

Fluidic Layout of Lab-on-a-Chip Platforms A Simulation Aided Approach

We introduce a simulation aided approach consisting of both network and computational fluid dynamics (CFD) simulations to accelerate the design process of Lab-on-a-Chip platforms.

Inspired by the success of efficient, network simulation based design of electronic systems, Hahn-Schickard utilizes a platform-based approach in regard to microfluidics and Lab-on-a-Chip applications. According to customer specifications a chip is designed that consists of a combination of fluidic unit operations. These fluidic unit operations each fulfill one basic function such as switching, valving, mixing or aliquoting of reagents, and are scaled and connected according to the needs of the application.

The microfluidic design process is performed according to the following steps:

- 1) Computer aided design (CAD) of a basic layout according to customer specifications
- 2) Network simulation based optimization of size and position of cavities and channels of the layout
- 3) Network simulation based derivation of the actuation protocol to run the chip on the processing device

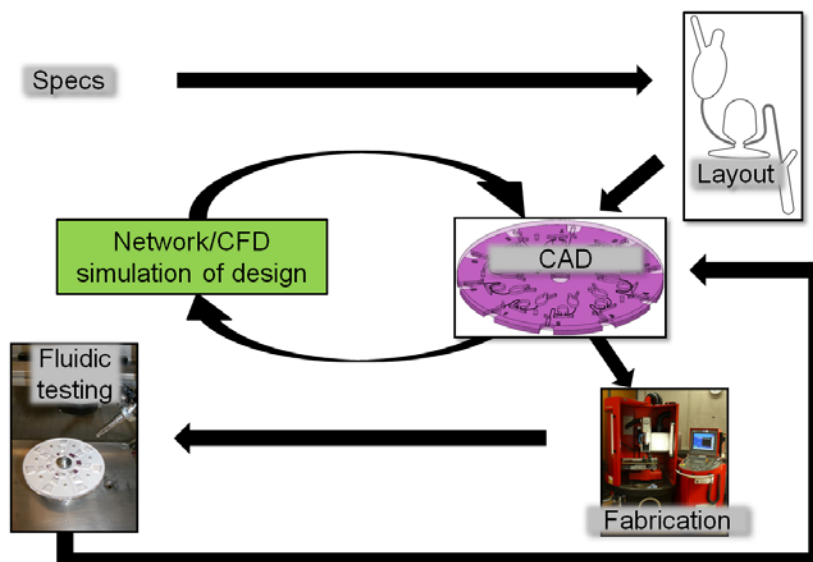


Fig. 1: Microfluidic design process.

- 4) Computational fluid dynamics (CFD) simulation based optimization of specific unit operations such as mixing cavities
- 5) Fabrication of the chip in-house
- 6) Experimental verification

Depending on the results, steps 1 to 6 are repeated until the project goal is achieved.

Customer benefit is a fast and robust design process of Lab-on-a-Chip devices due to the unique combination of simulation aided design and in-house prototyping at Hahn-Schickard.

All design steps can also be offered as independent services to a design process otherwise performed by the customer.