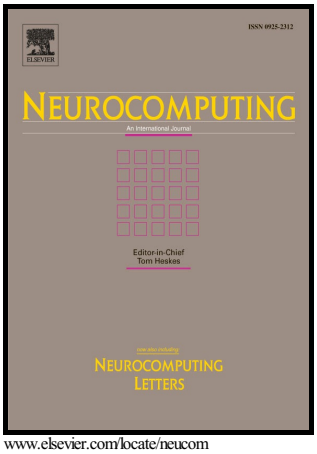

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Self-tuned local feedback gain based decentralized fault tolerant control for a class of large-scale nonlinear systems

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Abstract

In this paper, a decentralized fault tolerant control (DFTC) scheme is proposed for a class of large-scale nonlinear systems based on self-tuned local feedback gain against partial loss of actuator effectiveness (PLOAE). Consider a large-scale nonlinear system as a set of interconnected subsystems, a decentralized control method is proposed by employing two radial basis function neural networks (RBFNNs) for the fault-free system. Then, the unknown system is identified using RBFNNs. By establishing a decentralized observer, the derived self-tuned local feedback gain is placed before the proposed decentralized controller to guarantee control performance for the subsystem suffering from PLOAE fault. Finally, simulation examples are provided to demonstrate the effectiveness of the present DFTC scheme. The main contributions of this paper are: i) The unknown large-scale nonlinear system can be identified using locally measured states, so the actuator fault can be handled in its local subsystem. It implies that the performance degradation of the faulty subsystem cannot affect the fault-free subsystems. ii) The estimated effectiveness factor is placed before the proposed decentralized scheme. The fault tolerant control structure is simple since it does not need to be redesigned in the case of PLOAE.

Keywords: Large-scale nonlinear systems, partial loss of actuator effectiveness, decentralized fault tolerant control, self-tuned local feedback gain, neural network

1. Introduction

Nowadays, systems such as power systems, computer and telecommunications networks, economic systems, traffic systems and multi-agent systems are becoming more and more complex. Some advanced control techniques, such as neural networks [1], fuzzy logic control [2], composite learning control [3], dynamic surface control [4], adaptive control [5], were employed to design controllers for variety of systems. Control of large-scale systems, which are often considered as a set of interconnected subsystems, has received considerable attention. In order to deal with the difficulties of dimensionality, information constraints and structure uncertainties, it is efficient and effective to design decentralized control laws only depending on local measurable states to achieve an objective for the whole large-scale system. For instance, Harno *et al.* [6] constructed a decentralized nonlinear robust H_∞ controller for large-scale nonlinear uncertain systems, it can exploit known nonlinearities and interconnections between subsystems without treating them as uncertainties. Zhou *et al.* [7] developed a fuzzy decentralized control for a class of large-scale networked dynamic systems with network-induced time-delays, missing measurements and external disturbances, and obtained H_∞ performance for the closed-loop system. Liu *et al.* [8] developed a novel decentralized control strategy to stabilize a class of continuous-time large-scale systems using online learning optimal approach. Then, they extended this strategy to unknown dynamic systems by introducing an integral policy iteration algorithm [9]. Chen *et al.* [10] proposed an adaptive backstepping neural network (NN) control approach for a class of large-scale nonlinear

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