

---

# 3D Topology Optimization in Elasticity Using Level Set Methods

Emanuel Teichmann

17 November 2005

Supervisor: PD Dr. Heiko Andrä

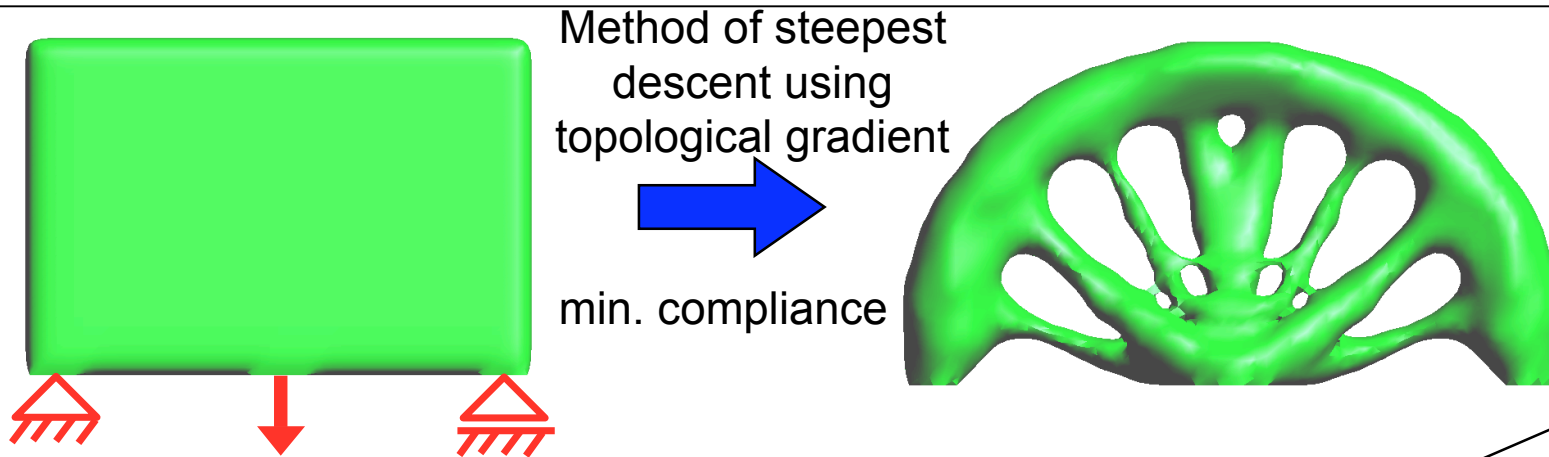
PhD starting date: 01 October 2004

---



**Fraunhofer** Institut  
Techno- und  
Wirtschaftsmathematik

# Motivation



## Topology Optimization:

Find an optimal material distribution within a given design space s.t. prescribed constraints (volume, maximal stress, etc.) are not violated.

$$J(\Omega, u) \rightarrow \min$$

such that

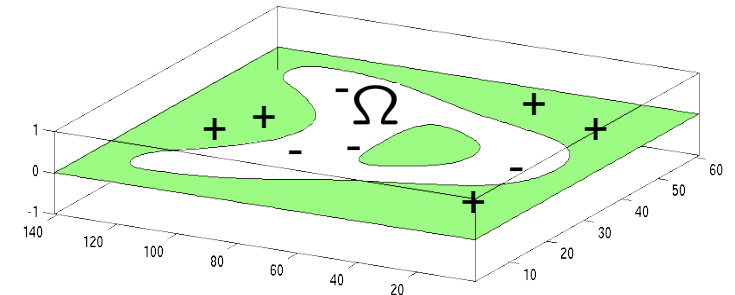
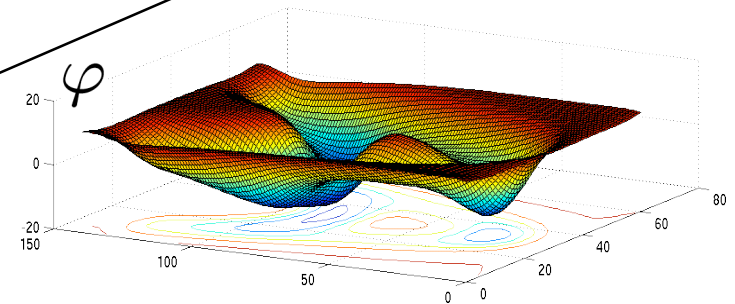
$$a(u, v) = f(v) \quad \forall v \in V,$$

$$|V| \leq \text{const.}$$

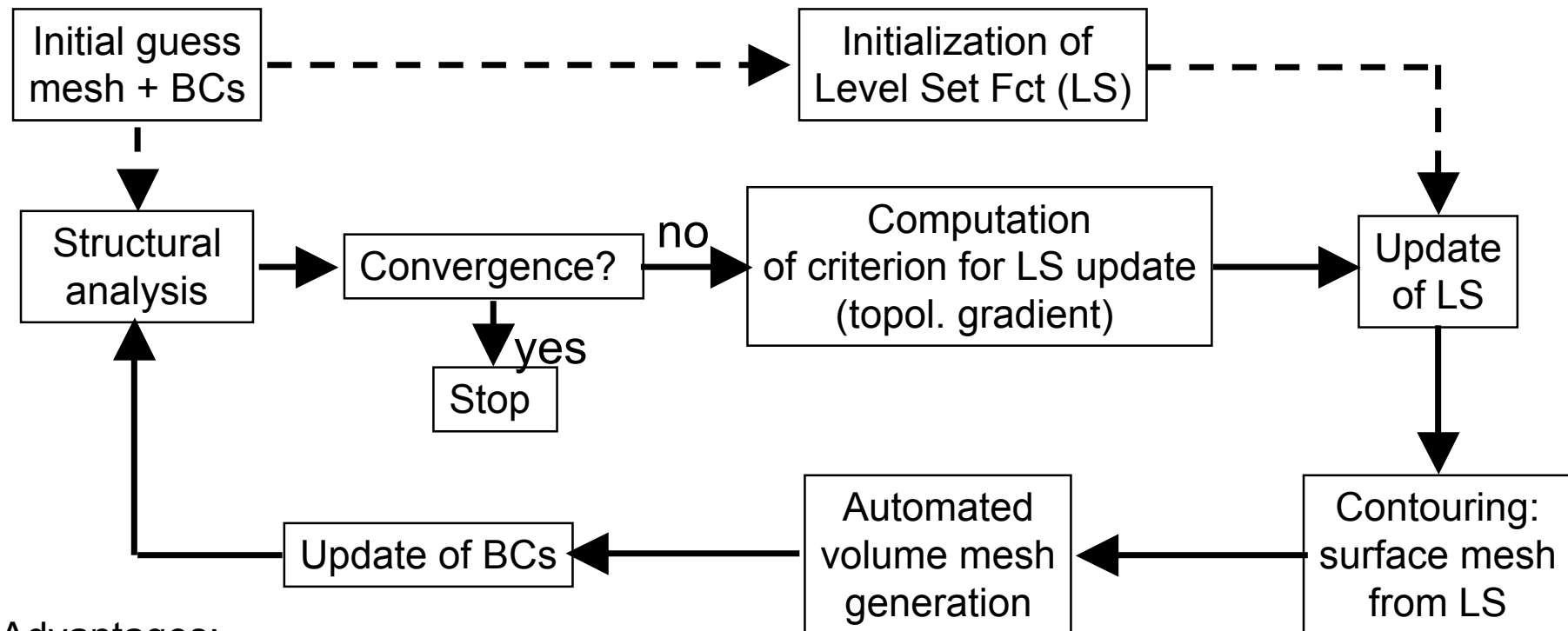
## Level Set Method:

Represent boundary as zero level set of a function

$$\varphi: \Omega_{DS} \rightarrow \mathbb{R}$$



# Algorithm: Topology Optimization using Level Set



## Advantages:

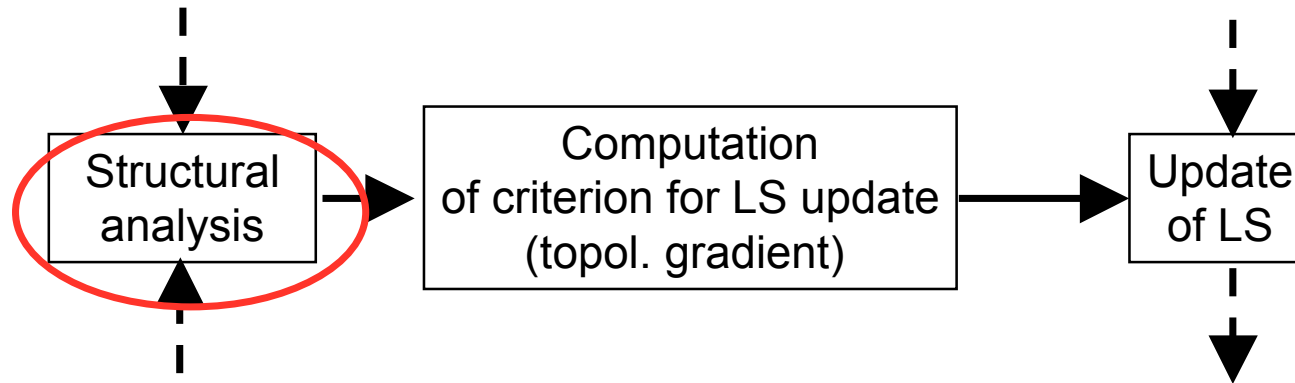
- Remeshing: adaptive discretisation for structural analysis
- Complete FE model in each iteration (needed for simulation of casting process)

## Disadvantages:

- Remeshing: costly, stability?
- Interpolation errors in update of BCs

## Benefits from the Special Radon Semester

---



- Crucial point: structural analysis. Introduction of an error
- Influence of this error on the topological gradient and the update of the level set function?

⇒ **ERROR ESTIMATION** is the basis for investigation of precision of level set update