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NON-CONVENTIONAL METHODS FOR NONLINEAR FLUID AND SOLID MECHANICS

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ABSTRACT

The Minisymposium focuses on non-conventional numerical techniques for nonlinear computational mechanics, mainly methods based on Taylor series and model reduction techniques, but alternative methods specific to nonlinear problems will be welcome. The applications can concern instabilities of fluid flows, buckling of structures, linear and nonlinear vibrations, nonlinear parabolic equations, metal forming and contact problems, sensitivity and re-analysis procedures.

Model reduction strategies are appealing alternatives for speeding-up the solution of complex models, however, their application in strongly coupled non-linear models remains delicate because of the difficulty of addressing efficiently the nonlinearity. It is also the case of Proper Generalized Decompositions – PGD, a new powerful discretization technique that is able to solve highly multidimensional problems by combining products of univariate functions or functions defined in spaces of moderate dimension. In the multidimensional nonlinear case PGD constructors are confronted to a major difficulty, the one of evaluating nonlinear functions of large finite sums decompositions. The solution of such multidimensional non-linear models requires advanced strategies for addressing the non-linear terms. Standard linearizations (fixed point, Newton …) and alternative strategies like ANM, LATIN method, empirical interpolations, etc, could be envisaged.

Asymptotic Numerical method relies on the computation of Taylor series with respect to a structural parameter (loading, Reynolds number…) or to an artificial parameter according to homotopy perturbation method. Theoretically, any smooth or smoothed nonlinear problem could be solved by ANM, but it seems very efficient for path following problems of highly nonlinear response curves and detection of bifurcation points. Thus applications to fluid or solid instabilities will be highlighted. ANM is often associated with a lot of classical numerical methods, as reduced-order modeling, convergence acceleration and Padé approximants, Automatic Differentiation for series computation.