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EXPERIMENTAL VERIFICATION OF TWO-DIMENSIONAL SELF-DEPLOYABLE SPACE STRUCTURES WITH CONVEX-PANEL

Abstract

This paper proposes a concept of two-dimensional self-deployable space structures using convex-panels and the feasibility is experimentally examined.

In deployable space structures, several research works have been performed for boom-membrane integrated deployable structures and deployable rigid-panel structures. In boom-membrane integrated deployable structures, because deployment force is concentratedly loaded on the membrane, the compressive loads on the booms become high. Therefore, the size of deployment is limited by buckling of the booms. In rigid-panel structures, because the panels are required for high bending stiffness, the thickness of the panels is high. Therefore, the size of deployment is limited by stowed volume.

The basic concept of convex-panel is generation of deployment force in deployable panel itself. Convex-panel is, like convex-tape, intentionally deflected and plural convex-panels are connected by adhesive tape to constitute a deployable structure. The deflection of convex-panel is flattened in the stowed configuration, resulting in storage of large strain energy. This strain energy generates the deployment force.

The proposed deployment method acts as distributed actuators for the deployable structures. The deployment force on every actuator is not so high. Therefore, this method can deploy large size deployable structures with avoiding buckling.

The proposed deployment method acts also as corrugated sheet after complete deployment. The deflected cross-sectional shape gives high bending stiffness to the structure. Therefore, the thickness of the panels can be low, resulting in a large size of deployment.

Several experimental models have been manufactured and examined to see the deployment properties to investigate the validity of the concept. We found that the deployment properties depend highly on the panel arrangement and we found a promising panel arrangement whose experimental model has successfully deployed in the deployment experiments.

In this study, the feasibilities of the two-dimensional self-deployable space structures with convex-panels are verified.