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Fluigi Cloud - A cloud CAD platform for microfluidic

Fluigi Cloud
A Cloud CAD Platform for Microfluidics

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Motivation

Microfluidic large scale integration (mLSI) is concerned with the development of microfluidic chips with hundreds of integrated channels and components. With the emergence of new synthetic biology technologies and sophisticated microfluidic chip designs, there is a growing demand for robust **computer automated design (CAD)** tools that will allow engineers to scale their chips to satisfy complex applications. The growth of cloud-based software platforms offers benefits that can address current limitations in microfluidic CAD. Namely, a cloud platform offers **resource sharing,** enables **high performance-demanding CAD jobs** to be executed, and offers a convenient **environment for collaboration** between research communities. With the ubiquity of cloud technologies, an online CAD platform for mLSI is a necessary tool to meet current design needs.

Approach

We have created an online cloud based platform for Microfluidic CAD. **Fluigi Cloud** is the cloud fabric where users can design microfluidic chips through **LFR** or **MINT** specifications using tools like **Neptune**. These designs can be compiled into **fabrication-ready schematics** for lithography or CNC milling. All of a users designs are **stored** on the cloud, or they may be **downloaded** for offline use. Fluigi Cloud is currently is a platform only for microfluidic CAD. Future releases will be expanded to integrate control of microfluidic chip hardware.

Acknowledgments

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Fluigi Computer Automated Design Workflow

Parametric high level description
Liquid Flow Relations (LFR)

LFR

Save | Compile | Delete | Download | New Workspace | New File

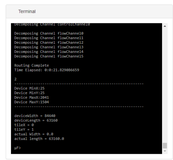
```
// Microfludic Two-Input Four-Output Serpentine Mixer
// Created on: Thursday, August 3th, 2017, 3:28:15 PM
// CIDAR Lab, Boston University

module TwoInTwoValveTrapSerpFourOut(finput flowInput1, flowInput2,      ...
                                    cinput controlInput1,controlInput2, ...
                                    foutput flowOutput1, flowOutput2,   ...
                                    flowOutput3, flowOutput4);          ...

    fchannel flowChannel1, flowChannel2, flowChannel3, flowChannel4;
    assign flowChannel1 = flowInput1 - controlInput1;
    assign flowChannel2 = flowInput2 / controlInput2;
    assign flowChannel3 = flowChannel1 + flowChannel2;
    assign flowChannel4 = flowChannel3 #;
    assign flowOutput1 = flowChannel4 ~;
    assign flowOutput2 = flowChannel4 ~;
    assign flowOutput3 = flowChannel4 ~;
    assign flowOutput4 = flowChannel4 ~;
endmodule
```

*An LFR design is **abstract** and **concise.***

A single LFR specification can be used to generate dozens of related microfluidic devices.

Fluigi Cloud

Microfluidic Mapper CAD Software Tool



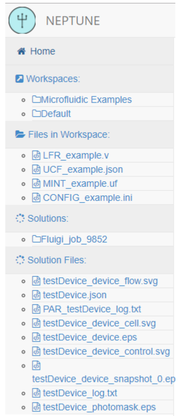
Detailed configurable design
Microfluidic Netlist (MINT)

MINT

Save | Compile | Delete | Download | New Workspace | New File

```
# Microfluidic Transposer
# Created on 7/25/2017 - 07.56.48
# CIDAR LAB - Boston University

3D DEVICE testDevice

    LAYER FLOW
PORT flowInPort0,flowInPort1,flowInPort2,outPort0 r=100;
V TREE fDevice0_YMixer 2 to 1 spacing=10000 flowChannelWidth=1000;
V TREE fDevice1_YMixer 2 to 1 spacing=10000 flowChannelWidth=1000;
H 3DVALVE cDevice0_3DValve radius=2000 gap=1000;
CHANNEL flowChannel0 from flowInPort0 2 to fDevice0_YMixer 1 w=100;
CHANNEL flowChannel1 from flowInPort1 2 to fDevice0_YMixer 2 w=100;
CHANNEL flowChannel2 from flowInPort2 2 to cDevice0_3DValve 4 w=100;
CHANNEL flowChannel3 from fDevice1_YMixer 3 to outPort0 4 w=100;
CHANNEL flowChannel4 from fDevice0_YMixer 3 to fDevice1_YMixer 1 w=100;
CHANNEL flowChannel5 from cDevice0_3DValve 2 to fDevice1_YMixer 2 w=100;
    END LAYER

    LAYER CONTROL
PORT controlInPort0 r=100;
CHANNEL controlChannel0 from controlInPort0 1 to cDevice0_3DValve 3 w=100;
    END LAYER
```

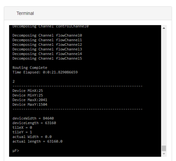
Share and collaborate by
Downloading Design Files



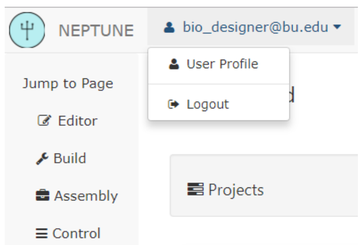
Supported File Types:

LFR & JSON
(parametric design)
MINT & INI
(detailed layout)
SVG
(CNC milling)
EPS
(Lithography)

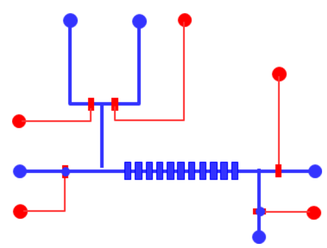
Fluigi Place and Route CAD Software Tool



All your **designs in one place**
on the Cloud



Microfluidic design output are
Fabrication-Ready SVG and EPS Schematics



Compatible with the
MakerFluidics Low Cost Fabrication Protocol