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LOCKING, EFFICIENCY AND ROBUSTNESS OF FINITE ELEMENTS AND OTHER DISCRETIZATION SCHEMES

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ABSTRACT

Although the topic of finite element technology is well understood in many respects, there still exist several open questions, especially for geometrically and physically nonlinear problems. Moreover, an increasing number of alternative discretization schemes have (re-) entered the stage, demanding new answers to old questions.

The fundamental aim of many research projects in the field of advanced discretization methods can be described in two main aspects: First, as a prerequisite for efficiency, the formulations are supposed to be free from locking. This comes along with optimal convergence rates for primal quantities (e.g. displacements) as well as derived quantities (e.g. stresses) already in the pre-asymptotic range of coarse meshes, independent of critical parameters like slenderness or Poisson's ratio. Secondly, the elements are expected to be free from artificial, non-physical instabilities. The latter is particularly demanding in the large strain regime.

In recent years, an increased activity in the development of non-standard discretization schemes can be observed: isogeometric (IGA) concepts along with finite element methods using NURBS and alternative shape functions (subdivision or T-splines); advanced stabilized

formulations based on first-order or mixed variational formulations in mechanics; virtual finite elements; compatible and mixed discretizations in mechanics; non-local (patch-based) or smoothed finite elements, discontinuous Galerkin methods, meshless methods or finite cell methods.

For some of these discretization schemes, especially the ones with smooth shape functions, fully locking-free formulations are not easy to find already for linear problems. One major challenge is to deal with highly unstructured approximation spaces.

The proposed mini-symposium invites all contributions from the field of locking, efficiency and robustness of finite elements and other, non-standard discretization schemes, both from method development and application. Typical topics are expected to be, but not restricted to:

- Locking-free formulations for solids and structural members like beams, plates and shells
- finite elements and non-standard discretization methods, like isogeometric, spline-based, meshless, discontinuous Galerkin and finite cell methods
- linear as well as geometrically and physically nonlinear problems
- Variational formulations in mixed and first/order form, with and without numerical stabilization
- efficiency, convergence, stability and approximation properties