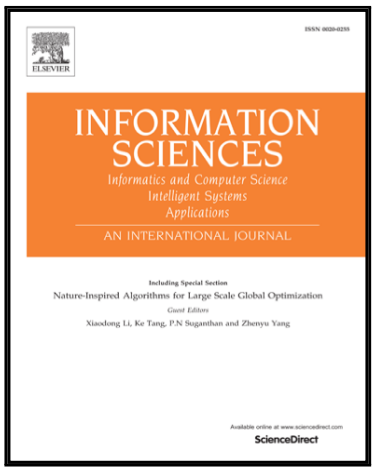

Secure state estimation for cyber-physical systems under sparse sensor attacks via a switched Luenberger observer

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Secure state estimation for cyber-physical systems under sparse sensor attacks via a switched Luenberger observer

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Abstract

This paper investigates the secure state estimation problem for cyber-physical systems (CPSs) under disturbance and sparse sensor attacks. Both the fixed and switched target attacks are taken into account. Compared with the fixed target attacks, the switched target attacks, which are not considered in most existing results, change the attack targets at a limited frequency. The basic idea is designing a switched Luenberger observer for an augmented system where attacks are seen as part of its states. A new projection operator is proposed to ensure the sparsity of the attack estimations. Then, sufficient conditions for the existence of the desired switched observer are proposed in terms of linear matrix inequalities (LMIs) where the techniques for the switched systems with stable and unstable subsystems are introduced for tackling the switched target attacks. Compared with the existing results, no iterative algorithm is required here, and the proposed observer estimates the state well even under switched target attacks.

Keywords: Cyber-physical systems, sparse sensor attack, projection operator, switched Luenberger observer, linear matrix inequalities

1. Introduction

Nowadays, cyber-physical systems (CPSs) which integrate computation, networking and physical processes tightly have attracted much attention of the scientific community. The integration does not mean the simple convergence of the physical world and the cyber space, but the deep interaction of all the physical and cyber components, i.e., power grids, deep sea exploiting systems [21], electric ground vehicle [28] and selective catalytic reduction system [27]. Meanwhile, CPSs need to guarantee the execution of multiple control policies and

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