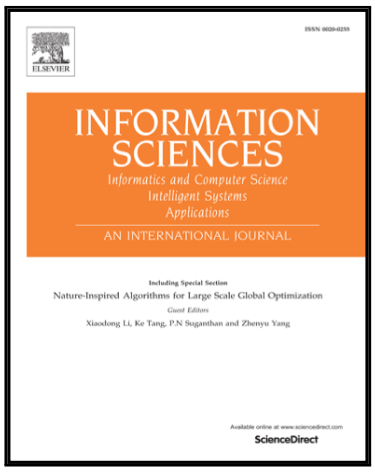

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Distributed formation control for teleoperating cyber-physical system under time delay and actuator saturation constrains

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Abstract

Teleoperating Cyber-Physical System (TCPS) is referred as a new generation of networked teleoperating system. Question of how to enable master operator and slavers to collaborate for sensing and control is largely unexplored. This paper is concerned with a distributed formation control problem for multi-slave TCPS under time delay and actuator saturation constraints. We first develop a min-weighted rigid graph based topology optimization scheme to reduce the redundancy of communication links in slavers, such that the information fusion can be simplified in the formation controller design. The sufficient conditions for stability are presented to show that the formation controllers can stabilize the master-slave TCPS in the presence of time-varying delay and actuator saturation constraints. Finally, to show the validity of our proposed result, both simulations and experiments are performed. It is demonstrated that the topology optimization reduces the redundancy of communication links in slave site at the expense of increased convergence time, while the formation controllers guarantee global asymptotic stability of teleoperation systems subjected to time-varying delay and actuator saturation constraints.

Keywords: Cyber-physical system; Teleoperation; Formation; Time delay; Saturation

1. Introduction

As a new generation of teleoperating system, teleoperating cyber-physical system (TCPS) collaborates master operators and slave sites to sense and affect their environment with

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