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JUMPSAT: QUALIFYING THREE EQUIPMENTS IN ONE CUBESAT MISSION

Abstract

JUMPSAT is a 3U CubeSat mission expected for launch in 2017. This is a collaborative project involving institutions (CNES, ONERA) and schools (ISAE Supaéro, TELECOM Bretagne). It aims at designing and qualifying a three axis stabilized 3U platform. Two payloads will be embedded: a low cost Star Tracker developed by ISAE Supaéro and a detector for particles trapped in the Earth magnetic field designed by the ONERA. This paper focuses on mission analysis constraints and consequent choices. The power budget represents one of its biggest challenges: both the attitude control system and the Star Tracker consume a lot of power, and cannot work at the same time during the whole orbit. However, the Star Tracker is efficient only if the satellite attitude is stabilized. In terms of orbit, the particles detector is the only payload requiring special characteristics. Meaningful observations are only possible at altitudes higher than 700 km, with most interesting zones above the South Atlantic and high latitudes. But a circular orbit with this altitude does not respect the French law about space operations. The on-board memory sizing takes into account the amount of data produced by the different sub-systems and the total visibility of the satellite by the ground stations. The HETE Primary Ground Stations will provide uplink and Downlink communications during the mission. In order to reach a compromise, simulations were performed: power and visibility budget were studied using softwares developed at ISAE Supaéro and the re-entry time was simulated thanks to the Java library Orekit. A down-dusk elliptical orbit between 500 and 1000km appeared as the best solution to reconcile the scientific aspect of the mission with the

power budget and the constraint imposed by the French legislation. From the visibility analysis, it was also stressed that the introduction of a ground station in Toulouse would be particularly welcome. The design of the Attitude and Orbital Control System focuses on the stabilisation of the three angular rates and the orientation of the satellite after its separation from the launcher, as well as on the transition between operational modes (e.g. Orbital Injection, Safe mode or Operational mode). Furthermore, while ensuring compliance with the launcher interface and the power requirements, the physical architecture is designed to optimize the available volume for the payload. Another design aspect is to carefully control the temperature of the CubeSat to ensure that all components are able to function properly.