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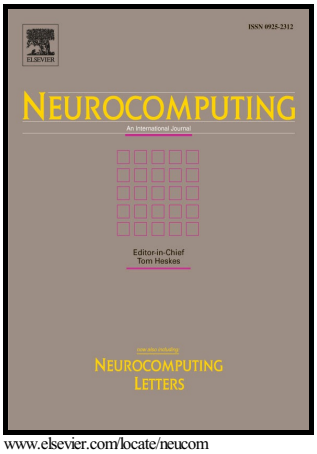

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Orientation of Radio-Telescope Secondary Mirror via Adaptive Sliding Mode Control

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Abstract

In this work a parallel manipulator (Stewart platform) is used to align and maintain the position of the secondary mirror of a radio-telescope. The six degrees of freedom platform gives the significant advantage of reaching the maximum performance for the positioning tasks. The near-singularity condition of the platform is analyzed and is handled by implementation of a new control law based on sliding mode with inner regularization procedure. Herein, the finite-time convergence of closed-loop system derived from designed control in the presence of external as well as internal disturbances/uncertainties is proved. The effectiveness of the proposed controller is verified via numerical simulation. We show that Sliding Mode Control with a gain matrix adaptation based on the Equivalent Control method can significantly reduce the undesirable chattering effect an therefore avoid the possible damages.

Keywords: Sliding mode control; Adaptive control; Near-singularity condition; Inner regularization procedure; Parallel platform; Radio-telescope orientation

1. Introduction

The radio-telescope antenna is a a widely used device to receive the radio-frequency radiation emitted by extraterrestrial sources and satellites. Since radio wavelengths are much longer than those of visible light, radio telescopes then must be very large in order to attain the resolution of optical telescopes. Radio telescopes can be classified differently, however depending on their design, they can be divided in one and dual reflector antennas. One–reflector antennas are the most familiar type of radio telescopes consisting of a parabolic antenna, so-called dish, which operates in the same manner as a television-satellite receiving antenna, to focus the incoming radiation onto a small antenna referred to as the feed, a term that originated with antennas used in radar transmissions.

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