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SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems Concepts (1)

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MECHANICAL PERFORMANCES ANALYSIS OF THE VARIABLE TOPOLOGY SPACECRAFTS

Abstract

In order to adapt to the multi-functional requirements or space environment of space exploration and increasingly complicated space operations, modern spacecraft systems require the design of modern spacecraft structure towards the reconfiguration, modularization and transformation. The conventional spacecraft structures are facing more and more new challenges, such as rapid response and long-term on-orbit maneuver. This paper proposes to resolve these problems using variable topology spacecraft. The variable topology spacecraft is a sort of new spacecraft, which is proposed with a background of increasingly complicated and multiple space missions. It should be noted particularly that the variable topology spacecraft can change its topology configuration, kinematic or dynamic parameters during the process of movement. The variable topology spacecraft which based on the topology mechanism is a new type of spacecraft of self-reconfiguration. By the combination and split of the modules, the change of connecting relationship and changing the type of kinematic pair, topology mechanism can change the spacecraft configuration in the process of missions on orbit adapting to different space operations and expanding the scope of application of the conventional spacecraft. The methodology of the research of the design and dynamics of variable topology spacecraft is outlined in this paper. Firstly, three topology configurations (Hinge-unfolded Pattern, Drawer-like Pattern and Bolted Pattern) which are the basis of variable topology spacecraft are designed. Secondly, based on orbital and functional requirements, the thermal environment of variable topology spacecraft is analyzed. Thirdly, complicated variable topology process is divided into several single variable topology processes, and the topology configuration of the spacecraft in these sub-processes remains. Fourthly, the structure dynamics simulation of single variable topology process is completed based on topology mechanisms design and thermal environment analysis with ANSYS, ADAMS. The simulation result is considered as the spacecraft structure parameters at the moment of the end of this single variable topology process. Finally, the spacecraft structure parameters at the end of the last single variable topology process are supposed to be the initial parameters of the next one. Therefore, the whole variable topology process simulation with topology method is completed by iterating the analysis process above. More functions, more development. And we can conclude that it is meaningful application for reference to take variable topology spacecraft in the future.