3D printing (fused deposition modelling) of metallic tubes with complex geometries

Master/Semester project

(Section: Microengineering, Bio Engineering, Materials Science, Robotics)

Fused deposition modelling (FDM) or fused filament fabrication is a 3D printing technique where a polymer melt is extruded through a nozzle onto a temperature-controlled build platform. A three-dimensional structure is successfully created by stacking the extruded polymer layer-by-layer. For most applications and structures, a flat build plate is usually sufficient. However, it can be limiting in some cases where fine features are required as overhangs and some post processing techniques like sintering are to be employed on the printed object.

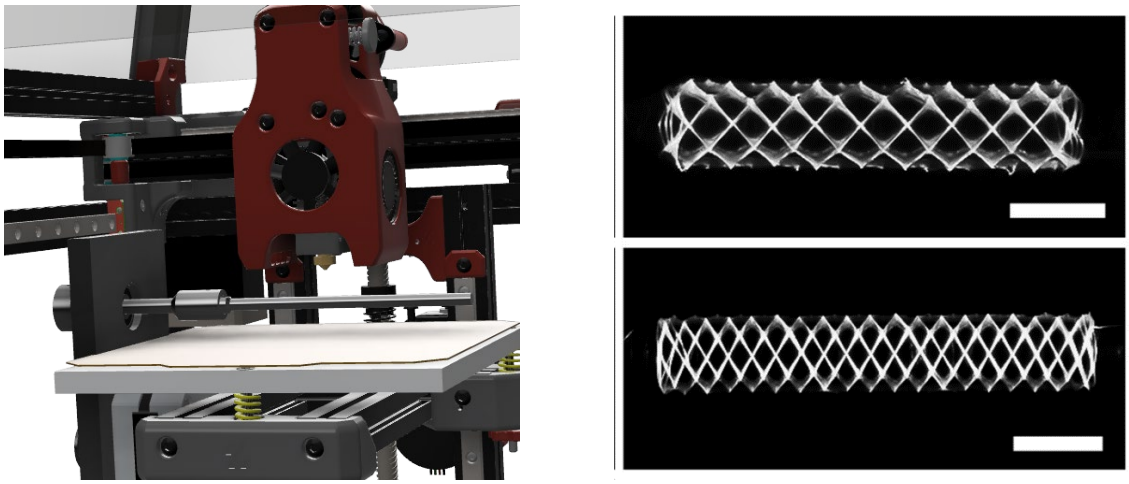

Figure 1. Schematic representing the idea of tubular collector on FDM printer (left). Potential design ideas for printing (right) 2mm scale. Diamond or auxetic designs to be tested using metal filled filaments.

A FDM printer usually uses a standard polymer filament with 1.75/2.85 mm diameter. A large variety of polymers have been processed using this technique with poly lactic acid (PLA) being the most utilized due to the ease in processability. Other materials such as Nylon, flexible thermoplastic urethane and fiber reinforced polymers have also been used and are available commercially. There is increasing interest in composite materials, specifically metal filled and ceramic filled polymers which can be used in FDM. The printed parts from these materials can be sintered (high temperature treatment) to obtain fully metallic and ceramic components.

This student project will involve building of a new Voron FDM printer and upgrading it for temperature controlled tubular collector. Once the software control is stablished for printing complex tubular structures, the idea will be to implement real-time monitoring of printing through image analysis. The next part of the project will involve printing of metal/ceramic filled polymer filaments with minimum resolution feasible. The printed parts will be sintered and analyzed to further optimize the FDM approach to obtain fully metallic/ceramic tubular constructs.

Possible tasks:

- Incorporating tubular collector on Voron 0.
- Temperature control of the collector.
- Software control for printing complex geometries with minimum resolution.
- Testing composite materials to print functional constructs (metal or ceramic filled FDM filaments).

Contact: Biranche Tandon *(biranche.tandon@epfl.ch)*

Useful reading: Hong et al, Open5x: Accessible 5-axis 3D printing and conformal slicing (https://dl.acm.org/doi/10.1145/3491101.3519782)

École polytechnique fédérale de Lausanne

Microsystems Laboratory 1
(Prof. J. Brugger)

EPFL STI IMT LMIS1
(Batiment BM)
Station 17
CH - 1015 Lausanne

Phone :
E-mail : biranche.tandon@epfl.ch
Office : BM 3.109