Modeling and Analysis of Real World and Industry Applications with Geomiso SEA: a New Hybrid CAD/CAE Software for Inelastic Static Isogeometric Shell Analysis and 3D Design with Advanced Spline Techniques

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In this paper the new Geomiso SEA software (www.geomiso.com) is proposed for applications on inelastic static isogeometric analysis with shell elements and advanced spline techniques. This hybrid program is applicable to real world and industry applications, while it satisfies the rising need for technical software of dual CAD/CAA nature. It is based on the isogeometric method, which has attracted a lot of attention for solving boundary value problems, as a result of using the same shape functions, means splines, for both describing the domain geometry and building the numerical approximation of the solution. T-spline-based isogeometric shell analysis has attracted increasing attention in automotive and aerospace industries, as it efficiently handles geometries with patches, discontinuities, and irregularities, while T-splines can design any geometry no matter how complex it is. Geomiso SEA is not just a plug-in, but a both on-premises and cloud-based software solution, which is used to simulate spline models of complex structures, or machine components, for analyzing their strength and behavior. This hybrid program, used for both design and analysis, has many features in common with both FEA software and design programs. It offers an innovative way to merge geometric design with mesh generation, by creating, with its modern graphical user interface, 3D models as tensor product grids. The utilization of the exact mesh for analysis eliminates geometric errors, while there is no need of repeating the geometry design for refinement purposes. In contrast, the standard finite element technique of remeshing with more and smaller elements, not only cannot fully utilize the available data of the exact mesh, but also makes engineers unable to benefit from advanced spline techniques, which are proved a mighty tool for IGA. Real world and industry applications on both thick (Mindlin-Reissner) and thin (Kirchhoff–Love) shells are demonstrated with a comparison between Geomiso SEA and FEA programs, and a comparison between shell and hexahedral elements. We compare the matrix assembly and solver time, as well as the accuracy of the numerical results. Parametric tests were also performed on the effects of the polynomial degree of the basis functions, and the number of patches, knot spans, control points, and integration points. This unique solution for seamless integration of the industrial design of shell geometries with its computational real-time testing, appears to be preferable to FEA programs, representing major improvements, such as higher accuracy, and considerably reduced computational time.
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