

Control development and challenges in space rendezvous & docking and formation flying

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Abstract

The control challenges in space rendezvous & docking and formation flying are presented. The control aspects of space rendezvous & docking are treated at SENER within the IBDM and SMART-OLEV projects, while formation flying control is the key issue of the future PROBA 3 project. The IBDM is an actively controlled Stewart platform enabling a rendezvous with another spacecraft similarly carrying an androgynous counterpart. A collision and successive contact between two opposing mechanisms is actively controlled with its six linear actuators in order to promote an alignment and subsequent mating. The IBDM control problem consists of numerous competing objectives including workspace and actuator constraints combined with the force control objectives during the capture phase. These are additionally complicated by the highly nonlinear system dynamics, high levels of rigidity and friction and the potentially wide range of mating spacecraft mass characteristics. The current modelling and control framework outlines the scheme for dealing with many of these issues, while others require the introduction of specially tailored advanced control methods. SMART-OLEV involves a different docking scheme with other types of complexities that the control formulation must deal with. Finally, formation flying control required in PROBA 3 is another major challenge in space control requiring advanced techniques in distributed control solutions.