Chair for Design Automation
TUM School of Computation, Information and Technology
Technical University of Munich

Design Automation and Simulation for Microfluidic Devices

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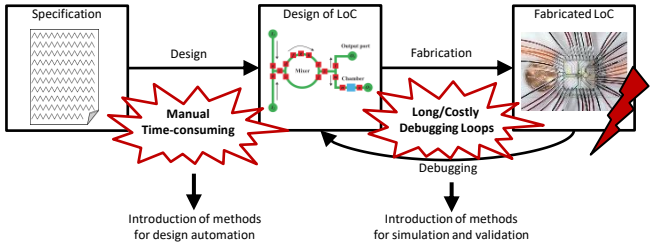
https://www.cda.cit.tum.de/research/microfluidics/

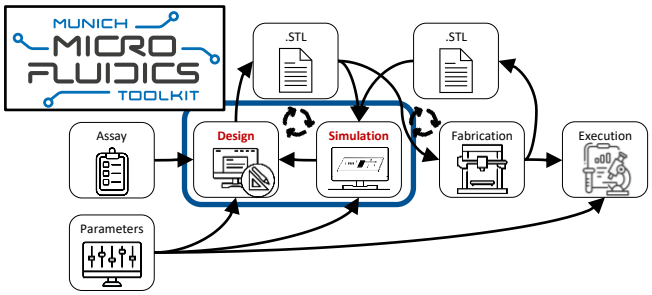
Motivation

The design and realization of microfluidic devices is a manual, tedious, and error-prone task. In addition, multiple iterations for prototyping are often needed until a physical realization is obtained which works as intended. In our work, we are developing design automation methods that allow for the generation of the desired design by the push of a button and simulation schemes which allow for validating those designs prior to fabrication.



Envisioned Design Flow

- Design steps are automated
- Simulation validates design choices prior to fabrication
- Multiple iterative design loops allow for an automatic refinement and design exploration
- Resulting tools are provided through the **Munich Microfluidics Toolkit**



Design Automation

Meander Designer

- Generates meander channels with a specific resistance
- Automates the task of manually drawing meanders
- Is online available and outputs SVG files:

Gradient Generator

- Generates arbitrary fluid concentrations at the outlets, where the number of outlets can be specified by the user
- Validated through CFD simulations (OpenFOAM) and physical realizations
- Is online available and outputs SVG files:

Channel Routing

- Connects components with microfluidic channels with rounded bends
- Automatic creation of channels with specific length or resistance
- Is online available and outputs the resulting design as SVG files:

Simulation

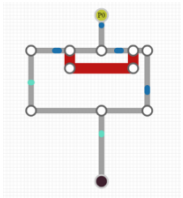
Different Abstraction Levels:

- Computational Fluid Dynamics (CFD)
  Pro: Accurate
  Con: Computationally expensive
- 1D Simulation
  Pro: Efficient
  Con: Rather abstract

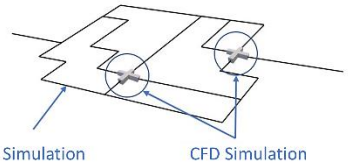
→Trade-off between accuracy and efficiency

- Combinations of both (hybrid)
- Available at:

1D Simulator



Hybrid Simulator



Your Design Tasks

- Where do you wish to have tool support?
- What manual tasks do you carry out?
- How is your experiment described?

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