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ATTITUDE CONTROL ALGORITHMS AIDED BY MULTIPOINT STATISTICS AND DISTRIBUTED MEASUREMENTS PROCESSING IN A SWARM OF CUBESATS

Abstract

This study has been conducted as a part of the Skoltech University project to deploy a swarm of 3U CubeSats in LEO. Our previous studies have shown that data exchange in a swarm of satellites may enhance the attitude determination and control system performance in individual satellites by using interpolated distributed measurements of magnetic field in the attitude determination loop. This work takes the concept a step further and investigates a scenario of having within a swarm a subgroup of spacecraft that are equipped with more precise magnetometers than the rest and are employed as a measurement network that serves the precise magnetic field map to the rest of the swarm spacecraft. We consider this servicing network to comprise four spacecraft, whose trajectories ensure the effective spatial configuration for distributed measurements in the region of interest (where the rest of the swarm spacecraft are). Using several interpolation techniques, such as Ordinary and Non-Ordinary Kriging, the servicing satellites provide statistical maps of the surrounding geomagnetic field in the form of semivariograms atlases for each Cartesian coordinate. These maps are then fed to the attitude determination routines of the other swarms satellites and processed by their respective Extended Kalman Filters. Thus, we propose a decentralized communication algorithm between satellites of different groups, based on which every satellite in the swarm improves its ADCS performance. We present our simulation results that show the advantages of the proposed method over the usage of independent controllers in each satellite.