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FUNDAMENTAL CHARACTERISTICS OF SELF-DEPLOYABLE CONVEX SHELL USING SHAPE MEMORY POLYMER

Abstract

We propose a concept of self-deployable shell structures connected shape memory polymer (SMP) shells which are configured to the convex shape in this research, where the convex SMP shell is deformed from a flat configuration to convex one by heating it.

The shape recovery process of the SMP convex shell realizes a self-deployable and highly-stable structures because the shape recovery of the SMP is not based on a release of elastic hinge but the material response to recover the memorized convex shape. In addition, the recovered convex shape of the SMP shell has clearly far higher bending stiffness than that of the flat state.

Preliminary experiments for the small SMP shell were performed to examine the fundamental deployment characteristics of the SMP shell without any deployment force, and showed that the shape recovery process of the shell from given stowed shape to flat state was very stable. Also, the experimental results indicated that after the deployment the SMP shell has high out-of-plane stiffness by properly design the cross sectional shapes such as convex shape.

Finally, the concept of the self-deployable SMP shell structure was verified to have several advantages for deploying structure, (i) it can deploy without impact on the structure in the course of deployment by applying thermal control, (ii) the convex configuration improves the structural stiffness by attaching it to the target structures, and (iii) the magnitude of deformation of the convex SMP shell is smaller than that of the conventional hinge mechanisms.