



MECH 493 project: Optimization and application of experimental setup for fluid injection into tissue

Background and research goal

Hollow microneedles are biomedical microdevices that provide a promising alternative to conventional drug delivery techniques. Being less than a millimeter in length, microneedles can improve patient compliance and precisely deliver drug-containing fluid into the skin. An experimental setup has been developed at UBC to study the mechanics of fluid injections into the skin by recording injection parameters, such as fluid flow rate and pressure, and visualizing the tissue deformation in real-time using optical coherence tomography (OCT). In the current setup, a spring-actuated system provides an insertion velocity to the microneedle, a linear motorized stage controls the retraction of the microneedle, a pressure controller forces the injected fluid through the microneedle and microfluidic sensors record the fluid pressure and flow rate. Different injection parameters are controlled and recorded through a LABVIEW program. This project aims to create an improved experimental setup, increasing the repeatability between tests and decreasing user error. The improved setup will allow users to generate reliable and repeatable injection data with significantly less initial training than required by the current setup. The current setup is the only reported experimental setup for observing fluid injections in real-time at micron-level resolution; an improved version will have the potential to expand our understanding of fluid injections into biological tissue and provide scientific insights on different injection parameters more quickly and reliably.

Tasks to be performed by the student

- Work with graduate students from the lab to identify experimental needs and shortcomings of the current experimental setup
- Create a new scientific instrument, possibly with support of SolidWorks
- Create parts by 3D printing or machining components
- Assemble and test the experimental setup
- Modify current LABVIEW program to improve the experimental sequence
- Prepare injection fluid, skin tissue sample and experimental setup for injection experiments
- Conduct injection experiments on excised porcine skin tissue through hollow microneedles, using the improved experimental setup
- Analyze the data and interpret the results in the context of the scientific literature

Facilities and team:

The experiments will be conducted in PPC 121, Pulp and Paper Centre. The student will work closely with Prof. Boris Stoeber's graduate student, Pranav Shrestha (email: pranav.shrestha@alumni.ubc.ca; phone: 250-858-3404).