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SPACE SYSTEMS SYMPOSIUM (D1)
Enabling Technologies for Space Systems (2)

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DESIGN OF DOCKING MECHANISM FOR SMALL SPACECRAFT

Abstract

Docking mechanisms have been employed in space mission for more than 50 years. Since Apollo program, docking ports became unavoidable subsystems to connect different spacecraft. With the start of the Space Stations era, the new concept of standardization was born: the participation of different contractors from various countries led to the definition of common design requirements. However, this standardization progress involved only large space structures and manned missions: in the field of small commercial and scientific automatic spacecraft there is a lack of docking technologies research and development.

At the same time, the design and exploitation of small satellites can reduce the cost to access space. Large structures such as segmented mirrors telescopes or solar arrays fields can be realized through the mechanical connection of many small satellites. Deep-space multi-probe automatic exploration programs could also benefit the employment of docking systems to extend and reconfigure their mission profiles.

In this framework this paper presents a new concept of docking system for small satellites.

The proposed system has axis-symmetric interfaces with a "probe and drogue" logic; to perform docking and undocking maneuvers it respectively demands a well defined chaser approach velocity to activate the passive latches and propulsion abilities to perform separation, avoiding the implementation of active locking mechanisms.

The mechanism design and preliminary validation through numerical simulations is presented: 3-D modeling, kinematic and dynamic analysis guided the development of the interfaces geometry. More complex collisions avoidance and structural analysis led to the definition of instrumented prototypes to verify the solution through simple validation tests.