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Multi-resolution Topology Optimization Using B-spline to Represent the Density Field

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ABSTRACT

This work proposes a novel multi-resolution topology optimization method using B-spline to represent the density field, and overcomes the defects of tedious post-processing of element-based models and low computational efficiency of topology optimization for large-scale problems. The design domain embedded in the B-spline space is discretized with a coarser analysis mesh and a finer density mesh to reduce the computational cost of finite element analysis. As design variables, the coefficients of the control points control the shape of the B-spline. The optimized B-spline can be quickly and precisely converted into a CAD model. Sensitivity filtering is additionally applied to enhance B-spline's smoothness and suppress QR-patterns. Numerical examples, including 2D and 3D cases, are tested to demonstrate that the proposed method significantly saves computational time without sacrificing the performance of the optimized structure. Moreover, the post-processing procedures are streamlined, resulting in continuous, smooth, and editable models.

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