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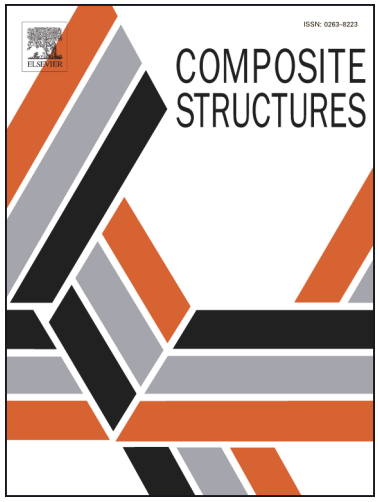

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Snap instability of shallow laminated cylindrical shells reinforced with functionally graded shape memory alloy wires

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Abstract

In the present paper, the snap buckling of the shallow SMA hybrid composite (SMAHC) cylindrical shells is investigated proposing the new algorithm with regard to the spatial and time variations of martensite volume fraction along the wires. The Crisfield-Ramm arc-length technique is employed to solve the nonlinear finite element formulations via FORTRAN code. In the current study, the spacing of the SMA wires is assumed to be changed gradually across the length and the width of the panel. As the thickness is very small, the volume gradient in the same direction should be tuned with changing of the wire diameters in each lamina. So far, the advantage of grading the SMA wires in all directions has never been cylindrical reported. The effect of the volume fraction of the SMA, type of the composite substrate, pre-tension of wires and the direction of the distribution of SMA wires, on snap instability modification are discussed in details. The results demonstrate the role of embedding SMA wires on the snap instability modification of shallow laminated shells in terms of increase of the upper limit load and the amount of the dissipated energy during the instability.

Keywords: Snap instability; Functionally graded; Hybrid composite; Phase-transformation algorithm; Shape memory alloy (SMA); Arc-length method.

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