### Author's Accepted Manuscript

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 PII:
 S0020-7403(16)00067-9

 DOI:
 http://dx.doi.org/10.1016/j.ijmecsci.2016.02.008

 Reference:
 MS3236

To appear in: International Journal of Mechanical Sciences

Received date: 1 July 2015 Revised date: 2 February 2016 Accepted date: 13 February 2016

Cite this article as: T.-T.-H. Le, N. Point, P. Argoul and G. Cumunel, Structural changes assessment in axial stressed beams through frequencies variatior *International Journal of Mechanical Sciences* http://dx.doi.org/10.1016/j.ijmecsci.2016.02.008

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#### ACCEPTED MANUSCRIPT

# Structural changes assessment in axial stressed beams through frequencies variation

T.-T.-H. Le<sup>a</sup>, N. Point<sup>a</sup>, P. Argoul<sup>a,b</sup>, G. Cumunel<sup>a,\*</sup>

<sup>a</sup>University Paris-Est, Laboratoire NAVIER (UMR 8205 CNRS-ENPC-IFSTTAR), Ecole des Ponts ParisTech, 6 et 8 Avenue Blaise Pascal, 77455 Marne-la-Vallée, France <sup>b</sup>University Paris-Est, IFSTTAR (MAST/SDOA), 14-20 Boulevard Newton Champs-sur-Marne, F-77447 Marne-la-Vallée 2, France

#### 8 Abstract

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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 10 relative variation is derived from the continuous formulation. In case of localized variations of density and 11 bending stiffness, this relation is a linear function of the relative variations of axial force, density, and 12 bending stiffness, with nonlinear coefficients depending on the location of density and bending stiffness 13 modification. These coefficients depend on the mode shapes of the initial state and not on the modes shapes 14 of the modified beam. Taking advantage of the necessary compatibility of the estimations obtained for each 15 frequency variation, a criterion is proposed to localize the modification. Once the location is determined, 16 the coefficients of the linear system can be calculated and then the quantification of the relative variations 17 is obtained. This localization and quantification procedure is then applied successfully to numerical sim-18 ulations with simultaneous modifications of axial force, density, and bending stiffness. For validation, the 19 method is applied to experimental data concerning beams without axial force and with mass modification 20 or bending stiffness only. The results for the bending stiffness modification are discussed and compared to 21 those obtained in literature. 22

23 Keywords: structural health monitoring / modal analysis / damage detection / localization

<sup>24</sup> of notches / Euler-Bernoulli beam / axial stressed beam /

#### 25 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

Preprint submitted to International Journal of Mechanical Sciences

<sup>\*</sup>Corresponding author

*Email addresses:* thi-thu-ha.le@eleves.enpc.fr (T.-T.-H. Le), nelly.point@enpc.fr (N. Point), pierre.argoul@ifsttar.fr (P. Argoul), gwendal.cumunel@enpc.fr (G. Cumunel)

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