Mixed isogeometric collocation methods

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Isogeometric Analysis (IGA) is a recent analysis framework aiming at bridging the gap between Computational Mechanics and Computer Aided Design (CAD). In addition to clear advantages in terms of geometry representation capabilities, the use of functions typically used by CAD systems (e.g., NURBS) leads to superior results with respect to standard finite elements on a per degree-of-freedom basis, thanks to their high regularity properties. In the framework of NURBS-based IGA, collocation methods have been recently introduced as an efficient and promising alternative to standard isogeometric Galerkin approaches, characterized by a high accuracy-to-computational-cost ratio. In this work, we study the approximation of incompressible elastic problems via isogeometric collocation. In particular, we introduce and discuss several mixed formulations and we present a number of numerical tests showing the behavior of the proposed methods. Moreover, we initiate the study of deformable fluid-saturated porous media. The combination of the superior accuracy and smoothness of spline basis functions with the low computational cost and simplicity of collocation techniques seems to constitute an optimal basis for accurately modeling complex and computationally demanding time-dependent problems expressed in mixed form, like those arising in the context of poroelastic media. In particular, we will focus on the one-dimensional application of the Biot model and present a mixed u-p formulation leading to very encouraging results.