McGill

Mechanical Engineering Seminar

Thursday, October 31, 2024
12:00-1:00pm
(Virtual: Lekan Molu Zoom Link)

Mr. Lekan Molu

Microsoft Research

Towards Adaptive Soft Robots with Improved Motion Strategies: Emerging Modeling and Control Methods

Abstract:

As a design principle, morphological computation engenders embodied intelligence in soft robots by improving their bending, torsion, twisting, or stiffness-to-weight ratio for motion generation. In this design paradigm, the internal actuators of a soft robot (re-)configure the mechanical nonlinearity of its (heterogeneous) material rather than reject them. This is aided by adaptive, time-efficient computational algorithms that deliver adept nonlinear motion strategies. In this talk, we shall focus on soft robots that possess one dimension longer than the other two and revisit the embodied design principle to probe new modeling and control methodologies. With our goal set on improved whole-body strain regulation, we ground our curiosity in reduced-order, finite-dimensional mathematical models to tame the infinite-degrees-of-freedom of soft robot continua: we establish the general structural properties that enable data-driven parameters identification and leverage these for whole-body multivariable feedback control. Lastly, towards improved time response and precision in the strain regulation of soft robots' deformation, we devise a composite, time-scale separated model and a hierarchical adaptive controller that harnesses external forces and physical constraints of the robot for improved motion execution. Our new tools demonstrate a step forward in the quest towards the real-time control of soft robotic systems.

Biographical Sketch

Lekan Molu is a Senior Researcher with Microsoft Research New York City with a focus on autonomous agents, learning-enabled adaptive, and intelligent augmentation systems. From 2019 to 2021, he was a postdoctoral researcher at the University of Pennsylvania (UPenn). Prior to UPenn, he briefly served as a postdoctoral scholar at the University of Chicago's Duchossois Center for Advanced Medicine (DCAM). In both places, he was associated with the soft and parallel robot mechanism design, modeling, optimization, and precise control for radiation delivery in head and neck cancer treatments. Prior to this, he received a PhD from the University of Texas at Dallas in 2019. During his PhD, he was a visiting researcher at the Medical Physics and Engineering division of UT Southwestern's Department of Radiation Oncology. He holds a MSc in Control Systems from The University of Sheffield. His research interests span robotics, learning-enabled control methods, and how emerging tools in modern machine learning can be leveraged to further improved everyday automation processes in embodied devices.