31st IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Satellite Operations (3)

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AUTONOMOUS ADCS COMMISSIONING FOR NADIR POINTING SMALL SATELLITES

Abstract

The Next Generation Microsatellite Platform (NGMP) is intended to cause a paradigm shift in small satellite design. Through maximisation of the payload mass fraction by utilising a highly integrated platform avionics, it will provide the capabilities of a SmallSat at the price point of a CubeSat. This will reduce the cost of entry to space, making it more accessible and enabling innovative applications to flourish by using this highly performant platform. For a satellite investment to make money, the revenue generated needs to exceed both the upfront development costs as well as the ongoing operational costs. This promotes the need for greater autonomy in the spacecraft operations. This need is also driven by the recent emergence of large-scale satellite constellations which must minimise operator interaction in order to provide cost-effective solutions.

The Launch and Early Orbit Phase (LEOP) of small satellites and in particular, the commissioning of the Attitude Determination and Control System (ADCS), is an operationally intensive activity due to the complexity and high risk nature of space missions. However, ADCS commissioning is a repetitive process which does not differ drastically between the majority of Low Earth Orbit (LEO) spacecraft, regardless of their ultimate application. Most missions follow different operational flows in order to reach the same end state, whilst requiring high levels of human supervision.

Presented here is an ADCS design and a novel operational philosophy which minimises ground intervention during LEOP and meets the requirements for nadir pointing, small satellite missions requiring high control accuracy. An analysis of the potential failure mechanisms during LEOP is performed to remove single points of failure and implement robust recovery techniques. State diagrams for the ADCS software are provided, illustrating the logical flow through the commissioning process. Finally, the importance of this solution for the NGMP is evaluated. Utilisation of the proposed ADCS philosophy is imperative for reducing the cost of LEOP and minimising operator dependence of the NGMP and indeed, other small satellite missions.