BioViz: An Interactive Visualization Engine for Microfluidic Biochips

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In order to shorten the required time for the analysis of medical substances, *digital microfluidic biochips* (DMFBs) have been suggested (see e.g. [2]). They allow for handling smallest amounts of samples and reagents on a circuit board and, thus, automatically execute medical experiments that are usually done manually in laboratories. However, there are various challenges in the development of these systems. Issues such as routing and layouting are complex and currently being investigated by various researchers and engineers.

Although first automatic solutions assist the designers, the obtained results are usually provided in a complex and non-intuitive fashion. This makes the utilization and evaluation of existing approaches for DMFB design a tedious task.

Designing the experiment in order for it to be run on a DMFB is a core issue, including steps such as routing (see e.g. [3], [4]) and placement (see e.g. [1], [5], [6]).

Creating solutions for these design steps requires engineers to test different setups, compare the results and debug their algorithms. Solutions, while being technically correct, often include negative aspects such as the following:

- Unnecessary movements
- Unnecessary cell usage
- Unnecessarily complex control logic
- Unintended mixing of fluids [7]

These aspects are difficult to spot without being able to visually inspect the design. Still, while designers would obviously benefit from tools that would allow them to easily inspect their solutions, no dedicated visualization tools have been built yet.

We present *BioViz*, an interactive visualization tool for DMFBs that explicitly addresses these problems. It allows for a design methodology which is easy to use and provides a hassle-free environment for the involved researchers and engineers. Fig. 1 shows the interface of the tool; Fig. 2 illustrates two different views for a DMFB.

The use cases we support contain grids of different layouts (i.e. also non-rectangular grids as in [8]), temporal blockages (used in e.g., [4]), pin assignments and pin actuations (used in many works on routing on biochips, see e.g. [3]), as well as the placement of modules (as needed in synthesis, see e.g. [1], [5], [6]).

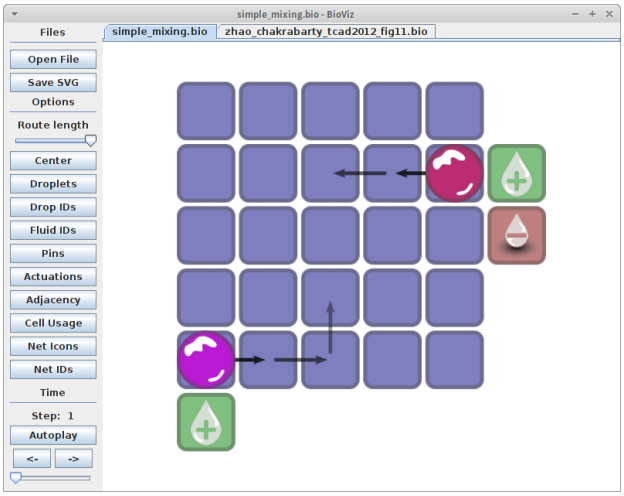

Fig. 1. Visualization of a simple biochip. User interface elements show visualization controls on the left, the visualization itself on the right.

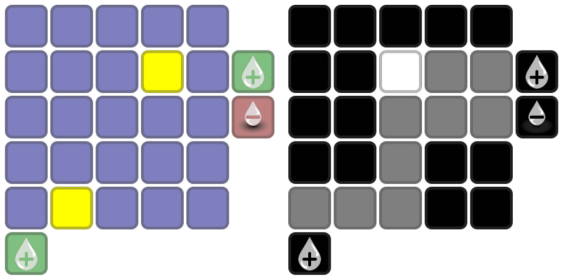

Fig. 2. Left: Currently actuated cells Right: Amount of cell actuations on a color scale from black to white.

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