LCM-Simulation and Optimization

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8) External researcher(s): no entry

9) Funding source(s):
   - Own resources of the professorship

10) Partner organizations: no entry

11) Short Summary: A Liquid Composite Molding (LCM)-simulation software is developed and coupled to Evolutionary Algorithms in order to achieve optimal process parameters.

12) Keywords: Engineering Sciences, Materials Technology, Simulation Engineering
13) **Project description:**
Liquid composite molding (LCM) processes are efficient means for producing fiber-reinforced composite structures. Finding an optimal process configuration is usually the product of a long-term, expensive trial-and-error method. Reliable process simulation tools might contribute significantly reduce production time, costs and risks.

Simulation of LCM processes has been implemented in an in-house developed Finite Elements toolbox in 2D, 2.5D and 3D. A Finite Element mesh with triangle respective tetrahedral elements is used. Other features are:
- areas of different permeability
- anisotropy
- detecting and tracking of air entrapments
- automatic closure of wetted vents
- automatic opening of wetted gates (for sequential injection)

The program is capable to be coupled to Evolutionary Algorithms. Applying this to an arbitrary structural part, the LCM process configurations will be optimized. Objective functions are the laminate’s quality (no air entrapments) on one hand and a short filling time on the other hand. Optimization variables are the gate and vent locations as well as injection pressures and timing.

Based on an experiment, optimization is performed on a complex 2D-part. The original configurations are set "by hand". The optimization algorithm is applied to this problem. The obtained gate locations and injection pressures remarkably improve the filling process compared to the original configurations.

14) **Popular description:** no entry

15) **Graphics:**

![LCM Simulation](image_url)
16) **Publications**: no entry

17) **Links to important web pages**:
   - [http://www.imes.ethz.ch/st](http://www.imes.ethz.ch/st)