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PICOSATELLITE BEESAT-4: 3-AXIS ATTITUDE CONTROL AND GPS BASED POSITIONING AND ORBIT DETERMINATION

Abstract

The picosatellite BEESAT-4 will be launched as a secondary payload at the end of May from Sriharikota with a PSLV launcher. The satellite bus is based on BEESAT-2, which was launched in April 2013. In contrast to the predecessor it has an implemented GPS receiver and a new payload data handling. All the environmental tests were successful and the satellite is ready for launch. During the mission operations the focus will be on determining a more accurate orbit. In the former satellites the SGP4 algorithm was used to determine the orbit, based on orbit elements from NORAD. These lead to an accuracy of 1-3km in positioning and even worse determination. Within a couple of days the In-Track difference can total more than 100km. Considering the idea of possible formation flights, this is not acceptable. The gained data will be used to compare In-Track difference, Cross-Track difference and Radial difference and will show how many positions per orbit are needed to obtain acceptable accuracies. Getting GPS fixes requires a stable satellite due to the restricted footprint of the antenna. The lobe is about 60 in size and an assisted start of the GPS receiver takes about 2 minutes. During this time the antenna should be pointed towards the same GPS satellites to find a 3D navigation solution. Achieving this goal requires knowledge of the attitude. On BEESAT-4 it is based on sun sensors, magnetic field sensors and MEMS gyroscopes. Together with a sun and a magnetic field model these vectors are put into a QUEST algorithm. Its output is the attitude of the satellite and, together with a given quaternion, the controller sets speed and acceleration of the 3 reaction wheels. After the commanded attitude is reached, further operations can start. For GPS operations the antenna will be pointed zenit to get the biggest possible field of view. This ensures a quick GPS fix and saves energy.