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# Isogeometric Topological Shape Optimization of Structural Problems using Level Set Approach

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Isogeometric topological shape optimization method for structural problem is developed using level set method. The isogeometric method is an emerging method that has numerous advantages over the classical finite element method due to its convenience of basis functions generated from NURBS. Therefore, a geometric model is easily converted to an isogeometric analysis model without loss of higher order geometric information such as normal vector and curvature. Nevertheless, the isogeometric method needs a lot of geometric information for complex geometric model and has a difficulty in representing a topological shape variation due to the nature of tensor product of NURBS. To overcome these difficulties, in the isogeometric framework, we employ a level set method where the initial domain is kept and its boundary is represented by an implicit moving boundary embedded in the level set function that facilitates to handle complicated topological shape variation and eventually leads the initial implicit boundary to an optimal topology. For representing voids in a domain where the level set function is defined, Heaviside enrichment function is utilized, which leads to continuous stress fields as well as discontinuous displacements fields even in a single patch. Since the implicit moving boundary is used, it is easy to represent the topological shape variations, where the overall shape is controlled by outer control points.

## REFERENCES

[1] S.H.Ha, S.Cho, Topological shape optimization of heat conduction problems using level set approach. *Numerical Heat Transfer B.*Vol. 48, pp. 67-88, 2005.
[2] Hughes TJR, Cottrell JA, Bazilevs Y, Isogeometric analysis: CAD, finite elements, NURBS, exact geometry and mesh refinement. *Comput Methods Appl Mech Eng*. Vol. 194, pp. 4135-4195, 2005.