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Small Distributed Space Missions (7B)

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ON IMPENDING SMALL SATELLITE FORMATION FLYING MISSIONS AND TECHNOLOGIES

Abstract

Small satellites are suitable for formation flying (FF) missions where a large number of spacecraft serve as distributed instruments for atmospheric sampling, construct a large distributed antenna platform, or make a large distributed aperture for imaging and other applications. Small satellites can enable distributed synthetic aperture radar (SAR), and interferometry inexpensively as compared to large conventional satellites. This paper presents a survey of 54 FF missions in various stages of development. An assessment of available technologies for relative sensing (position and attitude) and propulsion systems for small satellites will be presented. It is concluded that with the existing technologies, relative position sensing accuracy better than 0.01m over inter-satellite distances greater than 10m is not currently achievable. Moreover, it is shown by simulation that formation maintenance over 1 month for CubeSat-class missions separated by 100m or larger is not possible using the available thruster technology.

On the other hand, future science missions require much stringent requirements on position and attitude knowledge (at least an order of magnitude or more precise than those that can be met by the technologies available today). While many of the subsystem technologies are ready for implementation in space, further advanced developments are needed to enable the application of small satellites for formation flying missions that demand significant spacecraft and instrument pointing accuracies and autonomous onboard capability for maneuvering and reconfigurations.

Finally, the paper provides directions for future research and development in distributed spacecraft based on utilization of small satellite and instrument systems.