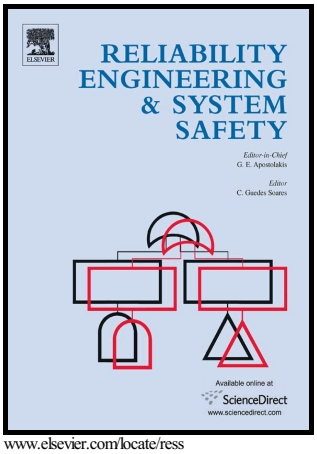

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Zhiyao Zhao, Quan Quan, Kai-Yuan Cai

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Abstract

Health performance prediction of a dynamical system aims at determining the probability or possibility that the system state will remain in a permitted area (safe set) or reach a forbidden area (unsafe set) at a future time instance. This paper proposes a health performance prediction algorithm for large-scale Stochastic Linear Hybrid Systems (SLHS) with small failure probability. In the studied SLHS, the continuous variable evolution is described by a set of stochastic linear differential equations, and the discrete state evolution is modeled by a first-order Markov chain. Furthermore, a safe set of the SLHS is described by a permitted area in the hybrid state space. Given an initial condition, a hybrid state evolution algorithm is proposed referring to the execution of stochastic hybrid systems. On this basis, a concept of health degree is introduced to evaluate the health performance of the studied SLHS. Finally, a multicopter with sensor anomalies is studied to validate the availability and effectiveness of the proposed method.

Index Terms

Health performance, stochastic linear hybrid systems, large-scale, small failure probability, multicopter.

ACRONYMS

HPE	Health Performance Evaluation
HPP	Health Performance Prediction
PDMP	Piecewise Deterministic Markov Process
SLHS	Stochastic Linear Hybrid Systems
SMC	Sequential Monte Carlo

I. INTRODUCTION

Stochastic Hybrid Models (SHM) aim to model a class of real-world systems, which are characterized by dynamics of both discrete states (such as functioning or failed) and continuous process variables (such as height or velocity) [1],[2]. Examples of SHM include the Piecewise Deterministic Markov Process (PDMP) [3],[4], the Switched Diffusion Process (SDP) [5] and the Stochastic Hybrid Systems (SHS) [6],[7]. For Health Performance

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The authors are with School of Automation Science and Electrical Engineering, Beihang University, Beijing 100191, China (e-mail: zzy_buaa@buaa.edu.cn; qq_buaa@buaa.edu.cn; kycai@buaa.edu.cn)