SM25S_11536

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Optimal Shapes of Parametrically Excited Beams

Alexei A. Mailybaev[(1)], Hiroshi Yabuno[(2)], Hiroyuki Kaneko[(2)]

(1) *Institute of Mechanics, Moscow State University, Russia*
(2) *Institute of Engineering Mechanics, University of Tsukuba, Japan*

Straight elastically supported beams of variable width under the action of a periodic axial force are considered. Two shape optimization problems for reducing parametric resonance zones are studied. In the first problem, the range of resonant frequencies is minimized for a given parametric resonance zone and a fixed amplitude of excitation. In the second problem, the minimal (critical) amplitude of the excitation force is maximized. These two optimization problems are proved to be equivalent in case of small external damping and small excitation force amplitude. It is shown that optimal designs have strong universal character, i.e., they depend only on the natural modes involved in the parametric resonance and boundary conditions. Efficient numerical method of optimization is developed. Optimal beam shapes are found for different boundary conditions and resonant modes. Experiments for uniform and optimal simply supported beams are conducted, which show a very good agreement with theoretical prediction.

View the extended summary