Estimation of Asymptotic Stability Regions via Homogeneous Polynomial Lyapunov Functions

Asymptotic stability regions of nonlinear dynamical systems are estimated by using homogeneous polynomial Lyapunov functions, which include quadratic Lyapunov functions as a special case. The nonlinear system is represented as a convex hull of some linear systems, and it is shown that the estimation can be formulated as an LMI optimization problem in an augmented state space.

Discontinuous Control of Nonholonomic Systems Using Nondifferentiable Lyapunov Functions

This research focuses on the problem of discontinuous controller design by using a non-differentiable Lyapunov function. We propose a new concept for a solution of the discontinuous system. We design a discontinuous controller for a nonholonomic system by using a non-differentiable Lyapunov function and analyze the stability of the controlled system by using the proposed solution. Moreover, we confirm the performance of the controlled system by computer simulation.

Stabilizability Analysis and Controller Design for a Nonlinear System with an Input Constraint

Researches on nonlinear systems with input constraints have been based on control Lyapunov functions that assure global stability, and the stabilizable region has not been investigated. In this paper, we investigate the stabilizability and the stabilizable region and design a controller that stabilizes the system. Then we show a simulation to demonstrate the usefulness of the controller.

Asymptotically Stabilization of Hamiltonian Systems Based on La Salle’s Invariance Principle

IDA (Interconnection and Damping Assignment) method is proposed in order to stabilize PCH (Port Controlled Hamiltonian) systems. Based on La Salle’s invariance principle, we derive sufficient conditions to use IDA method for global asymptotic stabilization. Furthermore, we extract free parameters that do not influence these conditions. These parameters can adjust the control inputs and the convergence rate of the states.

A New Method to Design Discontinuous Stabilizing Controllers for Chained Systems

In this paper, we propose a new method to design discontinuous stabilizing controllers for chained systems. The proposed controllers yield exponential convergence of the states to the origin. In our method, the closed loop system of a chained systems formulated by a linear differential equation with a regular/singular point at z=0. It is shown that the controller design method proposed by Astolfi, in which sigma process is used for coordinate transformation, is included in our method as a special case where the linear differential equation with a regular/singular point at z=0 is limited to its subclass, namely ar/linear differential equation. This method can be easily extended to apply to multiple chained systems.