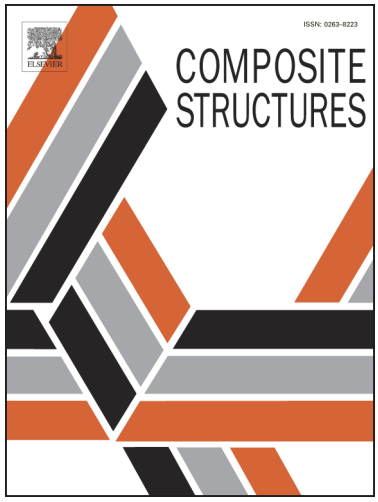

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Dynamic behaviors of phase transforming cellular structures

Jingran Liu, Huasong Qin and Yilun Liu*

State Key Laboratory for Strength and Vibration of Mechanical Structures, School of Aerospace Engineering, Xi'an Jiaotong University, Xi'an, China, 710049

Shaanxi Engineering Research Center of Nondestructive Testing and Structural Integrity Evaluation, Xi'an Jiaotong University, Xi'an 710049, China

*Corresponding author, yilunliu@mail.xjtu.edu.cn

Abstract: In this work, the dynamic behaviors of phase transforming cellular structures (PTCS) consisted of sinusoidal beam with bi-stable configurations are studied. A nonlinear spring-bead model is developed, where the mechanical properties of the sinusoidal beam are described by a nonlinear spring and the mass is concentrated at the bead. Therefore, the PTCS are modeled as a chain of nonlinear spring-bead. Based on the nonlinear spring-bead model, the quasi-static and dynamic behaviors of PTCS are theoretically and numerically studied, which shows abundant dynamic behaviors depending on the loading rate and damping coefficient. For a 2-layered PTCS, there are four deformation patterns, that is the snap through deformation of the sinusoidal beams for relative small loading rate and damping coefficient, the uniform deformation for relative large damping coefficient, and the pulse deformation of the springs near bi-stable configurations for relative large loading rate and small damping coefficient. While, for the multilayer PTCS, their dynamic behaviors are much more complicated due to the combined deformation of the multiple sinusoidal beams. However, the similar snap through and pulse deformation of the sinusoidal beams are also observed, respectively. To our knowledge, this work is the first time to systematically study the dynamic behaviors of PTCS.

Keywords: Phase transforming cellular structures; Sinusoidal beam; Bi-stable configurations; Nonlinear spring-bead model; Dynamic behaviors