approach, as well as the numerous worked examples, covering several applications that are of compelling interest including the adaptive control of chemostats and the stabilization of underactuated ships.

Researchers from applied-mathematical and engineering backgrounds working in nonlinear and dynamical systems will find this monograph to be most valuable and for graduate students of control theory it will also be an authoritative source of information on a very important subject.