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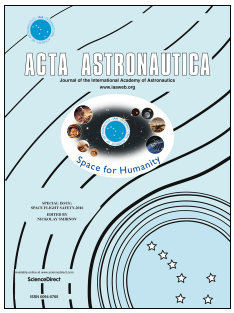

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A Novel Adaptive Finite Time Controller for Bilateral Teleoperation System

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Abstract-Most bilateral teleoperation researches focus on the system stability within time-delays. However, practical teleoperation tasks require high performances besides system stability, such as convergence rate and accuracy. This paper investigates bilateral teleoperation controller design with transient performances. To ensure the transient performances and system stability simultaneously, an adaptive non-singular fast terminal mode controller is proposed to achieve practical finite-time stability considering system uncertainties and time delays. In addition, a novel switching scheme is introduced, in which way the singularity problem of conventional terminal sliding manifold is avoided. Finally, numerical simulations demonstrate the effectiveness and validity of the proposed method.

□. Introduction

Tele-robots can achieve many complicated space operations because of the decision-making capability of human operators in the control loop. As a typical control approach of tele-robots, bilateral teleoperation means a human operator manipulates the master robot in local site, generating commands for the slave robot and thus indirectly interacting with the environment or objects in remote site. Also, a force feedback scheme is provided to the operator to improve task performances [1]. Because of the ability of human replacement, the approach is applied in multiple fields, such as space exploration [2], nuclear facilities maintenance [3], tele-surgery [4] and underwater/space robotics [5]-[7].

The main challenge existing in bilateral operation is time delays. In bilateral teleoperation, the master and the slave robots are coupled via a communication network, which usually suffers from substantial time delays, data limitations and information losses. The time delays existing in the loop influence the stability and degrade the teleoperation performance. Many methods were proposed to overcome

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