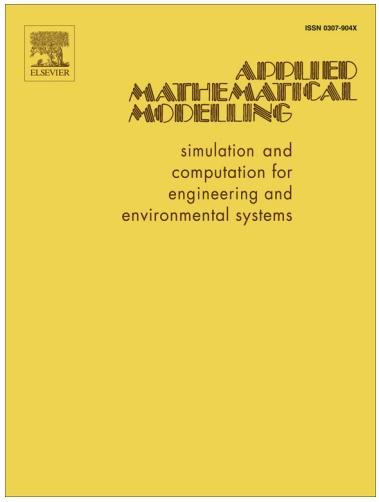

Free vibration analysis of a finite-length isotropic solid elliptic cylinder using exact three dimensional elasticity theory

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PII: S0307-904X(13)00240-0
DOI: http://dx.doi.org/10.1016/j.apm.2013.03.066
Reference: APM 9429

To appear in: *Appl. Math. Modelling*

Received Date: 9 February 2012
Revised Date: 5 March 2013
Accepted Date: 24 March 2013

Please cite this article as: S.M. Hasheminejad, A. Ghaheri, Free vibration analysis of a finite-length isotropic solid elliptic cylinder using exact three dimensional elasticity theory, *Appl. Math. Modelling* (2013), doi: http://dx.doi.org/10.1016/j.apm.2013.03.066

FREE VIBRATION ANALYSIS OF A FINITE-LENGTH ISOTROPIC SOLID ELLIPTIC CYLINDER USING EXACT THREE DIMENSIONAL ELASTICITY THEORY

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ABSTRACT-A three-dimensional analytical model based on Navier's displacement equation of motion is developed to describe the free vibrations of a simply supported elastic isotropic solid elliptical cylinder of finite length. Helmholtz decomposition theorem is invoked and the classical technique of separation of variables in elliptical coordinates is employed to solve the subsequent uncoupled governing differential equations as products of ordinary and modified Mathieu functions. Inclusive numerical data are provided in a systematic manner for the first several symmetric/anti-symmetric eigen-frequencies as a function of cross sectional eccentricity for selected cylinder length ratios. The incidences of "mode crossing" and "frequency veering" among different modes of the same symmetry group as well as swapping of the corresponding mode shapes in the veering region are examined. Also, selected three dimensional deformation mode shapes are illustrated. The precision of calculations is checked by performing proper convergence studies, and the correctness of results is demonstrated using a commercial finite element software as well as by comparison with the information in the accessible literature. The collection of presented data is believed to be the first meticulous attempt to determine the free vibration frequencies of finite-length simply-supported elastic elliptical cylinders in an exact manner.