NSERC USRA Summer Project 3
Development of 3D-printed microfluidic devices for studying defect-tolerant systems
with Dr. Bonnie Gray/Dr. Glenn Chapman

Project Description
There is strong interest in creating small, portable, biomedical sensors that integrate microfluidic systems, electronic processing circuits in a single system. However, an inherent issue in complex systems combining microfluidics and electronics is avoidance and/or circumvention of defects, both at fabrication time and during field operations. For this USRA project, you will explore the issue of the creation of defect avoidance in microfluidic sensor systems that are to be integrated with the electronic subsystems. This project is a joint project between Dr. Bonnie Gray and Dr. Glenn Chapman in ENSC.

Student Contribution
The student will develop designs to be printed using state-of-the-art 3D printers by our collaborators at Yamagata University in Japan. This will involve developing designs based on previous collaborative work between Drs. Gray and Chapman that modelled different geometries’ tolerances to defects and clogging due to, e.g., cellular debris (see Fig. 1).

Skills Needed:
The student should be in their third year or above. Some combination of the following skills is necessary:

1. Students with prior microfabrication experience, e.g., ENSC 495, or 3D printing experience will be given preference.
2. Other potentially helpful courses: strength of materials; anything in fluid dynamics; sensors coursework
3. Good computer skills, especially any computational modeling work with, e.g., ANSYS or similar.
4. Enthusiasm to learn new things and combine knowledge from disparate areas. We are looking for “hands on” people who like to tinker in the lab, and play around with modeling software.

For your interview, please be prepared to discuss/demonstrate knowledge in one or more of these areas.

Fig. 1. Example figures from one of our published papers: a) SEM image of SU-8 microfluidic channels showing the support posts and the top encapsulation layer.; b) Cathedral Chamber design showing support pillars and flow around stuck objects; c) Surface and particle tracing plots for a cathedral chamber system using the low flow method of successive blockage placement. We found this to be more tolerant than a simple parallel channel design.