MICRO-CONTROL ACTIONS OF SEGMENTED ACTUATORS LAMINATED ON PARABOLOIDAL SHELL REFLECTORS

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Abstract

Shallow paraboloidal shells of revolution are common components for reflectors, mirrors, etc. This study investigates the micro-control actions and distributed control effectiveness of precision paraboloidal shell structures laminated with segmented actuator patches. Mathematical models and governing equations of the paraboloidal shells laminated with distributed actuator layers segmented into patches have been developed. This was done by defining the distributed control forces and micro-control actions to include meridional/circumferential membrane and bending control components. This is based on an assumed mode shape function and the Taylor series expansion. The distributed control forces, patch sizes, actuator locations, micro-control actions, and normalized control authorities of a shallow paraboloidal shell are analyzed in a case study. Analysis indicates that 1) the control forces and membrane/bending components are mode and location dependent, 2) the meridional/circumferential membrane control actions dominate the overall control effect, 3) there are optimal actuator locations resulting in the maximal control effects at the minimal control cost for each natural mode. Analysis results provide generic design guidelines for actuator placement on precision shallow paraboloidal shell structures.
