A Comparison Study between Isogeometric Analysis and Finite Element Analysis for Nonlinear Inelastic Dynamic Problems with Geomiso DNL Software

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This research aims to compare the efficiency of isogeometric analysis and finite element analysis for nonlinear inelastic dynamic applications with the recently developed Geomiso DNL program. Geomiso DNL is a hybrid software solution, which combines isogeometric analysis and 3D design with NURBS and T-splines. The isogeometric method satisfies the rising industrial need for unification of the fields of computer-aided design and computer-aided analysis, while modern T-splines overcome limitations inherent to NURBS, permit local refinement, ensure higher-order continuity across patches, and provide great superiority of modeling irregular geometries with hole features. Therefore, this powerful generalization of the classical finite element method has attracted growing interest in both scientific community and industry.

Geomiso DNL is not just a plug-in, but a both on-premises and cloud-based software, which enables engineers to simulate dynamic phenomena, whose impact on products and structures in real-world environments can be more efficiently evaluated. This new software fully integrates the industrial design of any geometry with its computational real-time testing by facilitating the geometry modeling within analysis. A key feature is that this hybrid program provides parameterized geometries in the design, as it weaves the mesh generation process within CAD, while its comprehensible modern graphical user interface offers an innovative way to preserve the exact geometry at all refinement levels in contrast with finite element programs.

Applications to nonlinear plane stress, plain strain, and three-dimensional dynamic problems are demonstrated with a comparison between Geomiso DNL and finite element software packages. We compare the matrix assembly and solver time, as well as the accuracy of the numerical results, such as displacement, strain and stress fields, for typical examples arisen in structural dynamics. We also perform parametric tests on the effects of polynomial order of shape functions and the number of patches, elements, control points, and quadrature points. This program appears to be preferable to finite element software packages, as it represents major improvements, such as higher accuracy, robustness, and stability level, combined with significantly shortened computational cost. This research has been co-financed by the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call «RESEARCH–CREATE–INNOVATE» (project code: T2EDK-00338).

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