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ISOGEOMETRIC ANALYSIS: STRUCTURAL VIBRATIONS AND DYNAMICS

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Isogeometric Analysis (IGA) is a recent idea (see [1,2]) 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 CAD 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, with respect to standard finite elements, of the ratio between accuracy and number of degrees-of-freedom. In particular, the advantage of IGA over standard finite elements appears to be remarkably evident in the approximation of spectra (e.g., in the case of structural vibration studies) and of dynamics problems (cf. [3-8]).

A novel interesting family of isogeometric approaches is represented by collocation methods (see [9]), which have been proven to be a viable low-cost alternative to standard isogeometric Galerkin methods, able to drastically increase the ratio between accuracy and computational time, in particular for higher order approximations (cf. [10]). Isogeometric collocation methods have been shown to attain good and promising results in many fields: Among them, it is worth to highlight here the applications in the context of explicit elastodynamics (see [11]), or for the solution of the Cahn-Hilliard equation describing the dynamics of the phase separation process of immiscible fluids (see [12]), for which isogeometric collocation represents an accurate, efficient, and geometrically flexible option.

Within this framework, the present work aims at giving an overview of all the topics mentioned above, with a special focus on the spectral results discussed in [8] and on the implications these may have in the solution of elliptic boundary-value, parabolic initial-value, and hyperbolic initial-value problems.

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