ADTOP: An adaptive design-resolution based topology optimization approach for high resolution structures

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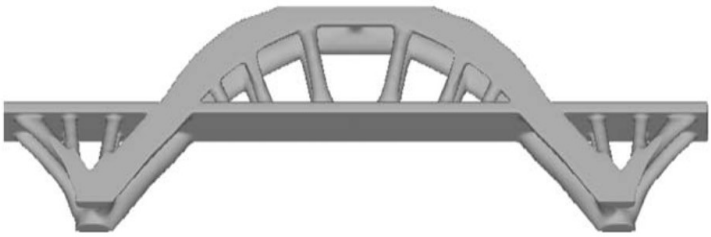
Topology optimization (TO) allows to produce efficient 3D structures for a given amount of material and subjected to certain constraints. Conventionally in TO, the domain is discretized into a number of finite elements and every element is associated to a density value which indicates the volume fraction of the element filled with the given material. From manufacturing point of view, the fine features should be clearly represented and these volume fractions should be discrete (0 or 1). However, often with coarse meshes, intermediate values are obtained which cannot be fabricated. A possible choice is to use a finer mesh, however, since finite element analysis (FEA) is an expensive step in TO, using a very fine mesh is prohibited in terms of the computational costs.

In some recent works, authors have attempted to decouple the analysis and design meshes in a way that allows to have several design points inside a single finite element (*e.g.* MTOP, iMTOP). While this approach can help to reduce the computational burden to some extent, a recent work within our group shows that such an approach can only bring in limited improvements and using it in an inappropriate manner might possibly be inefficient. Some preliminary numerical simulations by a former M. Sc. student have confirmed our results.

An existing bridge design



Optimal topology of the bridge by MTOP

We would like to combine our research results with some rigorous analysis to formulate an efficient scheme for efficiently placing design points in a given domain.

Aim of the project:

The student is expected to achieve the following milestones:

1. Understand the concepts of topology optimization and explore the literature on decoupling the design and analysis meshes.
2. Verify our research on some benchmark problems in the field of TO and use these results to further formulate an efficient adaptive scheme for placing design points in the domain during the course of TO.

Requirements:

We are seeking an enthusiastic individual with an interest to work on topology optimization. Familiarity with Python is required.

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