

Editorial: innovative approaches in computational structural engineering

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Editorial on the Research Topic

Innovative Approaches in Computational Structural Engineering

Over the last few decades, tremendous development has been made in the field of computing technology, in terms of both computer hardware and software development. As a result of this progress, numerical computation has now become one of the most effective tools for scientists, researchers, and professional engineers around the world. Although this has led to great achievements in computer-based structural engineering, the increasing necessity to solve complex problems in engineering requires the development of new ideas and innovative methods for providing accurate numerical solutions in affordable computing times ([Plevris and Tsiatas, 2018](#)).

The Research Topic “ Innovative Approaches in Computational Structural Engineering” aims to provide a forum for the presentation and discussion of state-of-the-art innovative developments, concepts, methodologies, and approaches in scientific computation applied to structural engineering. It involves a wide coverage of timely issues on computational structural engineering with a broad range of research and practical applications.

The collection includes both research and advanced applied topics, with particular emphasis on innovation in computational structural mechanics and engineering. The contributions come from 58 leading researchers and professionals from 10 countries around the world who are actively involved in the field of computational structural engineering. The papers in the collection cover various relevant scientific areas such as modeling in

structural engineering; finite element methods; boundary element methods; static and dynamic analysis of structures; performance-based design; structural optimization; meshless methods; modeling of advanced and innovative materials such as shape memory alloys; non-linear structural analysis; system identification methods; structural stability; GPU computing; earthquake engineering; seismic vulnerability; incremental dynamic analysis; structural damage assessment; smart structures and systems; structural reliability; structural health monitoring and control; optimization; and composite materials, with application to engineering structures.

Papers in the Collection

In the 1st paper of the collection, Mitropoulou et al. present a methodology to identify the most appropriate damage index, able to provide a reliable description of the structural damage level. A performance-based design framework is formulated based on this damage index, which is to be used as a design tool for achieving safer and more economic designs. For each damage index under consideration, design optimization problems for structural systems are solved by means of a popular metaheuristic search algorithm.

Next, Charalampakis and Tsiatas examine three uniaxial phenomenological models, i. e., the Graesser-Cozzarelli model, the Wilde-Gardoni-Fujino model, and the Zhang-Zhu model, which are currently used for the description of a Shape Memory Alloy (SMA) behavior. The examination process reveals several limitations and drawbacks, including the large number of parameters and the unclear effect of specific parameters in the overall response. Based

on this analysis, powerful metaheuristics are employed for system identification and a new simple rate-independent model is proposed, which addresses all issues in a unified manner producing excellent fit with the experimental data.

The 3rd paper by Yiotis and Katsikadelis deals with the solution to the vibration problem of cylindrical shell panels using the Meshless Analog Equation Method (MAEM). The method is based on the principle of the analog equation, converting the original equations into three substitute ones, two Poisson's and one biharmonic, which are solved using a meshless method. The use of integrated Multiquadric—Radial Basis Functions (MQ-RBFs) to approximate the fictitious sources allows the approximation of the solutions sought by new RBFs, which accurately approximate both the solution and its derivatives. Several shell panels are analyzed using the method, and the numerical results demonstrate its efficiency and accuracy.

Soroushian, A. (2008). A technique for time integration analysis with steps larger than the excitation steps. *Commun. Numer. Methods Eng.* 24, 2087–2111. doi: 10.1002/cnm.1097