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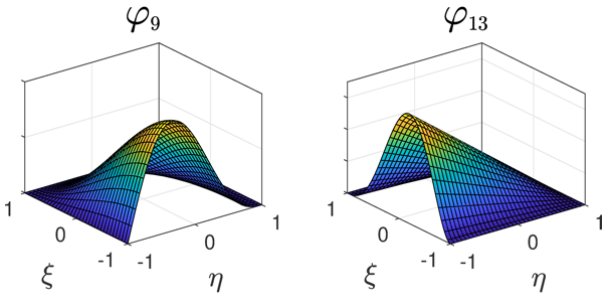
PREDAVANJE

Laminated Kirchhoff nanoplates based on the strain gradient theory: development of conforming and nonconforming finite element models

Dr. Michele Bacciocchi
University of San Marino, DESD Department



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Biography

Michele Bacciocchi was born in San Marino, October 3rd, 1990. He obtained the Bachelor and Master's degrees in Civil Engineering at the University of Bologna (Italy) in 2012 and 2014, both with grade 110/110 cum laude. PhD in Civil, Chemical, Environmental, and Materials Engineering was accomplished at the same University in 2018.

From November 2017 to November 2018, he was Research Fellow at the University of Bologna (Italy). From October 2018, he held his task of Adjunct Professor at the University of Bologna (Italy) and at the University of San Marino (San Marino). From March 2021 to February 2022, he was Research Fellow at the University of Modena and Reggio Emilia (Italy).

Currently, he is Assistant Professor at the University of San Marino, in the field of Structural Mechanics. He is teacher of "Advanced Structural Mechanics" and "Computational Mechanics" at the same institution.

His present research is focused on the numerical analysis of laminated composite plates made of innovative materials. The development of finite element codes to deal with the static and dynamic response of these structures is also his interest. Likewise, the latest research is focused on green materials and solutions for sustainable buildings and constructions.

He is author of more than 58 international peer reviewed journal papers, 6 books (in Italian and English) and more than 30 abstracts in national and international conferences. He was member of the organizing committee (Conference Co-Chair) of 6 International Conferences on composite structures and materials.

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Abstract

Laminated Kirchhoff nanoplates based on the strain gradient theory: development of conforming and nonconforming finite element models

Dr. Michele Bacciocchi
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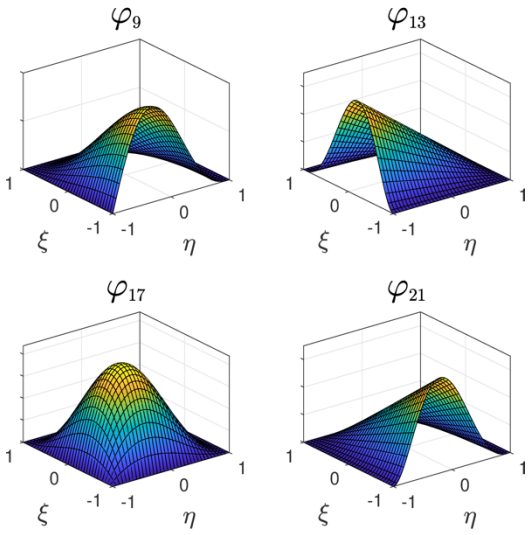

Nonlocal theories are becoming more and more popular due to the increasing use and analysis of micro- and nano-scaled structural elements. Classical continuum theories turn out to be inadequate to model such components. In particular, the mechanical behavior of these nanostructures is influenced by the material microstructure.
The strain gradient theory takes into account the micro/macro scale interactions by introducing the internal length into the definition of the three-dimensional stress components. Consequently, computational difficulties clearly arise from this constitutive assumption, due to the fact that stress-strain relations depend on the nonlocal nature of the model.
As far as plate structures are concerned, the strain gradient theory is limited to the analysis of isotropic and graded structures. General lamination schemes, as well as arbitrary boundary conditions, are not taken into account.
The main aim of this research is the development of a finite element code based on the strain gradient theory able to deal with thin laminated plates, extending the analysis to general stacking sequence and various restraints. Such studies are carried out in the theoretical framework provided by the Kirchhoff model.
Conforming and nonconforming finite elements are developed to this aim. In particular, higher-order Hermite interpolation functions are employed to approximate both membrane and bending degrees of freedom.
This numerical approach is validated by the comparison with the results taken from the literature for isotropic and simply supported laminated plates. Analytical solutions are available only for cross-ply and angle-ply lamination schemes. A simple and effective matrix notation is developed in order to simplify the computer implementation.