ADVANCED MODELLING AND NUMERICAL METHODS FOR THE NONLINEAR ANALYSIS OF BEAM AND SHELL STRUCTURES

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ABSTRACT

Beam and shell structures are used as primary components in various engineering applications. Their prevalence is further encouraged by new materials that enable the design of highly optimised shapes. These structures can exhibit complex mechanical responses driven by plasticity and other nonlinear material behaviours, coupled with geometrical nonlinearities and strongly influenced by imperfections. Consequently, developing numerical approaches that offer robustness, efficiency, and accuracy in analysing these types of structures is a topic of significant interest in computational mechanics, involving modelling, discretization methods, and nonlinear solvers. Based on these premises, this mini-symposium aims to bring together scientists worldwide working on advanced methods for the nonlinear analysis of structures used in civil, mechanical, marine, aerospace, and biomedical engineering applications.

Topics to be addressed within this session include (but are not limited to):

- Enhanced structural models for beam and shell structures experiencing material nonlinearities and large deformations.
- Discretization methods using strong formulations (e.g., collocation and differential quadrature methods, inverse differential quadrature methods) and weak formulations (e.g., finite element method, boundary element method, isogeometric analysis, VEM formulations).
- Advanced computational methods for evaluating the nonlinear behavior of beams and shells in both static and dynamic scenarios.
- Path-following strategies in static and dynamic analyses.
- Efficient and stable time integration schemes (both implicit and explicit).
- Reduced-order models.
- Nonlinear coupled problems (e.g., magneto-electro-thermo-mechanical problems, fluid-structure interactions).
- Multi-level and multi-scale analysis.
- Numerical methods for reliable safety assessments, including cases involving exceptional loads.
- Structural optimization and control considering nonlinear behavior.
- Limit and shakedown analysis.
- Delamination in composite beams and shells.