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Optimizing Topology Optimization with Anisotropic Mesh Adaptation

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Abstract

Mesh adaptation is rarely used in topology optimisation, with exceptions found in continuous methods such as phase field [1] and some level-set techniques [1,2]. Anisotropic mesh adaptation involve not only refinement and coarsening operations, but also smoothing and swapping, which allow for the appearance of elongated elements aligned with physical features, such as those found in structural optimisation.

We use an anisotropic mesh generator based on local mesh modifications and an open source finite element engine (FEniCS) in combination with the method of moving asymptotes. Discrete sensitivities are calculated automatically [3] and converted to continuous ones, such that they can drive the mesh adaptation and be interpolated between meshes.

Results for stress and compliance constrained volume minimisation indicate that mesh independence is possible in a rounded 2D L-bracket geometry, the rounding fillet being 1% of the characteristic length scale. Finally the combination is tested for 3D compliance minimisation, where 50 is found to be a typical average element aspect ratio, indicative of the speedup relative to isotropic mesh adaptation.

References

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