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Development of a monolithically 3D printed reciprocating pump for HPLC

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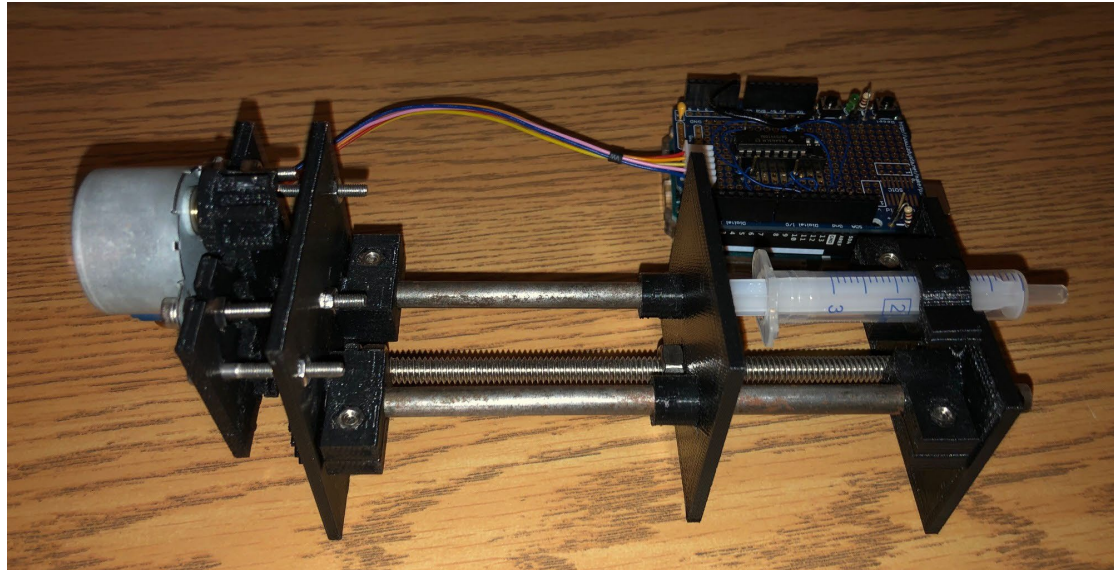
Thesis Advisor: Dr. Robert LeSuer

Introduction

- Development of a reciprocating pump by means of 3D printing
- 3D printing of scientific instrumentation provides a cheaper, more accessible alternative to commercial instrumentation



OMIS demonstrates viability of open source instrumentation



- OMIS—The Open Millifluidic Inquiry System
- 3D printed syringe pump controlled through Arduino

Interested in OMIS? Check it out here:

<https://www.sciencedirect.com/science/article/pii/S246806721830052X>



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Introduction

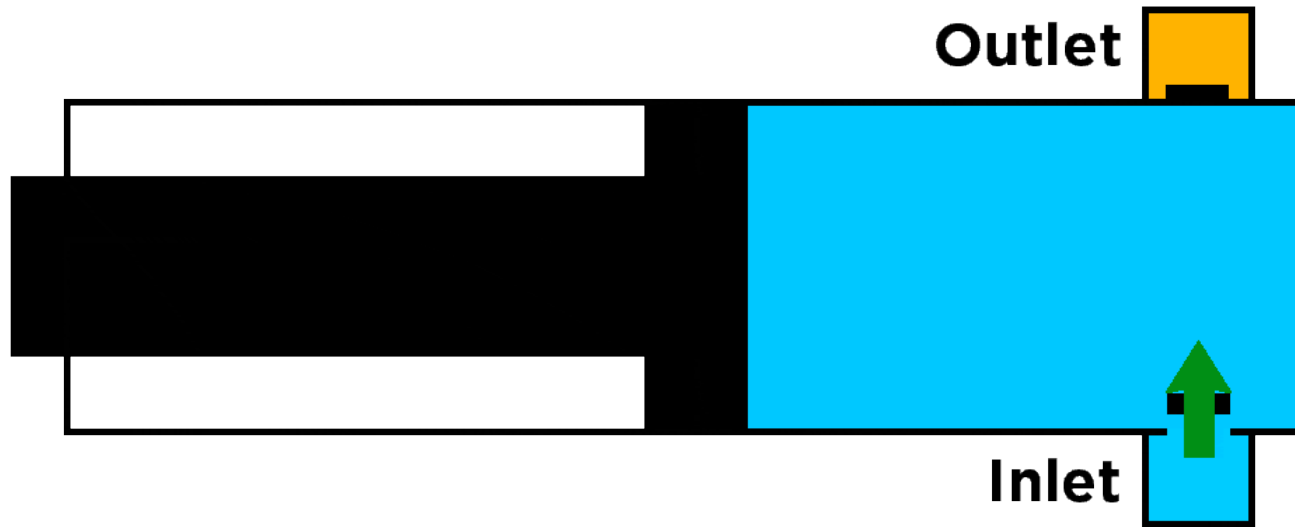
- High performance liquid chromatography (HPLC) is a separation method
- High pressure is needed for effective separation
- High pressure is provided by a reciprocating pump



Introduction

- Advantages of a reciprocating pump:
 - Small internal volume (35-400 μL)
 - Generate pressures up to 10,000 psi
 - Relatively constant flow rates can be achieved





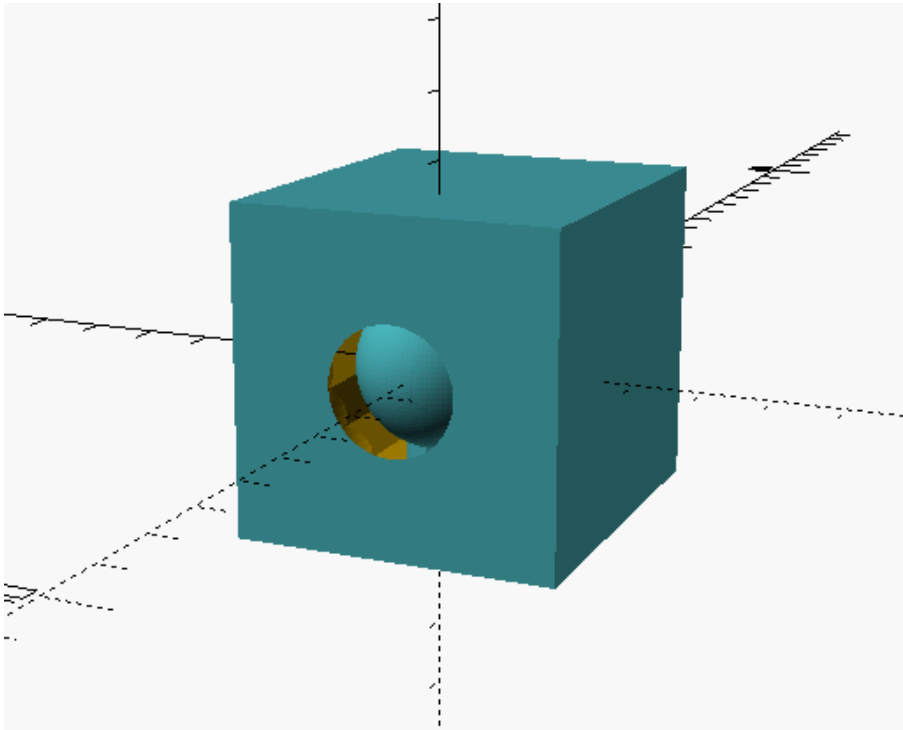
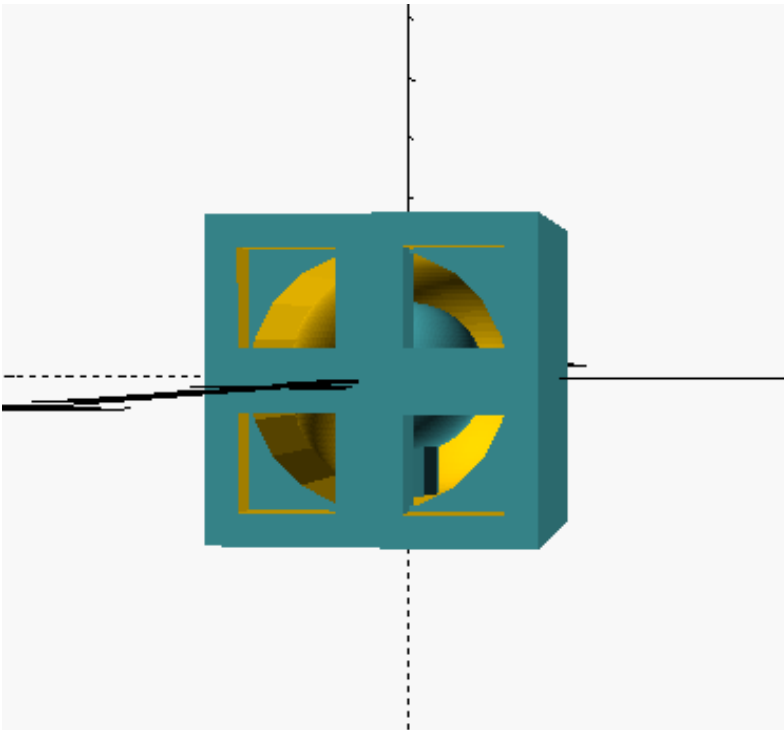
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Methods

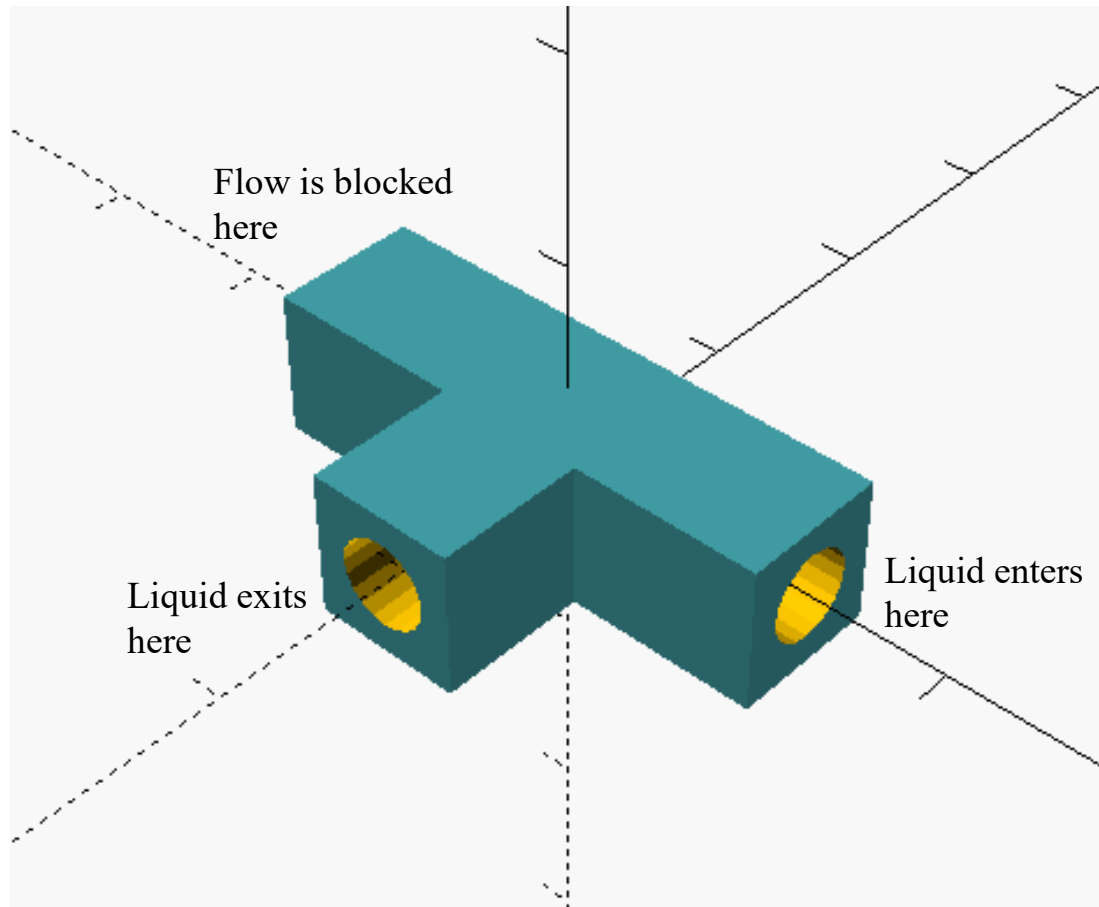
- All prints designed using OpenSCAD software
- All prints printed with Prusa i3 MK2S 3D printer
 - Extruder at 212°C, bed at 57°C
- Polylactic acid (PLA) filament—Gizmodorks



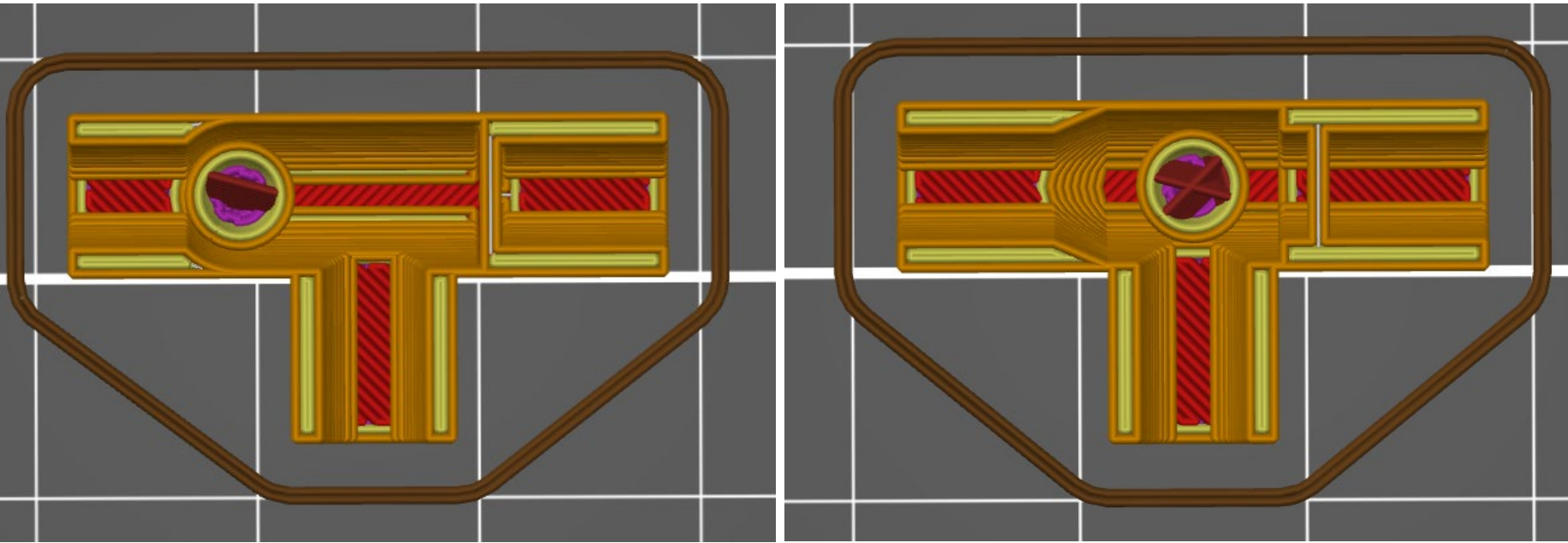
Valve design permits flow in one direction



Test valve utilizes two tubing ports



Conical valve is a promising design



Future directions

- Quantify efficacy of conical versus spherical valve design
- Design reciprocating piston
- Implementation of two check valves and piston to create a complete pump
- Investigate fluid dynamics to minimize the pulsing flow
- Determine pressure of fluids exiting the pump





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Thank you!

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