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RELATIONSHIP BETWEEN STOWAGE CONDITIONS AND SELF-DEPLOYMENT PROPERTIES FOR SHAPE MEMORY POLYMER CONVEX SHELL

Abstract

This study investigates a low impact stable self-deployment of shape memory polymer convex shell. The deployable shell structures made of connected shape memory polymer (SMP) shells, which are configured to a convex shape. In this research, the convex SMP shell is deformed from a flat configuration to a convex one by heating it. The completeness and rate of deployment can be controlled to avoid a great impact to the structure in the course of deployment by applying thermal control, and to offer higher stiffness of the deployed structure due to the convex configuration of the shells. In addition, the shape recovery process of the SMP convex shell realizes self-deployable and highly stable deployment capabilities because the shape recovery of SMP utilizes material response to recover the memorized convex shape rather than the release of an elastic hinge. Experiments were performed for two-dimensional deployable structures with SMP convex shells to examine the relationship among material temperature, curvature of convex shells, and their elastic moduli. The shape recovery process of the shell from the given stowed shape to the memorized convex shape was shown to be very stable, and the experimental results indicated that the mechanical properties of the tape connecting each convex shell are significant in obtaining demanded deployed states. The deployment characteristics observed in the experiments demonstrated the achievement of complete deployment and the gradual decrease in the deployment speed, implying that low-impact deployment can be realized by this concept. Moreover, some adjustable conditions to make stowage conditions were examined to vary the deployment rate. As a result, the controllable stowage conditions has an effect to better deployment properties.