Ultra-Light, Deployable Space-Truss Structures with Dynamic Response Mitigation

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ABSTRACT

This article is devoted to space truss structures commonly used for solar panel installations or telecommunication antennas. Such structures have obvious advantage of beneficial ratio of their stiffness to mass. One of challenges in satellite engineering is focused on special design of ultra-light structures (compacted during transportation to the orbit), able to deploy into large cantilever with e.g. photovoltaic panels (being on the orbit). This approach brings another advantage – the structure can better withstands the launch loads in compact configuration.

The structures on the orbit are subjected to thermal loads or can oscillate shortly after self-deploying. Therefore, an effective technique, in order to suppress the transient vibrations in low frequency range, is a very appealing solution. To this end, active (for example utilizing a force feedback control algorithm presented in [1]) and semi-active approaches (e.g. friction-based dampers [2-3]) have been developed by researchers.

The proposed smart topology (SMARTOP) of the structure allows easy, zero-energetic transformation from the compact, 2D form into the final, 3D configuration, making use of stored pre-stress energy, released with use of specially controlled clutches. Mitigation of dynamic structural response can be performed also playing with pre-stressing effect.

Numerical simulations of the SMARTOP structure functionalities will be presented. Main innovations are in specially design topology and so-called smart clutches performing controlled release of stored strain energy in a proper timing.

REFERENCES

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