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Automatica

(Survey Paper) Stability analysis for stochastic hybrid systems: A survey

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Abstract

This survey addresses stability analysis for stochastic hybrid systems (SHS), which are dynamical systems that combine continuous change and instantaneous change and that also include random effects. We re-emphasize the common features found in most of the models that have appeared in the literature, which include stochastic switched systems, Markov jump systems, impulsive stochastic systems, switching diffusions, stochastic impulsive systems driven by renewal processes, diffusions driven by Lévy processes, piecewise-deterministic Markov processes, general stochastic hybrid systems, and stochastic hybrid inclusions. Then we review many of the stability concepts that have been studied, including Lyapunov stability, Lagrange stability, asymptotic stability, and recurrence. Next, we detail Lyapunov-based sufficient conditions for these properties, and additional relaxations of Lyapunov conditions. Many other aspects of stability theory for SHS, like converse Lyapunov theorems and robustness theory, are not fully developed; hence, we also formulate some open problems to serve as a partial roadmap for the development of the underdeveloped pieces.

(Survey Paper) Multivariable adaptive control: A survey

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Abstract

Adaptive control is a control methodology capable of dealing with uncertain systems to ensure desired control performance. This paper provides an overview of some fundamental theoretical aspects and technical issues of multivariable adaptive control, and a thorough presentation of various adaptive control schemes for multi-input–multi-output systems, literature reviews on adaptive control foundations and multivariable adaptive control methods, and related technical problems. It covers some basic concepts and issues such as certainty equivalence, stability, tracking, robustness, and parameter convergence. It discusses some of the most important topics of adaptive control: plant uncertainty parametrization, stable controller adaptation, and design

conditions for different adaptive control schemes. The paper also presents a detailed study of well-developed multivariable model reference adaptive control theory and design techniques. It provides an introduction to multivariable adaptive pole placement and adaptive nonlinear control, and it concludes by identifying some open research problems.

Convex saturated particle filter

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Abstract

In many systems the state variables are defined on a compact set of the state space. To estimate the states of such systems, the constrained particle filters have been used with some success. The performance of the standard particle filters can be improved if the measurement information is used during the importance sampling of the filtering phase. It has been shown that the particles obtained in such a way approximate the true state of the system more accurately. The measurement is incorporated into the filtering algorithm through a user-specified detection function, which aims to detect the saturation as it occurs. The algorithm derived from the aforementioned principle is called the Saturated Particle Filter (SPF). In our previous work we have derived a complete SPF framework for the class of systems with one-dimensional constraints. In this paper we derive a novel Convex SPF that extends our method to multidimensional systems with convex constraints. The effectiveness of the new method is demonstrated using an illustrative example.

Stochastic model predictive control for constrained discrete-time Markovian switching systems

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Abstract
In this paper we study constrained stochastic optimal control problems for Markovian switching systems, an extension of Markovian jump linear systems (MJLS), where the subsystems are allowed to be nonlinear. We develop appropriate notions of invariance and stability for such systems and provide terminal conditions for stochastic model predictive control (SMPC) that guarantee mean-square stability and robust constraint fulfillment of the Markovian switching system in closed-loop with the SMPC law under very weak assumptions. In the special but important case of constrained MJLS we present an algorithm for computing explicitly the SMPC control law off-line, that combines dynamic programming with parametric piecewise quadratic optimization.

Quadratic control of stochastic hybrid systems with renewal transitions

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Abstract
We study the quadratic control of a class of stochastic hybrid systems with linear continuous dynamics for which the lengths of time that the system stays in each mode are independent random variables with given probability distribution functions. We derive a condition for finding the optimal feedback policy that minimizes a discounted infinite horizon cost. We show that the optimal cost is the solution to a set of differential equations with unknown boundary conditions. Furthermore, we provide a recursive algorithm for computing the optimal cost and the optimal feedback policy. The applicability of our result is illustrated through a numerical example, motivated by stochastic gene regulation in biology.

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Nothing interesting.