

Faculty of Engineering

ASPIRE Summer Research Program 2026-2027

Project Title: Refining a cardiac blood loop

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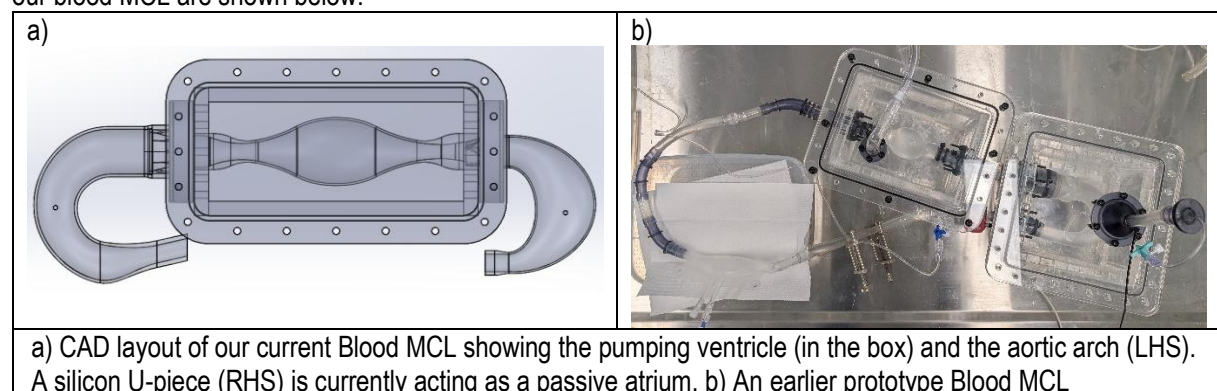
Objective

Design and implement an actively controlled atrium chamber for our left heart blood flow loop.

Project Details

Cardiovascular flows are those that move blood around the body. As biomedical engineers we are interested in understanding blood flows, particularly those related to diseases and in medical devices such as mechanical heart valves, VADs* or ECMO** devices. Thrombosis (formation of blood clots) is a major, often life threatening, complication of abnormal blood flow.

Our lab at VHI (Victorian Heart Institute) uses multiple approaches to study thrombosis in cardiovascular flows. This project focuses on our Blood MCL which is a mock circulation loop that uses human blood. Most MCLs use a blood analogue fluid such as water/glycerol to simulate the fluid properties (density/viscosity) of blood, but this does not allow us to directly study thrombosis. To overcome this a current PhD project has focused on developing the Blood MCL. The use of blood imposes significant constraints compared to our traditional MCL including reducing the volume by 90% and a complete redesign of the pumping mechanism. The design and a prototype of our blood MCL are shown below.



A limitation of our current design is that it does not accurately replicate the function of the heart's atrium, where the atrium is the filling chamber that pushes blood into the ventricle during atrial systole. Adding an actively controlled atrium to our Blood MCL would improve the capacity (volume flow rate) of our system and also allow us to replicate cardiac diseases involving atrial disfunction, in particular atrial fibrillation

The proposed SRP project is to design, fabricate and implement an actively controlled atrium. The general design and control system will likely be similar to that of the existing ventricle. You will work alongside the PhD student who built the existing system.

Project Timeline

TASK	1	2	3	4	5	6	7	8	9	10
Lab induction										
Understand the current blood MCL & literature review										
Design molds for new atrium										
Design pressure box and associated connectors										
Oversee or fabricate* pressure box										
3D printing of connectors and molds										
Molding of atrium(s)										
Assembly and testing										
Assist PhD student with blood MCL experiments**										

The timeline assumes that the student is proficient in CAD

*Some tasks will depend on the existing skillset of the student

**It is expected that we will run blood loop experiments during this time. These experiments require a team to complete, you will be trained to assist.

Prerequisites

The project will suit a student who has a strong interest in:

Biomedical engineering (although this might not be your major), including understanding the fluid mechanics of the cardiac cycle and relevant mechanical devices/diseases

Fabrication using 3D printed molds (incl. designing with CAD and printing the molds)

Problem solving

Student Placement Agreement

A student placement agreement must be signed by the project supervisor and the student prior to commencement of the ASPIRE program.

[LV0554-72741 ASPIRE Program Co-Curricular-Student-Placement-Agreement-Short-term.docx](#)