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The Nitsche's Method and Applications in Isogeometric Analysis

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ABSTRACT

The Nitsche's method is originally proposed as a technique to impose boundary conditions, nowadays it is widely used for isometric analysis (IGA) and corresponding topology optimization applications. Based on our previous research [1], we present a simple way to derive the Nitsche's formulations for different kind of boundary and interface conditions, and studied this technique in the context of IGA discretization, especially for patch coupling and contact problems. The skew-symmetric variant of the Nitsche's method is then further studied. For linear boundary or interface conditions, the skew-symmetric formulation is parameter-free. For contact conditions, it remains stable and accurate for a wide range of the stabilization parameter. Topological optimization plays a guiding role in the conceptual design process. For multi-patch models in engineer practices, the Nitsche's method is used to glue different meshes to perform multi-patch IGA and then topology optimization [2]. The discrete variable topology optimization algorithm based on integer programming is adopted in order to obtain clear boundaries for topology optimization [3,4]. Taking advantages of curved-edge elements in IGA, topology optimization in the framework of IGA can obtain locally smoother material boundaries than traditional FEM under the same level of mesh resolution. In addition, in order to accelerate the computational process with extremely large amount of degrees of freedom and get high-resolution results, we extend our study to the PETSc framework with high performance clusters.

KEYWORDS

Isogeometric; Nitsche; topology optimization; PETSc

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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