Editorial

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Special Issue on Nonlinear Dynamics

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The papers published in the Special Issue were selected by the Guest Editors, Professor Yuri Mikhlin, Professor Matthew Cartmell, and Professor Jerzy Warminski from papers presented at the mini-symposia ''Nonlinear Dynamics of Structural and Machine Elements'' and ''Nonlinear Phenomena in Mechanical and Structural Systems'' in the framework of the Eighth European Nonlinear Dynamics Conference (ENOC 2014) which took place at the Vienna University of Technology, Vienna, Austria, on 6–11 July 2014.

The goal of this special issue is to collect the best papers from different disciplines but with the common scientific purpose of demonstrating the importance of certain fascinating phenomena found in nonlinear dynamics that do not necessarily exist in the linear scientific world. The beauty and importance of nonlinear dynamics is therefore demonstrated both in the novel theoretical models and technological applications that are presented in this selection of papers.

There are nine research articles contained within this special issue, all of which relate directly to concrete problems in engineering and present diverse and interesting applications for modern analytical and numerical modelling techniques.

The contents of the nine papers of the special issue can be briefly summarised, as follows.

1. Nonlinear interactions in deformable container cranes by A. Arena, W. Lacarbonara and M. P. Cartmell

Nonlinear dynamic interactions are investigated in harbour quayside cranes due to a two-to-one internal resonance and a three-dimensional model of a typical container crane hoisting system is derived, accounting for the elastic interactions between the crane boom and the container dynamics. The reduced governing equations of motion are obtained by using the Euler-Lagrange equations employing the mode shapes of the two-span crane boom as trial functions. Examination of the fixed points of the modulations equations, together with a stability analysis yields a rich bifurcation behaviour. It is shown that the consideration of cubic nonlinearities beyond the usual quadratic geometric and inertia nonlinearities encountered in such a system leads to bifurcations that are not predicted by low order analysis.

2. Nonlinear energy sink with combined nonlinearities: enhanced mitigation of vibrations and amplitude locking phenomenon by N. Benarous and O. V. Gendelman

This article presents the dynamic response of a primary linear oscillator with a nonlinear energy sink (NES) that comprises a purely cubic oscillator with an internal rotator. It is demonstrated that this NES remains efficient for a much broader range of initial energies as compared to a regular cubic NES operating with the same mass.

3. Vibrations of beams with a breathing crack and large amplitude displacements by G.N. Carneiro and P. Ribeiro

The influence of a geometrical nonlinear effect on the vibrations of a beam containing a breathing crack is demonstrated in this paper. The derived mathematical model takes into account the opening and closing of the crack and this introduces asymmetries into the dynamical response. It is shown that the crack influences mainly the accelerations and velocities of the response of the nonlinear beam.

4. Dynamic instability of ring-stiffened conical thin-walled rocket fairing in supersonic gas stream by M. V. Chernobryvko, K. V. Avramov, V. N. Romanenko, T. J. Batutina, and U. S. Suleimenov

In the paper, a dynamical model of ring-stiffened conical shells operating in a supersonic gas stream is

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derived and investigated. The principle result is that the shell space mode is analysed for the case of a Hopf bifurcation when the dynamic stability of the shell is lost.

5. Modelling and simulation of a compliant tilting-pad air bearing by F. Duijnhouwer and H. Nijmeijer

The Compliant Tilting Pad Air Bearing concept in which a tilting pad bearing with the pivot of the pads placed on radial springs is a promising aerodynamic bearing solution. This model is used in nonlinear time domain analysis for rotor systems fitted with this type of bearing and can be used to predict their stability. Two- and three-dimensional time domain simulations in which the model is implemented are discussed in detail.

6. Large amplitude vibrations of heated Timoshenko beams with delaminations by E. Manoach, J. Warminski and A. Warminska

In this work, the large amplitude vibration is investigated in a heated Timoshenko composite beam with delaminations. The model considers contact interaction between sub-laminates including normal forces, shear forces and additional damping due to the interactions between the sub-laminates. The influences of the delamination, geometrical nonlinearity and elevated temperature on the beam response are all analysed in detail.

7. Nonlinear vibrations of fluid-filled functionally graded cylinders considering a time dependent lateral load and static preload by F. Silva, R. Montes, P. Goncalves and Z. Del Prado

This paper considers the nonlinear vibrations of a simply supported fluid-filled functionally graded cylindrical shell subjected to a lateral time-dependent load and axial static preload. The Donnell theory and the piston theory are both used to describe the shell-fluid interaction. The perturbation technique and the Galerkin method are then applied. The influence on the natural frequencies of variations in the two constituent materials along the shell thickness is discussed, in the context of bifurcation.

8. Characterizing the nonlinear behavior of a pseudo-elastic oscillator via the wavelet transform by V. Piccirillo, J. M. Balthazar, A. M. Tusset, D. Bernardini and G. Rega

In this article, a nonlinear shape-memory oscillator (SMO) which is subjected to an ideal and non-ideal excitation is investigated. The restoring force is described by a thermomechanical model which is capable of detecting hysteretic behaviour. The SMO can exhibit periodic or non-periodic responses, and the effects of external sources on the oscillator are explained through the scalogram analysis of a continuous wavelet transform by introducing a new measure which is termed the *Scale Index*.

9. Dynamics of nonlinear variable helix milling by N. D. Sims

This new study explores two aspects of variable helix tool stability, namely, the role of nonlinear cutting stiffness and the role of multi-frequency effects. The single-frequency solution is first described, based upon a Laplace transformation of the equations of motion. This solution is then compared to previous multi-frequency predictions by the author. It is concluded that the multi-frequency and tool loss-of-contact phenomena have a greater influence on the variable helix stability.

As a final remark, we would like to thank all the authors for their contributions, and we hope that this special issue will be useful to other researchers in the development of further investigations in the field of nonlinear dynamics and its many applications in engineering. We are pleased to acknowledge the assistance provided to us in preparing this special issue by Professor John Chew, the Editor-in Chief of the Journal of Mechanical Engineering Science, Part C, and Kate Walsh of SAGE.

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Editors