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Thermal buckling analysis and stacking sequence optimization of rectangular and skew shape memory alloy hybrid composite plates

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Abstract

This paper deals with analysis and optimization of rectangular and skew composite plates with embedded Shape Memory Alloy (SMA) wires with respect to thermal buckling. The governing equations are derived based on First Order Shear Deformation Theory (FSDT) and the critical buckling temperatures are calculated using Generalized Differential Quadrature (GDQ) method. The influences of SMA volume fraction, lay-up orientation, pre-strain of SMA fibers, dependency of material properties on temperature, and geometrical parameters like skew angle on thermal buckling of the structure are examined. Results demonstrate that SMAs can play a significant role in delaying buckling when the structure is under thermal loads. Then, in the second part of results, optimization of shape memory alloy hybrid composite (SMAHC) plates is presented in order to maximize critical buckling temperatures. A four-layer composite plates with two SMA-reinforced layers is considered for the optimization problem in which the orientations of fibers are the optimization variables. As the critical buckling temperatures cannot be obtained through a closed-form solution, the optimization process takes a lot of time. Therefore, a powerful meta-heuristic algorithm called Firefly Algorithm (FA) which is based on the flashing fireflies, is implemented to find the best answers. A comprehensive verification

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