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A NEW ROBUST POSITION AND ATTITUDE ESTIMATION APPROACH FOR A NON-COOPERATIVE TARGET SATELLITE

Abstract

The objective of this paper is to present a new attitude and position estimation method for non-cooperative satellites in the scenario of rendezvous and docking orbital operations. This study comes in sight of a new aerospace field of service in space by autonomous space serviceable vehicles. The most prominent feasibility demonstration of space service activity was shown by the Orbital Express project, carried out in 2007. In this new area of the space exploration the client satellite to be serviced is supposed to be out-of-service thereafter unable to provide its position and attitude by itself, typical scenarios in case of damaged or powerless spacecraft. In this case the estimation of position and attitude of the client spacecraft is absolutely needed to compose the control, guidance and navigation system of the serviceable vehicle. A new estimation method is introduced, as an extension of Horald-Phong's method which is based on a dual quaternion parameterization of the rigid transformation. The proposed method includes an online calibration of a monocular visual satellite subsystem in such way that the computational time is reduced and robustness is produced. Extensive simulations are made pointing out advantages of the new method in comparison with its original version. In order to carry out the experiments a simulated 2D data is generated by combining a 3D virtual reality model of a target-satellite and its relative dynamics with respect to the camera system. The attitude is modeled by the Euler equations and the relative position by the Hill's model. The proposed pose estimation method is discussed deeply in the particular scenario. The feasibility of the method in the particular case of space service is properly demonstrated by considering quasi-real data. Furthermore the results show the suitability of the method for the satellite attitude and position estimation.