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Back to results | 1 of 1

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Estimating ensemble average power delivered by a piezoelectric patch actuator to a non-deterministic subsystem (Article)

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Abstract

View references (20)

Engineering systems such as aircraft, ships and automotive are considered built-up structures. Dynamically they are taught of as being fabricated from many components that are classified as 'deterministic subsystems' (DS) and 'non-deterministic subsystems' (Non-DS). Structures' response of the DS is deterministic in nature and analysed using deterministic modelling methods such as finite element (FE) method. The response of Non-DS is statistical in nature and estimated using statistical modelling technique such as statistical energy analysis (SEA). SEA method uses power balance equation, in which any external input to the subsystem must be represented in terms of power. Often, input force is taken as point force and ensemble average power delivered by point force is already well-established. However, the external input can also be applied in the form of moments exerted by a piezoelectric (PZT) patch actuator. In order to be able to apply SEA method for input moments, a mathematical representation for moment generated by PZT patch in the form of average power is needed, which is attempted in this paper. A simply-supported plate with attached PZT patch is taken as a benchmark model. Analytical solution to estimate average power is derived using mobility approach. Ensemble average of power given by the PZT patch actuator to the benchmark model when subjected to structural uncertainties is also simulated using Lagrangian method and FEA software. The analytical estimation is compared with the Lagrangian model and FE method for validation. The effects of size and location of the PZT actuators on the power delivered to the plate are later investigated. © 2013 Elsevier Ltd.

Indexed keywords

Analytical estimations
Deterministic modelling
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