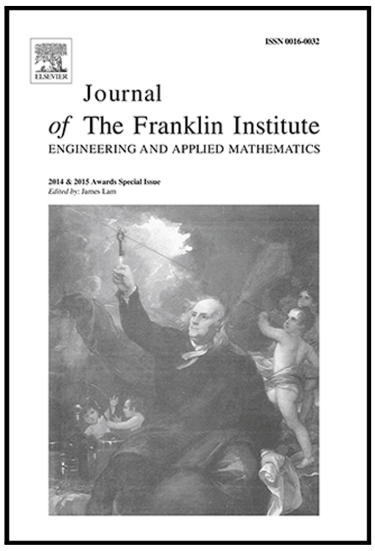

Composite Fault-Tolerant Control with Disturbance Observer for Stochastic Systems with Multiple Disturbances

Shixiang Sun, Xinjiang Wei, Huifeng Zhang, Hamid Reza Karimi, Jian Han

PII: S0016-0032(18)30328-4
DOI: 10.1016/j.jfranklin.2018.05.016
Reference: FI 3450

To appear in: *Journal of the Franklin Institute*

Received date: 21 January 2018
Revised date: 10 April 2018
Accepted date: 9 May 2018

Please cite this article as: Shixiang Sun, Xinjiang Wei, Huifeng Zhang, Hamid Reza Karimi, Jian Han, Composite Fault-Tolerant Control with Disturbance Observer for Stochastic Systems with Multiple Disturbances, *Journal of the Franklin Institute* (2018), doi: 10.1016/j.jfranklin.2018.05.016

Composite Fault-Tolerant Control with Disturbance Observer for Stochastic Systems with Multiple Disturbances

Shixiang Sun[a], Xinjiang Wei[a*], Huifeng Zhang[a], Hamid Reza Karimi[b], Jian Han[a].
[a]School of Mathematics and Statistics Science, Ludong University, Yantai, Shandong Province, 264025, China
[b]Department of Mechanical Engineering, Politecnico di Milano, 20156, Milan, Italy

Abstract

In this paper, a composite fault tolerant control (CFTC) with disturbance observer scheme is considered for a class of stochastic systems with faults and multiple disturbances. The disturbances are divided into two parts. One represents the stochastic disturbance with partial known information which is formulated by an exogenous system. The other is independent Wiener process. A stochastic disturbance observer is designed to estimate exogenous disturbance. To make the first type of disturbance can be rejected and the fault can be diagnosed, a composite fault diagnosis observer with disturbance observer is constructed. Furthermore, a composite fault-tolerant controller is proposed to compensate disturbances and faults. Finally, simulation examples are given to demonstrate the feasibility and effectiveness of the proposed scheme.

Key words: Stochastic system; Multiple disturbances; Fault diagnosis observer; Stochastic disturbance; Composite fault-tolerant Controller; Disturbance observer based control.

1 Introduction

To improve reliability of control systems, the problem of fault detection and diagnosis has been paid more attention over the past two decades [1, 2, 3]. Furthermore, due to the existence of faults and disturbances simultaneously, the FTC problem will be more complicated. To solve the difficulties, many approaches have been presented [4, 5, 6, 7, 9]. In [4], a robust observer was presented to simultaneously estimate system states, fault signals, and their finite time derivatives for nonlinear descriptor systems. In [5], the robust fault detection filter design problem was studied for uncertain linear time-invariant (LTI) systems, with both unknown inputs and modelling errors. In [6], an optimal FTC scheme was discussed for a class of nonlinear systems, where generalized H_∞ optimization was applied to diagnose fault and attenuate disturbances. In [7], a composite observer was proposed to simultaneously estimate system states and actuator faults to attenuate disturbances for descriptor systems. In [8], a H_∞ controller in the internal model architecture was presented to realize fault diagnosis and accommodation for a class of linear systems with disturbances. However, in most of the aforementioned results in literature, the authors mostly focused on fault detection problems, which would lead to the decline of the accuracy of control. Moreover, the disturbances are assumed to be norm-bounded so that some robust control schemes can be applied.

Corresponding author: Xinjiang Wei. Email: weixinjiang@163.com. The work is supported by National Science Foundation of China 61374108.