Isogeometric Collocation Methods: An introduction with some applications

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Isogeometric Analysis (IGA) is a recent idea (Hughes et al., 2005) introduced to bridge the gap between Computational Mechanics and Computer Aided Design (CAD). The key feature of IGA is to extend the finite element method representing the geometry by functions - such as NURBS - typically used by CAD systems, and then invoking the isoparametric concept to define field variables. Thus, the computational domain exactly reproduces the NURBS description of the physical domain, and, also thanks to the high regularity properties of the employed functions, numerical testing in different situations has shown a substantial increase in the accuracy-to-number-of-degrees-of-freedom ratio with respect to standard finite elements. In the framework of NURBS-based IGA, collocation methods have been recently proposed as a viable and interesting low-cost alternative to standard isogeometric Galerkin approaches. In this work, we introduce such methods and focus on some applications, including elastostatics and explicit elastodynamics, as well as the solution of the Cahn-Hilliard equation, for which isogemetric collocation represents an accurate, efficient, and geometrically flexible option.

Keywords: Isogeometric collocation; NURBS; Elasticity; Explicit dynamics; Cahn-Hilliard equation; Phase field modeling.