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Structural changes assessment in axial stressed beams through frequencies variation

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Abstract

This paper concerns the localization and quantification of simultaneous structural modifications by dynamic analysis in Euler-Bernoulli beams, with or without axial force. A first-order estimation of frequency relative variation is derived from the continuous formulation. In case of localized variations of density and bending stiffness, this relation is a linear function of the relative variations of axial force, density, and bending stiffness, with nonlinear coefficients depending on the location of density and bending stiffness modification. These coefficients depend on the mode shapes of the initial state and not on the modes shapes of the modified beam. Taking advantage of the necessary compatibility of the estimations obtained for each frequency variation, a criterion is proposed to localize the modification. Once the location is determined, the coefficients of the linear system can be calculated and then the quantification of the relative variations is obtained. This localization and quantification procedure is then applied successfully to numerical simulations with simultaneous modifications of axial force, density, and bending stiffness. For validation, the method is applied to experimental data concerning beams without axial force and with mass modification or bending stiffness only. The results for the bending stiffness modification are discussed and compared to those obtained in literature.

Keywords: **structural health monitoring / modal analysis / damage detection / localization of notches / Euler-Bernoulli beam / axial stressed beam /**

1. Introduction

The demand for enhanced performance and reliability of structures in terms of safety, noise-level and durability is ever increasing. Over the past few decades significant research have been conducted on structural

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