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PROBA-3 MISSION: IN ORBIT DEMONSTRATION OF A HIGH PERFORMANCE RELATIVE POSITION AND ATTITUDE CONTROL

Abstract

Proba-3 is ESA's first high-precision formation flying mission. It is conceived as a small-scale technology demonstrating mission, consisting of two spacecraft flying in a close formation in a highly elliptical orbit. Proba-3 is currently about to start its Phase D and is scheduled to be launched by the end of the decade. As for all missions in the PROBA framework, also PROBA-3 includes a scientific objective: When flying in formation, both spacecraft will form a Sun coronagraph instrument, where one SC carries the optical payload while the companion forms the external (Sun disk) occulter. Due to the orbital dynamics, the formation is autonomously broken and re-acquired every orbit, having to control the relative position and pointing with very stringent performance requirements. In addition to the nominal scientific mission, several formation flying demonstrating manoeuvres will be performed including formation resizing, retargeting and roll.

There are multiple drivers which have led to the final design and implementation of the formation flying control. The controller has been designed as a robust 6DoF multi-input multi-output (MIMO) system which simultaneously takes care of both the attitude and the relative position accounting for the different dynamical environments needed for all mission operations. Being a low-cost mission, there are significant limitations in the available units for the spacecraft control. These had to be tackled in order to achieve the necessary performance.

This paper presents how the formation flying control has been designed and how the limitations have been overcome to meet all the needs at mission level. In addition, the most relevant validation results are presented, including robustness analysis results as well as the statistically varying parametrical (Monte-Carlo) simulations.