MULTI-NOZZLE PRINTHEAD FOR CONSISTENT, RAPID IN-SITU DELIVERY OF BIOINKS WITH A HANDHELD BIOPRINTER

Supervisor: Prof. Axel Guenther

Contact Email: axel.guenther@utoronto.ca

Research Area: Bioprinting, 3D printing, material optimization, bioengineering

Project Description: The project relates to the formation of unique biomaterial-based structures using state-of-the-art 3D printing and bioprinting technologies. The employed printheads allow for the precise positioning of cells and recapitulation of the structure of the tissue of interest. Specifically, we have developed a handheld bioprinter for the delivery of skin precursor tissues to treat burn wounds. Our platform technology consists of three components: (a) a handheld bioprinter instrument, (b) a cellular bioink, and (c) disposable parts for bioink delivery. We have previously demonstrated the only in situ bioprinting approach capable of covering wound areas at a rate >0.2 m^2/h or 10% of the total body surface area per hour using a multi-nozzle microfluidic printhead mounted to the handheld bioprinter[1,2]. Recently, we have developed a portfolio of new bioinks that outperform the bioinks investigated in our previous publications[2]. We plan to evaluate these bioinks with both the handheld bioprinter and other commercial 3D bioprinters available to us in the CRAFT Tissue Foundry (www.craftmicrofluidics.ca).

During your MEng project, you will identify the optimal bioprinting window for our new proprietary bioinks and optimize the means for its rapid and consistent delivery to form different biologically relevant structures using commercial bioprinters e.g., the RegenHU (3-axis) and Advanced Solutions (6-axis) bioprinters. You will investigate the printability of different bioink formulations using a factorial design of experiment approach. You will collaborate with PhD students from the Guenther lab and research and technical staff from the National Research Center of Canada to assess the ability of candidate bioinks to support long-term tissue culture. All the research will be carried out in the state-of-the-art CRAFT Tissue and Microfluidic foundries[3].

Please contact us if you are interested or have further questions. We look forward to eager, detail and team oriented, and hard-working MEng students to contribute to this exciting project.

Opportunities provided by the MEng project:

1. Gain research experience working in microfluidic and tissue foundries while learning from the senior graduate students of the Guenther Lab, as well as researchers and technical staff from the National Research Council of Canada.
2. Support research that will lead to publications, patents, and potentially the creation of a start-up company
3. Tackle challenges related to translating technologies from bench to industry

Useful resources:

Hakimi, N. *et al.* Handheld Skin Printer: In-Situ Formation of Planar Biomaterials and Tissues. *Lab Chip* **18**, 1440-1451 (2018).

Cheng, R. Y. *et al.* Handheld instrument for wound-conformal delivery of skin precursor sheets improves healing in full-thickness burns. *Biofabrication* **12**, 025002 (2020).
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