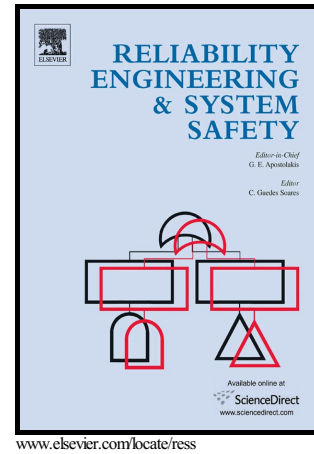


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Abstract

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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