

SBME ANNUAL SYMPOSIUM

Poster Flash Talks

June 4, 2024 | 11:40 am - 12:00 pm



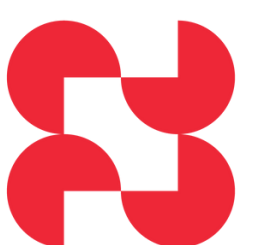
Katarina Zosel

PhD, SBME

Supervisor: Dr. Francis Lynn

Computational Investigation of the Developmental Pathways of Stem-cell Derived Islet Cells

Type 1 diabetes occurs from the autoimmune destruction of insulin-producing β -cells in the pancreas, resulting in hyperglycemia and lifelong complications. Transplanting donor pancreatic islets, which include β -cells, is a promising alternative to insulin injection but not scalable as donor supply does not meet patient demand. Creating β -cells from human pluripotent stem cells can provide insulin independence without relying on donors. However, sc- β -cells have impaired glucose-induced insulin secretion, indicating a knowledge gap in sc- β -cell differentiation. Computational analyses of cell states throughout the sc- β -cell differentiation procedure and comparison to donor β -cells identified candidate genes and pathways limiting maturation and β -cell production. Modelling the knockout or over-expression of key genes predicts cell fate changes which are now being tested in vitro. These in vitro validations hope to inform changes to sc- β -cell differentiation procedures, increasing the production of mature sc- β -cells, and expanding access to sc-treatments for type 1 diabetes.





Daniel Aguilar Hidalgo

Research Associate, SBME
Supervisor: Peter Zandstra

Symmetry-breaking, scaling and growth control in adherent pluripotent stem cell-derived developmental organoids

Fundamental to developmental systems is the spontaneous emergence of cellular domains and growth regulation, encompassing intricate phenomena such as self-organization, size scaling, and complex growth dynamics, capable of producing structured cellular patterns, symmetry-breaking events, and growth arrest. We study these features in two-dimensional gastruloids, employing a combination of mathematical modeling and quantitative imaging techniques. We identified parameters controlling the emergence, shape, and size of BRA+ patterns in micro-patterned mouse pluripotent stem-cell colonies, and found that large colonies displayed centro-symmetric patterns, whereas colonies around 200um diameter developed spontaneous asymmetries. Additionally, pattern size scales with total colony size, while exhibiting complex growth dynamics capable of arresting pattern growth, suggesting that cells possess positional information relative to the colony size they inhabit. These results remained consistent across colony size and cell density, with a linear colony-size-dependent scaling factor. These findings provide a foundation for engineering developmental systems and guiding functional cellular pattern self-organization.





Iryna Liubchak

PhD, SBME

Supervisor: Dr. Karen Cheung

Photocrosslinkable GelMA hydrogels support neurite outgrowth in a microscale in vitro spinal cord injury model

I present a novel study of an application of the hydrogel biomaterial crosslinked with visible blue light for the outgrowth of neuron extensions in 3D cell culture conditions. I'm working on defining the composition and polymerization parameters of the hydrogel to support the outgrowth of extensions from primary neurons in a microscale spinal cord injury (SCI) on-a-chip model, and to ensure a successful application of the hydrogel at the SCI site in laboratory animals via the minimally invasive needle injection. A hydrogel biomaterial aims to support the axons to enter the SCI site and promote growth to make functional synapse connections with non-damaged neurons helping to restore the loss of physiological, motor and sensory functions below the level of SCI.





Parsa Tadayon

Masters', SBME

Supervisor: Fidel Vila-Rodriguez

Computational investigation of impact of gyral geometry on low-intensity transcranial focused ultrasound neuromodulation for a standardized target in the left dorsolateral prefrontal cortex

Low-intensity focused ultrasound (LIFU) is a novel, non-invasive, and highly focal tool capable of modulating region-specific brain activity. There are limited studies with the purpose of quantifying the precision of LIFU for cortical targets, and challenges of such a focal technique to aim at complex geometric structures such as the cerebral cortex. Our objective was to investigate the impact of gyral geometry on the energy distribution of LIFU in the dorsolateral prefrontal cortex. Head modelling, cortical parcellation, target standardization, and acoustic simulation were performed using T1w and T2w MRI data from 20 individuals. On average, 38.1% of the energy was delivered to the middle-frontal gyrus while 10.4% of the energy was delivered to the middle-frontal sulcus. The results demonstrate the capability of LIFU to deliver energy to specific cortical regions with high accuracy and precision though individual neuroanatomical differences do play a role in the variability of results between subjects.





Naomi Jung

Masters, SBME

Supervisor: Rihzi Wang

We Don't Talk Anymore: Disruptions to the Lacunocanalicular Network in Prostate Cancer Bone Metastasis

Prostate cancer bone metastases (PCBM) increase mortality risk, cause intractable pain and result in elevated fracture risk for patients. Bone homeostasis is disrupted resulting in predominantly osteoblastic lesions. Mechanosensitive osteocytes orchestrate bone remodeling and are embedded in the bone matrix in voids called lacunae which extend into canaliculi - the lacunocanalicular network (LCN). We hypothesize that the disruption of the LCN is integral to the loss of homeostasis and contributes to excess and disorganized matrix deposition, and increased fracture risk.

We performed synchrotron nanoCT imaging on 4 vertebral trabecular bone samples at 50 nm voxel resolution. Images were segmented using a U-Net based convolutional neural network and quantitative descriptors of the LCN were found. The LCN in osteoblastic bone lacks the anisotropic organization seen in control bone. The lacunae in osteoblastic bone are: at increased density, not aligned to a common axis, and lack adequate canalicular connection. These changes suggest altered osteocyte mechanosensitivity, irregular interstitial fluid flow, and a reduced ability to resist crack propagation during fracture in osteoblastic PCBM bone.

