Auto-generated structured meshes for shape optimization

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The generation of stable and accurate meshes is a fundamental task in the area of shape optimization. As it usually comes as an iterative process, re-meshing is a key bottleneck in the quest for efficient optimization procedures. Hence, current approaches aim to avoid re-meshing by rather moving the grid points. Instead, we propose an approach that involves re-meshing only in a highly structured manner, thus computationally less expensive. It is based on the idea of composite finite elements. This technique leads to very regular meshes, where most of the grid and the entries of the governing PDE are not altered. This leads to a speed up in both the mesh generation and the computation of the matrix. At the same time, the regular structure contributes to means of efficient implementation on modern computer architectures.
We show results for the setting of optimizing the failure probabilities of mechanical components under load (e.g. tensile load) and how to apply Krylov subspace recycling to these meshes to solve the governing PDE.

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