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Preface

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This Special Issue, entitled *New trends in Dynamics and Stability* aims to provide an up-to-date overview on recent research results obtained within GADeS: the AIMETA Group of Dynamics and Stability. This group, which is part of AIMETA, the Italian Association of Theoretical and Applied Mechanics, was founded in 2012 aiming to stimulate the development of interdisciplinary research activities involving scientists with different cultural backgrounds. Applications originated from civil and mechanical engineering, that is, concerned about solid dynamics, structural dynamics, machine dynamics, dynamical system theory, stability, bifurcation and control theory: the specific themes of interest of GADeS are comprised in this Special Issue. The authors who were invited to contribute to the project investigate the mentioned subjects using different viewpoints, such as applied mathematics as well as techniques in different branches of research in civil and mechanical engineering.

The collected results cover a wide variety of research areas such as solid mechanics, structural dynamics and control theory: analytical, numerical and experimental results are presented adopting deterministic as well as stochastic methods.

Among the activities of GADeS, previous to the present Special Issue, we wish to mention, on one side, periodical meetings joining all the scientific components of the group: they represent a fruitful occasion to share latest results as well as to start new projects. On the other side, a research prize is awarded in recognition of outstanding achievements to youngest members of the group aiming to promote and encourage, in particular, their scientific growth.

The articles included in this Special Issue are divided into different Sections, following a classification similar to that appearing in the previous Special Issue [1], namely

(A) Solids
(B) Structures
(C) Vibrations and Wind
(D) Monitoring and Control
(E) Fluids.

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Section A collects 5 articles which deal with various aspects concerning solid bodies, referring to mathematical models suitable to describe the physical behaviour when combined actions of different effects need to be taken into account, or non-standard materials are considered. Thus, in [2], a creep problem is considered. Specifically, two different models are presented and discussed aiming to describe the stress-strain response of the material which shows different stages, each of which is characterised by a different behaviour. The compatibility of the models with the second law of thermodynamics is also analysed. In [3] the behaviour of thermo-electro-mechanical simple materials with fading memory is studied. The combined effects of the different physical actions on the body are taken into account adopting a Green–Naghdi model to describe the thermoelastic behaviour of the considered materials. Further developments concerning the Green–Naghdi model are comprised in [4], where wave propagation is studied within an unbounded isotropic homogeneous strongly elliptic thermoelastic material with microtemperatures. Perturbation methods are employed whose results are numerically verified. Innovative materials are considered in [5], where, after the introduction of fractional derivatives, a model which describes magnetic hysteresis phenomena is discussed. Maxwell equations are considered to take into account all the different actions on the material. In addition, further to the consistency of the model with the principles of thermodynamics, also numerical simulations are provided to show that the results are in good agreement with experiments on hysteresis. Magnetic effects are also considered in [6], where a magneto-viscoelasticity model is studied. Indeed, new materials are constructed inserting micro-particles, which are sensitive to an external magnetic field, in a viscoelastic matrix. Thus, the behaviour of the material can be controlled via an external magnetic field. Both the cases of a relaxation modulus which is regular as well as singular, at the origin, are considered.

Section B comprises 5 articles which are concerned about different aspects of structural dynamics. In [7] viscoelastic structures, in linear regime, i.e. when displacements and deformations are assumed to be small and the stress-strain relationships are linear, are studied. A variety of rheological models for viscoelastic solids may be handled via the proposed approach such as the Kelvin–Voigt model, standard and n-parameters models, and also the so-called Wieckert–Maxwell model. Some applicative examples are also provided. In [8] the dynamical response of a taut string traveled by a single moving force is studied in the nonlinear regime. Perturbation and numerical methods are employed. In particular, results obtained via *Multiple Scale Method and Straightforward Expansion* are compared with numerical computations: a good agreement between the numerical and the Straightforward Expansion when geometric nonlinearities are carefully taken into account is shown. In [9], the authors propose an innovative approach to study the moving load problem on Euler-Bernoulli beams, with Kelvin–Voigt viscoelastic translational supports and rotational joints. The system is equipped with Kelvin–Voigt viscoelastic tuned mass dampers (TMDs). Then, its validity is confirmed via numerical simulations referring to a a beam with multiple supports/joints, both in the case of a moving concentrated force and in the case of a series of concentrated forces. In [10] a better understanding of the substructure decoupling problem (the identification of an unknown substructure embedded in a known larger structure) is achieved by analyzing different sets of disconnection forces. Disconnection forces are virtually applied to the larger structure in order to reproduce the dynamic behavior of the substructure to be identified. Several sets of disconnection forces can be devised: the trivial set, consisting of forces acting at the coupling degrees of freedom (DoFs) and opposite to the constraint forces; non trivial sets acting at different DoFs but still able to cancel the effect of the constraint forces. In [11] asynchronous modes of vibration are considered in the case of linear conservative discrete systems representing a simplified model of a building. In particular, to begin with, the occurrence of asynchronous modes of vibration in a one-storey-frame model is considered. Subsequently, a three-storey shear building is modelled. Notably, the presence of upper floors is observed to play the role of vibration controllers and, hence, it is of interest as far as earthquake-borne vibrations are concerned. Also possible energy harvesting applications are mentioned.

Section C contains 4 articles where vibration problems, also induced by an external wind, are considered. Energy harvesting from flow-induced vibrations is studied in [12] where a dynamical systems subject to high levels of damping is considered. In particular, both theoretically and experimentally, a problem of aeroelastic flutter instability of a two degree-of-freedom system is studied. Heavy damping are considered also in the subsequent article [13] where earthquake-induced structural responses are studied. A refined Frequency Domain Decomposition (rFDD) approach, devised by the authors, is employed to estimate natural frequencies, mode shapes and modal damping ratios: they are then compared with experimental data. The reliability of a simplified approach for the time-history analysis of a slender masonry tower is studied in [14] based on a Bouc and Wen model. Such a model, extensively employed to describe a variety of hysteretic behaviours is adapted to the case under investigation. In particular, static non-linear analysis is used to set the few needed parameters to construct a suitable single-degree-of-freedom (SDOF) oscillator to consider as a model for simulations. The article [15] studies thunderstorm effects and wind response. In particular vertical winds acting on structures. The thunderstorm wind time histories are simulated by considering that wind speed varies with random fluctuations.

Two articles are collected in Section D. In [16] a monitoring system on some bridge is considered. Low-cost sensors, whose performance is enhanced by appropriate processing boards and software, are used aiming to propose affordable equipments which can be used to implement damage detection strategies for aerospace, civil or mechanical engineering infrastructures. Also in [17] a control system, Model Reference Adaptive Control (MRAC), is studied to deal with the behaviour of tall buildings subject to natural loads induced by winds or earthquakes.

The closing Section E contains two articles on mathematical models which describe fluids. In [18] a Cauchy problem in the case of the porous medium equation with nonlinear convection is studied. Asymptotic results are obtained. In [19] small oscillations of a system viscous liquid-barotropic gas in a container are analysed via spectral methods. Two auxiliary problems are employed to reduce the problem to a system of two operator equations in a suitable Hilbert space. Thus, a previous result is extended to the case of an inviscid fluid.

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