Supervisor: Prof. Axel Guenther guenther@mie.utoronto.ca
Title: Preparation aligned collagen sheets with increased elastic modulus
Brief Description:

Our laboratory has developed an experimental approach for the shear-induced formation of aligned collagen sheets with elastic moduli of up to 10MPa. The sheets are ~5 micrometers thin, 15mm wide and arbitrarily long. The goal of this project is to systematically study the roles of shear and strain on the elastic modulus. Based on recently published tensile data for aligned collagen fibers (http://pubs.acs.org/doi/abs/10.1021/acs.nanolett.6b02828) we expect as-produced aligned collagen sheets to exhibit in a significant (at least tenfold) increase in elastic modulus.

The technology is anticipated to enable a wide range of applications that include bioprinted blood vessels, bio-hybrid interfaces and transient electronic devices.

Supervisor: Prof. Axel Guenther guenther@mie.utoronto.ca
Title: 3D-bioprinting of fixation strategies for tubular structures and assemblies
Brief Description:

Our laboratory has developed a microfabricated co-axial printhead for extrusion-based bioprinting of tubular biopolymer structures and tissues. The thesis project will focus on 3D bioprinting geometries that allow the tubular tissues and tissue assemblies to be controllably perfused, pressurized, collapsed, and multiplexed. In the thesis project, a biocompatible thermoplastic will be used for filament extrusion using a commercial bioprinter available at the Centre for Microfluidic Systems.

Supervisor: Prof. Axel Guenther guenther@mie.utoronto.ca
Title: Sheet-based higher-order structures
Brief Description:

The unique biomechanical properties of tissues are intrinsically linked to the spatial organization of protein-based biopolymers. This project involves the development of a numerical model for wrapping thin elastic sheets into load-bearing structures. The model will be developed in a finite element code (Abaqus) and provide a quantitative link between the tensile properties of the sheet, the spatial assembly of the sheet, and the properties of the assembled structures. The knowledge generated in this project will be instructive for bio-printing hollow organs.