Integrated system for two-dimensional isoparametric and isogeometric analysis of finite elements

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ABSTRACT

This work contemplates the development of an integrated computational tool with graphical interface for two-dimensional finite element analysis in the isoparametric and isogeometric scope. The tool consists of the integration between two software. The first one, named FEMEP (Finite Element Method Educational Computer Program) [1], is dedicated to the steps of modeling, mesh generation, and attribute management. It has a graphical user interface that is developed in Qt and is implemented in the Python programming language. The second is the FEMOOLab (Finite Element Method in an Object Oriented Laboratory) program [2], which is a Finite Element solver implemented in MATLAB to perform analyses of elasticity and thermal diffusion problems of the models previously generated with FEMEP. Both software are open-source and modular, following the object-oriented programming paradigm. In addition, the system is thought to serve as an educational tool, offering students and researchers of computational mechanics a complete and friendly computational environment to learn and understand implementation aspects about isogeometric FEM analysis, as well as supply teachers with a didactic software that helps in the teaching-learning process in the classroom.

The computational tool developed provides sophisticated capabilities for the mesh generation stage [3], allowing the use of the technique of hierarchical decomposition of the domain [4]. The modeling of the problem can be done through predefined parametric curves: line, polyline, cubic spline, circle, circle arc, ellipse, and ellipse arc. All curves are treated as NURBS (Non-Uniform Rational Basis Spline), an essential condition for isogeometric analysis. The tool also features some automatic resources that facilitate the modeling process, such as the intersection and division of curves and the recognition and generation of closed regions. In the analysis process, the isogeometric formulation uses the NURBS basis functions to represent the model's geometry and also the field variables [5], while in the isoparametric formulation of the standard FEM, the basis functions used to interpolate the field variables are used to approximate the geometry.

REFERENCES

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