

## Massively Parallel Topology Optimization

### Abstract

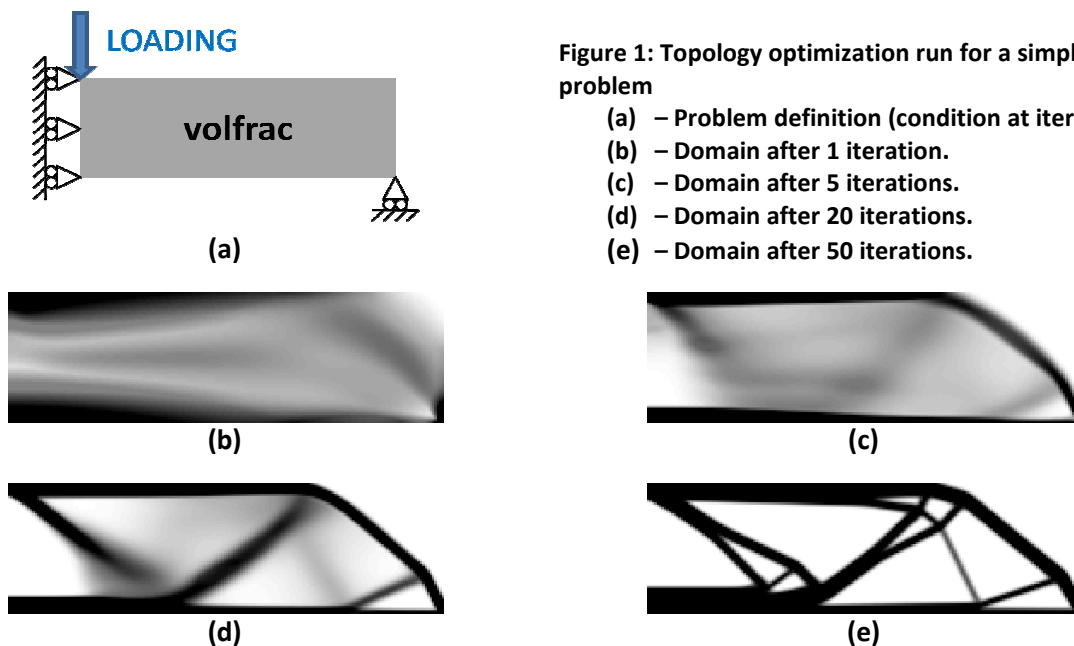
The goal of this project is to build the basic framework for a “Massively Parallel Topology Optimization Code”. Topology Optimization is a design technique where the shape is not pre-defined by the user, but rather the code figures out where it is optimal to increase or decrease the design variable. All that is supplied by the user is a domain, restrictions and boundary conditions. Applied to structural engineering, this technique allows engineers to reach “perfect” structures, based on the optimality condition predefined.

### Introduction

Deep within the topology optimization algorithm, there is an analysis code (usually FEM<sup>1</sup>). Topology optimization is a highly iterative algorithm where the analysis and update phases alternate each other until a final design evolves. The update phase requires a non-linear optimization algorithm<sup>2</sup>, nevertheless it is not within the scope of this project to study them in a parallel fashion.

The FEM phase usually stands out for most of the running time and within the FEM, solving the linear system is by far the most time consuming part of all. Thus, making a `small improvement within the FEM phase and considering that the FEM analysis is performed several times for a single problem, we expect to achieve a much smaller running time overall.

Results for a simple problem can be seen in Figure 1.



<sup>1</sup> FEM: Finite Element Method

<sup>2</sup> Popular optimization algorithms for topology optimization are: OC (Optimality Criteria) and MMA (Method of Moving Averages), among others.