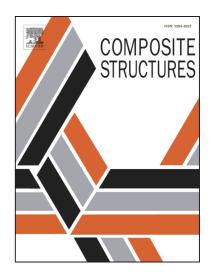
Accepted Manuscript

Nonlinear dynamical analysis of 3D textiles based on second order gradient homogenized media

H. Reda, Y. Rahali, J.F. Ganghoffer, H. Lakiss

PII:	S0263-8223(16)31221-1
DOI:	http://dx.doi.org/10.1016/j.compstruct.2016.07.053
Reference:	COST 7653
To appear in:	Composite Structures
Received Date:	17 July 2016
Accepted Date:	19 July 2016



Please cite this article as: Reda, H., Rahali, Y., Ganghoffer, J.F., Lakiss, H., Nonlinear dynamical analysis of 3D textiles based on second order gradient homogenized media, *Composite Structures* (2016), doi: http://dx.doi.org/10.1016/j.compstruct.2016.07.053

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Nonlinear dynamical analysis of 3D textiles based on second order gradient homogenized media

H. Reda^{1,2}, Y. Rahali³, J.F. Ganghoffer^{1,*}, H. Lakiss² ¹LEMTA, Université de Lorraine. 2, Avenue de la Forêt de Haye. TSA 60604, 54504 Vandoeuvre-les-Nancy, France ²Faculty of Engineering, Section III, Lebanese University, Campus Rafic Hariri, Beirut, Lebanon ³Unité de recherche de mécanique des solides, structures et développements technologiques. ESSTT. Université de Tunis, BP56, Bab Mnara 1008, Tunisia

Abstract

The general objective of this contribution is the analysis of wave propagation phenomena within architecture media, relying on an effective substitution continuum obtained by homogenization. The proposed methodology is quite general and applicable to any 3D repetitive network of beamlike structural elements, considering beams undergoing large transformations. Based on the writing of the equations of motion of a nonlinear second order gradient continuum, we analyze the nonlinear wave propagation in the obtained homogenized nonlinear second order gradient continuum. The resulting wave equations are of Boussinesq type, the solution of which being elliptic functions. The influence of the degree of nonlinearity on the dispersion relations is analyzed, highlighting subsonic and supersonic modes propagating respectively with a velocity lower (resp. higher) than the velocity of linear non-dispersive waves. Subsonic and supersonic modes correspond respectively to regimes of high and low nonlinearity characterized by the so-called universal constant. The three modes of propagation (longitudinal, vertical and horizontal shear) are compared in terms of dispersion relations, phase and group velocity diagrams.

The existing anisotropy of wave propagation becomes more marked when the degree of linearity increases. The horizontal and vertical shear modes disappear successively when increasing the wavenumber.

Keywords: second gradient nonlinear continuum models; nonlinear wave propagation; homogenization methods; wave dispersion effects; subsonic and supersonic modes, textile structures.

1. Introduction

Architectured materials, and especially repetitive network materials made of structural elements like beams, constitute a wide class of structures having the capacity to filter waves in certain directions and frequency range. The mechanical response of such networks has fostered a lot of research activity in the literature, but the evaluation of their dynamical and acoustic properties [1,2] remains a scientific challenge [3-9]. The dynamic response and wave propagation properties of periodic lattices and structures have raised numerous studies especially in aeronautics, for the objective of reducing or absorbing vibrations, shock and sound in structural components [1,2]. Materials [10,11], structures and devices [12] exploiting spatial periodicity are involved in a growing number of areas, such as ultra light architectured materials [10,11,13], phononic crystals [8,5,14-22], or acoustic metamaterials [3-7] and [23-25]. These structures raised in the recent

Download English Version:

https://daneshyari.com/en/article/6705141

Download Persian Version:

https://daneshyari.com/article/6705141

Daneshyari.com