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THE RELATIVE STATION KEEPING SENSOR SYSTEM OF THE ESA PROBA-3 CONSTELLATION

Abstract

Spacecraft tight formation flight heralds a paradigm shift shortly, for space mission performances and design, and drive a wide specter of novel measurement techniques. Synthetic aperture systems with km to Mm baselines have been discussed for decades (e.g. Darwin and Lisa), but inadequate relative station keeping techniques has delayed progress in the field.

The ESA driven Proba-3 mission, currently expected to launch in 2022, will be the first mission operating two spacecraft in a controlled tight formation. The mission consists of a coronagraph on one space segment, which will observe the Sun's coronal region, while a second segment will act as solar occulter for the first segment. Diffraction effects are minimized and resolution in the inner corona region is improved by maintaining the occulter some 144m in front of the coronagraph to millimeter level relative position accuracy. This relative position is continuously measured using the Vision Based Sensor (VBS) system, by means of a double camera system on the occulter segment, which by deriving accurate positioning of 8 redundant LED mires on the coronagraph segment, offers transverse position accuracy better than 100μm on this baseline distance.

We describe the Proba-3 VBS system design in details, present advantages and constraints and provide validation of accuracy, robustness and autonomy from measurements from representative ground tests. Finally, we discuss the scalability immediately available to support the large baselines envisaged for synthetic aperture missions and short baselines needed for rendezvous and docking applications.