J. Appl. Comput. Mech., 4(5) (2018) i-iii
DOI: 10.22055/JACM.2018.13916

ISSN: 2383-4536
jacm.scu.ac.ir

M&MoCS
Shahid Chamran University of Ahvaz

Journal of
Applied and Computational Mechanics

Editorial

Preface

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Published Online November 25 2018.
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Abstract. In a friendly meeting between Professor Manolis Papadrakakis (Technical University of Athens, Athens, Greece), Dr. Michalis Fragiadakis (Technical University of Athens, Athens, Greece), Dr. Vissarion Papadopoulos (Technical University of Athens, Athens, Greece) and Dr. Aram Soroushian (Structural Engineering Research Centre, International Institute of Earthquake Engineering and Seismology, Tehran, Iran), on June 2017, the idea of this special issue was initiated. Many invitations for paper submission were sent to specialists, academics, and experts, around the globe, while two members were added to the guest editorial team, and the Journal of Applied and Computational Mechanics was set for the publication. The received papers first experienced a round of revision for enhancement of the papers and then were subjected to the ordinary peer-revision procedure of the Journal of Applied and Computational Mechanics. The consequence is the six papers presented in this special issue.

Special Issue: Applied and Computational Issues in Structural Engineering.

1. Introduction

The Special Issue contains six peer-reviewed papers. The papers cover various aspects of applied computational and experimental structural and mechanical engineering, including nonlinear analysis of shells, time integration and the numerical stability, different finite element analysis methods, wave motion, mixed strong form representation, and out flow discharge.

2. Authors and abstracts

1. Mohammad Rezaiee-Pajand; E. Arabi: On the Geometrically Nonlinear Analysis of Composite Axisymmetric Shells.

Composite axisymmetric shells have numerous applications; many researchers have taken advantage of the general shell element or the semi-analytical formulation to analyze these structures. The present study is devoted to the nonlinear analysis of composite axisymmetric shells by using a 1D three nodded axisymmetric shell element. Both low and higher-order shear deformations are included in the formulation. The displacement field is considered to be nonlinear function of the nodal rotations. This assumption eliminates the restriction of small rotations between two successive increments. Both Total Lagrangian Formulation and Generalized Displacement Control Method are employed for analyzing the shells. Several numerical tests are performed to corroborate the accuracy and efficiency of the suggested approach.

2. Elisabetta Manconi; Sergey Sorokin; Rinaldo Garziera; Alf Soe-Knudsen: Wave Motion and Stop-Bands in Pipes with Helical Characteristics Using Wave Finite Element Analysis.

Pipes are widely used in many industrial and mechanical applications and devices. Although there are many different constructions according to the specific application and device, these can show helical pattern, such as spiral pipes, wire-reinforced pipes/shells, spring-suspension, and so on. Theoretical modelling of wave propagation provides a prediction about the dynamic behavior, and it is fundamental in the design process of these structures/devices and in structural health monitoring techniques. However, standard approaches have limitations in terms of difficulties in modelling and impossible computational cost at higher frequencies. In this study, the wave characteristics in waveguides with helical patterns are obtained using a Wave Finite Element (WFE) method. The method is described for a 1D and 2D waveguide with helical properties and it is illustrated by numerical examples. These include the optimization of stop-bands for a fluid-filled pipe with concentrated masses and a cylindrical structure with helical orthotropy.

3. David Tae; Kumar K. Tamma: Mixed Strong Form Representation Particle Method for Solids and Structures.

In this paper, a generalized particle system (GPS) method, a general method to describe multiple strong form representation based particle methods is described. Gradient, divergence, and Laplacian operators used in various strong form based particle method such as moving particle semi-implicit (MPS) method, smooth particle hydrodynamics (SPH), and peridynamics, can be described by the GPS method with proper selection of parameters. In addition, the application of mixed formulation representation to the GPS method is described. Based on Hu-Washizu principle and Hellinger-Reissner principle, the mixed form refers to the method solving multiple primary variables such as displacement, strain and stress, simultaneously in the FEM method; however for convenience in employing FEM with particle methods, a simple representation in construction only is shown. It is usually applied to finite element method (FEM) to overcome numerical errors including locking issues. While the locking issues do not arise in strong form based particle methods, the mixed form representation in construction only concept applied to GPS method can be the first step for fostering coupling of multi-domain problems, coupling mixed form FEM and mixed form representation GPS method; however it is to be noted that the standard GPS particle method and the mixed for representation construction GPS particle method are equivalent. Two dimensional simple bar and beam problems are presented and the results from mixed form GPS method is comparable to the mixed form FEM results.

4. Ebrahim Izadpanah; Saeed Shojaee; Saleh Hamzehei-Javaran: Time-Discontinuous Finite Element Analysis of Two-Dimensional Elastodynamic Problems using Complex Fourier Shape Functions.

This paper reformulates a time-discontinuous finite element method (TD-FEM) based on a new class of shape functions, called complex Fourier hereafter, for solving two-dimensional elastodynamic problems. These shape functions, which are derived from their corresponding radial basis functions, have some advantages such as the satisfaction of exponential and trigonometric function fields in complex space as well as the polynomial ones simultaneously, that make them a better choice than classic Lagrange shape functions, which only can satisfy polynomial function field. To investigate the validity and accuracy of the proposed method, three numerical examples are provided and the results obtained from the present method (complex Fourier-based TD-FEM) and the classic Lagrange-based TD-FEM are compared with the exact analytical solutions. According to them, using complex Fourier functions in TD-FEM leads to more accurate and stable solutions rather than those obtained from the classic TD-FEM.

5. Abdolreza Astaraki; Mahmood Hosseini; Aram Soroushian; Mohammadreza Jalili Ghazizadeh: Experimental and Numerical Investigations on the Effect of Rectangular Openings' Aspect Ratio on Outflow Discharge.

Up to now, a few formulas have been suggested by scholars for the amount of discharge from openings, however, the effect of opening's geometry on the amount of discharge has not addressed thoroughly. In this study, to assess the effect of rectangular openings' aspect ratio on the discharge amount, experimental and numerical investigations have been conducted on the discharge amount from rectangular openings at the bottom of tanks. In the experimental part of the study different water depths have been considered and the amounts of discharge have been measured for openings with identical area, but different aspect ratios. In the numerical part of the study the test results have been compared to those obtained from finite-volume-based numerical simulation. The experimental and numerical results are in good agreement, and both show that there is a trend of increase in the amount of discharge with increase of the opening's aspect ratio. The amount of this increase is from 13% to 21% for hydraulic head varying between 0.3 to 0.6 meters. On this basis, the conventional orifice formula for calculation of the rectangular opening discharge needs modification.

6. Aram Soroushian: A General Rule for the Influence of Physical Damping on the Numerical Stability of Time Integration Analysis.

The influence of physical damping on the numerical stability of time integration analysis is an open question since decades ago. In this paper, it is shown that, under specific very general conditions, physical damping can be disregarded when studying the numerical stability. It is also shown that, provided the specific conditions are met, analysis of structural systems involved in extremely high linear-viscous damping is unconditionally stable. A secondary achievement is that, when the linear-viscous damping increases, the numerical damping may increase or decrease.

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