POLITECNICO DI MILANO

Biochip Course

Experimental Lab

Instructions

Marco Carminati

a.y. 2020/2021

March 22th 2021

New Laboratory Activity

Goal: design, fabricate and test of a microfluidic device using 3D printing in small teams

Expected learning outcomes:

- Develop hands-on experience
- Develop autonomous project organization skills
- Experience teamwork
- Develop presentation skills

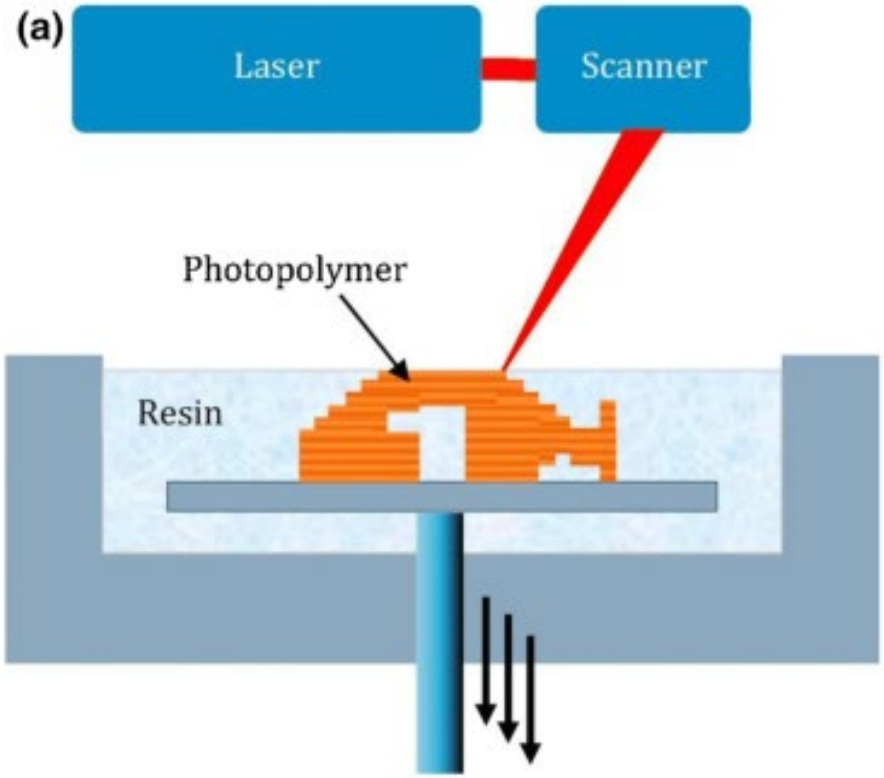
If COVID restrictions will not allow physical presence in the lab, tests will be remotized (presentations discussion will be on-line)

No evaluation in the exam (optional activity), ranking is possible

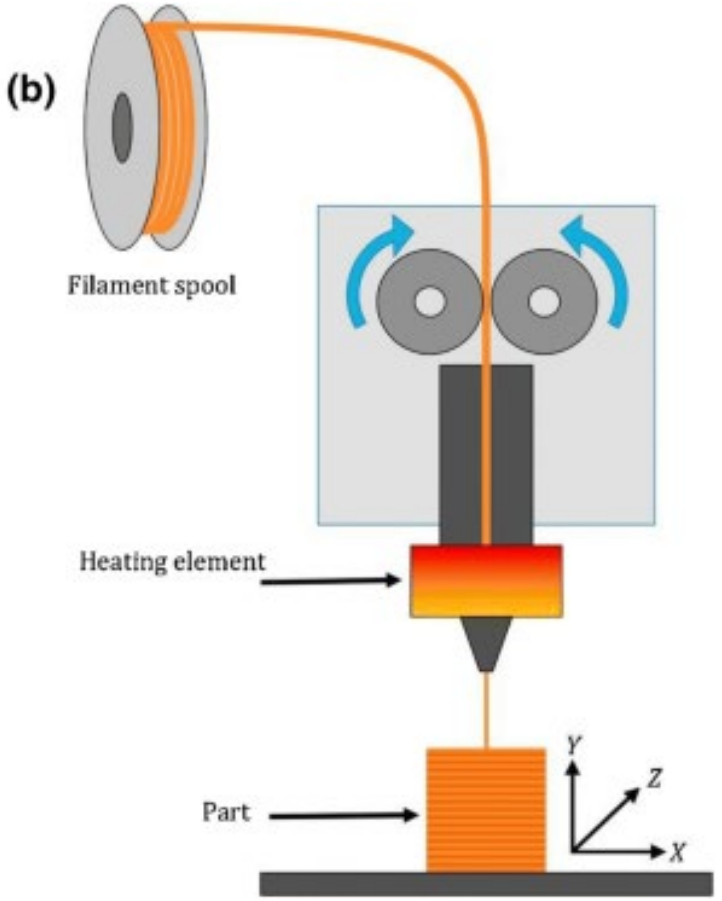
The Technology: Additive Manufacturing

3D Printing

Stereolithography



Fused Filament



The Printer

Form 3 by FormLabs

25 μm resolution (x, y and z)

(take some margins)

Transparent resin

The 3D CAD Design Software

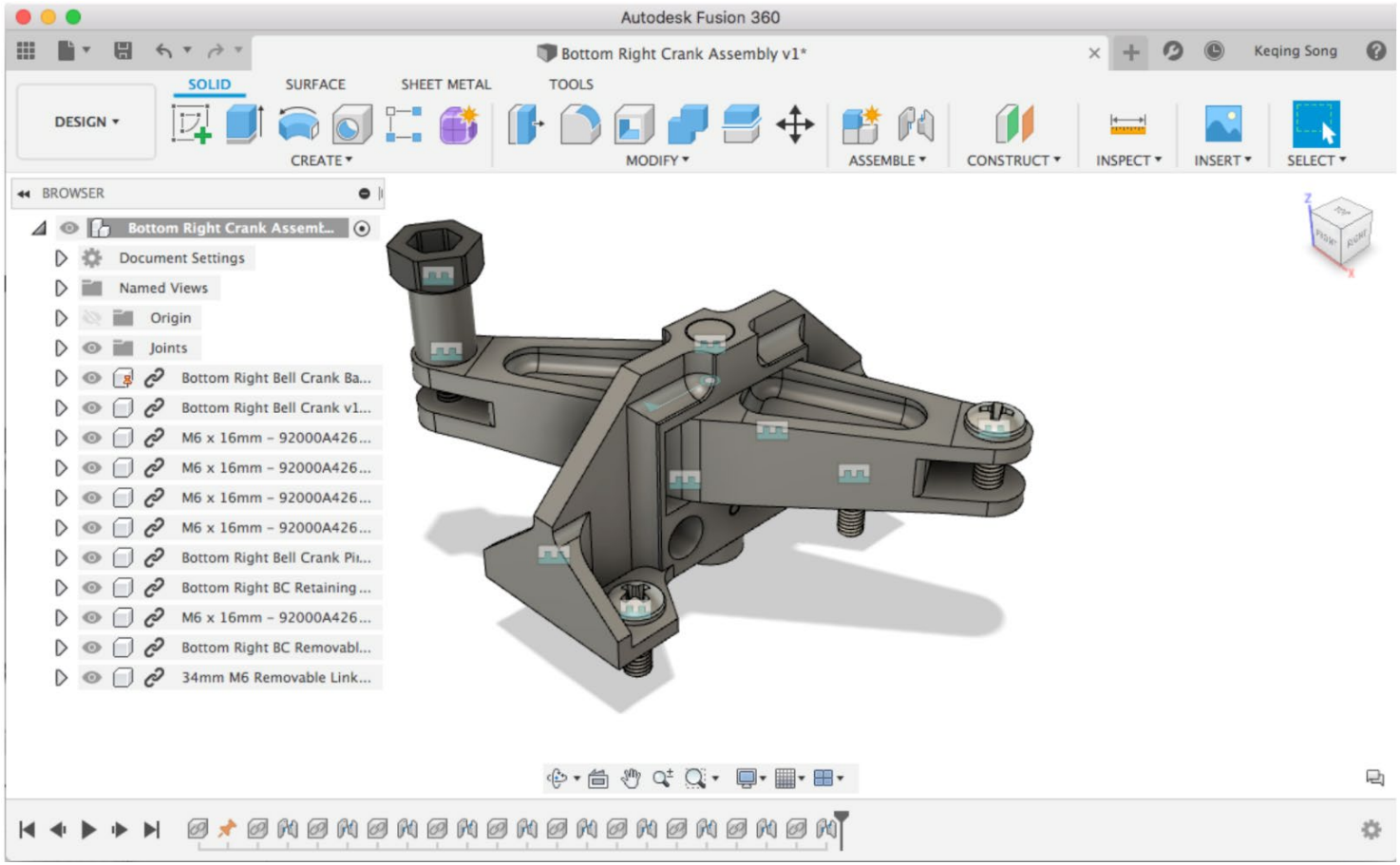
Fusion 360 by Autodesk

Free for students

Tutorials on-line

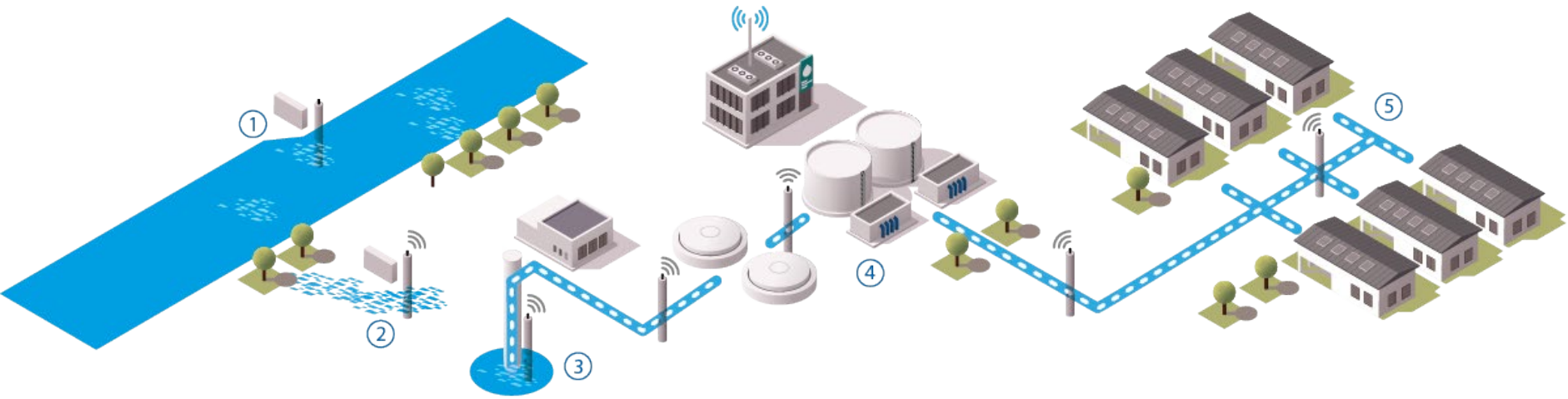
Teamwork in Cloud

Output: .stl file for 3D print



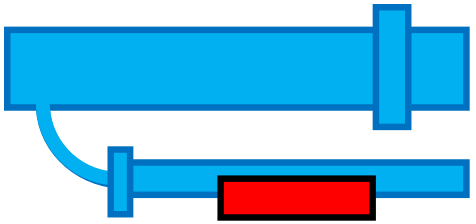
The Application Goal

Target: design a microfluidic device for on-line and remote analysis of the quality of drinking water in the distribution pipeline

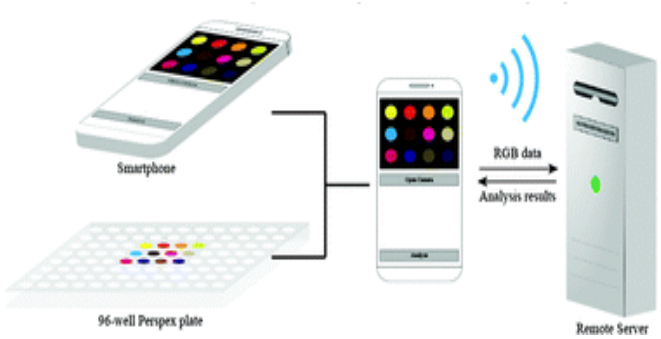


Starting Point: Manual Colorimetric Tests

Water distribution



Microfluidic Device



Camera readout

Colorimetric Solutions for Water Analysis

https://www.jbl.de/en/products/jbl-shop-for-aquarium-pond-terrarium?country=us#tag-536,tag-537

Choose a minimum of 2 solutions (pH + another one) from the JBL catalog

Design Requirements

Basic requirements:

- Choose the parameters to monitor (check protocol)
- Design the channels, chambers, mixing
- Minimize device area (e.g. 2cm × 5cm)
- Compute fluidic resistance and check driving pressure, Q
- Check mixing volumes and times of the colorimetric solution
- Propose a test protocol

Optional advanced points:

- Study automatic sample loading (no pipette/syringe pump)
- Study color recognition issues with smartphone camera
- Study additional sensors (e.g. electrochemical)
- Study fluid dynamics in COMSOL…

Activity Plan

The practical lab activity is divided in **4 phases**:

1. Design of the microcannels (at home in teams, I'll create a MS Teams virtual class for each group)
2. Discussion in the classroom (3-slide presentation per team)
3. Fabrication day (May 24 *to be confirmed*)
4. Characterization day (May 26 *to be confirmed*) with pumps, water, colored fluids, chemicals, pH meter, microscopes.

Deadlines

1. **March 31** Team formation and registration at:

https://forms.office.com/Pages/ResponsePage.aspx?id=K3EXCvNtXUKAjjCd8ope65iV_t8uZvBMmR6svL4phANURTdMRDlDRUoxNDBBN1RISUdMWERSSFFMQi4u

(~4 team members, register even if you are alone)

2. **May 10 Submission** of final ***stl*** file (named as the team)

upload to https://polimi365-my.sharepoint.com/:f:/g/personal/10033968_polimi_it/EpqisGhfxrlBs3WYh9h_HDcBgtmZgsebFpDOVEhFRCRXQA?e=OqwFtp and email with choice of chem.

3. **May 17/19 Class Presentation** and discussion

4. **May 24/26 Experimental Lab** (Alfa room, Building 24)