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A NOVEL ATTITUDE QUATERNION FILTER FOR THE ESA EUROPEAN STUDENT EARTH ORBITER (ESEO)

Abstract

This paper describes an attitude determination experiment that has been designed and developed by students at the Technical University of Delft. The experiment was developed for the European Student Earth Orbiter (ESEO) satellite, the main educational project of the European Space Agency. Being a software-based payload, the experiment shall be loaded onto the satellite's OBDH, where it makes use of sensor and control signal outputs to perform several tests while the satellite is in Low Earth Orbit. Four algorithms from different families of estimators are run in parallel and generate telemetry for further analysis and comparison. One of the four algorithms makes use of a maximum information rate filter which computes the information rates of six possible reduced measurement matrices and selects one for use in the estimation process based on the maximum trace of the associated information rate matrix. The payload shall provide probability distributions for the selection of each different measurement matrix within the telemetry in order to determine the causality underlying the selection of a particular reduced measurement matrix based on features of the orbit and the used measurents. This paper lays out the foundation of the attitude determination experiment by first demonstrating the algorithms that are tested. The validity of these algorithms for in-situ use is shown through extensive Monte Carlo simulations. The software design is described, as well as the performance analysis results from testing on the actual satellite OBDH hardware. This includes memory usage reports, runtime testing results and code robustness verifications.Extensive Monte Carlo simulations are performed in order to correlate the information-based reduced measurement selection with physical features of the simulated orbit and attitude. The proposed analysis is to be further validated by the actual payload during the ESEO mission.