Temperature and strain feedback control for shape memory alloy actuated composite plate

ABSTRACT

There are several input variables that can be used to control the deflection of a shape memory alloy (SMA) composite system such as the resistance or temperature of the SMA actuator and position or strain of the composite plate. It is common to control the actuator directly, however SMA is nonlinear and it exhibits hysteresis which may result in inaccurate control of the plate's deflection. Thus controlling the plate's deflection may be more effective by using input measurement from the composite plate. The aim of this study is to propose the optimal feedback variable deflection control of a fiberglass composite plate system using SMA actuators. Two types of variables were investigated which were temperature of the SMA actuator and strain of the composite plate. The feedback control system for SMA actuated composite plate was implemented with different types of sensors; thermocouple and strain gauge. When current is supplied to the SMA actuator, it will contract and produce a force that will deflect the composite plate. During this process, the SMA actuator's temperature changes with the current supplied and the strain of the composite plate changes during deflection due to torsion and bending. Thus, it is proposed to use these variables as the input to the feedback of the smart composite plate system to control the movement of the plate. Using the adopted control technique of the experimental test bench presented here, the strain feedback system was more effective and energy efficient compared to the temperature feedback for the control of morphing composite plate.

Keyword: Feedback control; Composite; Shape memory alloy; Temperature; Strain