ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation and Control (2) (6)

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LOW-EARTH ORBIT SPACECRAFT RELATIVE ORBIT AND ATTITUDE DECENTRALIZED ESTIMATION.

Abstract

In recent years, the field of spacecraft design is witnessing an emerging paradigm shift from traditional large single satellites to distributed small satellites acting in a collaborative manner. Several types of missions would be hardly achievable if not for a distributed space mission approach. In order to enable these emerging distributed space missions, critical technology activities need to be addressed. A critical field for mission success is spacecraft relative position and attitude estimation and control.

The proposed work is concerned with a study on relative navigation accuracy enhancement in a multi-satellites network thanks to the coupling between the relative orbital and attitude dynamics. The case of low-earth flying satellites, with a relatively strong coupling due to the atmospheric drag, is considered. Furthermore, a decentralized configuration of the estimation algorithm is suggested, where each satellite builds a local navigation estimate based on local measurements and transmitted information through inter-satellites links. The DelFFi mission is proposed as a case study; DelFFI is a two CubeSat formation flying mission by the Delft University of Technology in the framework of the QB50 mission.

The final manuscript will present the linearized relative orbit-attitude dynamics for a multi-satellites system, include an observability analysis of the coupled dynamical system, present the development of a decentralized relative orbit-attitude observer, and illustrate the proposed navigation algorithm performances through extensive numerical Monte-Carlo simulations. Performance comparisons with a decoupled attitude-orbit estimator and with a centralized estimator will be performed.