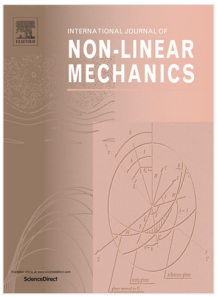
Accepted Manuscript



Nonlinear large deformation analysis of shells using the variational differential quadrature method based on the six-parameter shell theory

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PII: S0020-7462(18)30078-7
DOI: https://doi.org/10.1016/j.ijnonlinmec.2018.08.007
Reference: NLM 3065

To appear in: *International Journal of Non-Linear Mechanics*

Received date : 6 February 2018
Revised date : 11 August 2018
Accepted date : 16 August 2018

Please cite this article as: R. Ansari, E. Hasrati, A.H. Shakouri, M. Bazdid-Vahdati, H. Rouhi, Nonlinear large deformation analysis of shells using the variational differential quadrature method based on the six-parameter shell theory, *International Journal of Non-Linear Mechanics* (2018), https://doi.org/10.1016/j.ijnonlinmec.2018.08.007

Nonlinear large deformation analysis of shells using the variational differential quadrature method based on the six-parameter shell theory

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Abstract

The present work is concerned with the application of the variational differential quadrature (VDQ) method [Appl. Math. Model., vol. 49, pp. 705–738], in the area of computational mechanics, to the nonlinear large deformation analysis of shell-type structures. To this end, based on the six-parameter shell model, the functional of energy in quadratic form is derived based on Hamilton's principle which is then directly discretized by the VDQ technique. The formulation of article is presented in a general form so that it can be readily used for different structures such as beams, annular plates, cylindrical shells and hemispherical shells under various loading conditions. In order to reveal the accuracy of developed solution strategy, it is tested in several popular benchmark problems for the geometric nonlinear analysis of shells. The results show that the present numerical method is capable of yielding highly accurate solution in the nonlinear large deformation analysis of shells. It is also easy to implement due to its compact and explicit matrix formulation.

Keywords: Large deformation analysis; Six-parameter shell model; Variational differential quadrature method

1. Introduction

Shells are fundamental engineering structures with various applications in different fields [1-3]. Hence, studying their mechanical behaviors has been the subject of many research works up to now. In particular, the large deformation analysis of shells is a challenging topic in the related literature. One can follow this field of research from the work of Sabir and Lock in

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