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DRAG-BASED ORBIT PHASING THROUGH ATTITUDE AND ARTICULATION CONTROL

Abstract

Modern small satellite constellations are demanding quick spacecraft commissioning and high duty cycle for their payload operations. In a conventional small satellite mission architecture, operations time is often split between different modes that require different spacecraft attitudes to achieve their goal. For example, drag-based orbit maneuvering can be used for creating relative separation between constellation members, and with spacecraft consisting of single rigid bodies, dedicated attitude manipulation is required to perform these operations. The attitudes that take advantage of the body asymmetries to modify the drag area are generally incompatible with the attitude maneuvering required for payload operations. At the constellation scale, these downtimes in the payload operation schedule can greatly reduce the overall capability of the system. By including deployable, articulating solar arrays in the design of small spacecraft, array pointing can be decoupled from the main payload pointing operations. With these pieces decoupled, payload operations can proceed uninterrupted while the articulating arrays enable power generation or drag-based orbit maneuvering. The focus of this paper is the demonstration of the articulating arrays as a means of enabling drag-based orbit phasing, while agile attitude maneuvering for payload operations proceeds concurrently. The dynamic equations of the multibody system are derived, and guidance, navigation, and control considerations for achieving decoupled attitude and articulation objectives are presented. Results are shown for attitude performance as well as for the orbit maneuvering performance achieved through array articulation.