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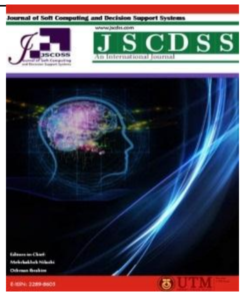

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Enhancement of the Satellite Attitude Control Using Optimal Regulator Scheme

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Abstract

Accuracy of satellite control for space investigation has priority during its mission. This study aims to design a controller for the satellite attitude control which carries scientific sensor package. The modeling of the satellite with its electronic device is carried out in order to capture the states of systems then the appropriate controller strategy is applied to keep the satellite at the fixed value. In addition, to satisfy the design characteristics two control schemes in comparative manner are discussed namely, state feed-back controller and linear quadratic regulator (LQR). The results show LQR helps satellite to follow its reference signal along with desired overshoot and settling time.

Keywords: Satellite Attitude Control, Optimal Regulator, Settling time, Controller

1. Introduction

Exploration for perceiving tremendous phenomenon in the space has been the one of the interminable desire for human being in throughout the history of the human life. These days by improving the technology the novel devices have been sent into the space for universe investigation purposes. Among of various equipments, satellites have been used prevalently. Satellites are commonly utilized as data and information conveyer between earth and surrounding apace. Therefore, control of satellite in the space come into picture as essential aspect for cosmos investigation. As matter of fact in designing of satellite, position an orientation control of satellite in the space is major consideration for designer (Zhang et al., 2013; Ahmed and Kerrigan, 2014). It can be said that receiving or transmitting accurate signals depends on how well satellite placed in the space.

Keeping the satellite in the desirable attitude is one of the real obsessions of scientist and control engineers because of existing of disturbances such as solar pressure (Bai and Wu, 2014), micrometeorites, electrical noises and other floating cosmic objects causing deviation of the satellite attitude from normal path or its direction (Ovchinnikov and Ivanov, 2014). Moreover, most of satellites are carrying the electro-communication devises thus, fluctuation in attitude result in missing the signal from transmitter. Of course, attitude stabilization during the satellite mission should be taking into account by control engineers (Haichao et al., 2013; Di et al., 2014). It follows that; to rely on transmitted information the package must be isolated against any noise and disturbance to stay in desired position. This sustained position can relatively be assigned by pointing either one star or group of stars through the limitless space. The maneuverability and attitude are controlled by star tracker method (Yuwang et al., 2014).

One of the current methods to track and sustain satellite in the specific position is using the light of starts in space to keep the relative position of satellite with respect to shiny star which called star tracker control (Birnbaum, 1996; Kai et al., 2013; Samaan and Theil, 2012). In Kai et al.,(2013) it was shown the autonomous navigation by implementing a relative position measurement between a group of satellites using star sensors and inter-satellite links. They applied the navigation method which is based on dynamic and measurement model. Some researcher focus on improving sensors in term of signal processing technique in which novel method is used to reduce star tracker navigation error such as measurement uncertainties and increase the controllability of satellite (Rufino and Accardo, 2002).

As reported by Ho, (2012) identification methods are uniquely used to track lost stars in spaces that also called star identification. In this study two phases are discussed, firstly feature extraction and secondly for catalogue search. As it said earlier attitude control of satellite is presented in large amount of research and also case studies. For example; Wang et al. (2013) applied regularized robust filter for attitude control system for star trackers in which relative installation error of star tracker in attitude measurement data is controlled. To eliminate the low-frequency periodic error of star tracker the kalman filter method is utilized in which this error can be identified by extracting the Fourier parameters of estimated gyro drift (Jiongqi et al., 2012). Attitude estimation algorithm for the satellite with three star trackers is implemented by Chen et al, (2012) in which the extended kalman filter is used to