Department of Biomedical Engineering
The Chinese University of Hong Kong

Engineering Living Muscles for Biohybrid Robots: From Tissue Training to High-Performance Locomotion

Professor TAN Yu Jun
Assistant Professor
Department of Mechanical Engineering
National University of Singapore

Date : 6 August 2026 (Thursday)
Time : 2:30 pm
Venue : Room 1122, William M W Mong Engineering Building, CUHK

Abstract

Biohybrid robots integrate living tissues with engineered structures to achieve functions that are difficult to reproduce using conventional actuators alone. Among the available biological actuators, engineered skeletal muscle is particularly attractive because it is soft, adaptive, energy efficient, and capable of responding directly to electrical, chemical, and mechanical stimuli. However, the limited force output and inconsistent performance of engineered muscle tissues remain major barriers to the development of practical biohybrid robots.

In this talk, I will present our recent work on strengthening engineered skeletal muscle and translating improved tissue performance into robotic locomotion. We developed an autonomous self-training platform that harnesses the spontaneous contractions of developing muscle tissues to provide repeated mechanical loading without external control or power. This training strategy substantially enhanced muscle force generation and enabled the fabrication of high-strength skeletal muscle actuators. To demonstrate their robotic capability, we developed OstraBot, a twin-tail biohybrid swimming robot powered entirely by engineered muscle tissues. A physiology-based muscle contraction model was used to guide the mechanical design of the robot and identify the stiffness and operating-frequency conditions that maximize energy transfer from the muscle to the surrounding water. The resulting robot achieved record locomotion performance among skeletal-muscle-powered biohybrid robots.

I will also discuss how bioinspired and multifunctional materials, including self-healing skins, low-power optical interfaces, and biodegradable substrates, may support future biohybrid systems. These advances point toward a new generation of robots in which living actuators are not simply embedded into machines, but are trained, integrated, and engineered as functional robotic components.

Biography

Yu Jun Tan (National University of Singapore, NUS) is an Assistant Professor in the Department of Mechanical Engineering, where she is a PI at both the NUS Centre for Additive Manufacturing (AM.NUS) and the Advanced Robotics Centre (ARC). Dr. Tan's research integrates materials science, mechanics, and bioengineering to develop next-generation bio-derived, bioinspired and biohybrid materials for biorobotics. Her group investigates the processing, deformation, and functional behaviours of soft materials (such as bio-based polymers, gels, and living tissues) with particular emphasis on self-healing, electro-mechanical behaviours, and large-deformation mechanics. By linking fundamentals with sustainable design, her work advances the development of adaptive, self-powered, and eco-responsible machines. She has published over 40 peer-reviewed papers in top-tier journals, including Nature Materials,

Nature Electronics, Nature Communications, Science Robotics, Science Advances, and Advanced Materials. Her publications have been featured on journal covers and highlighted in the media. She is a recipient of the MIT Technology Review's "Innovators Under 35" Asia Pacific 2021 (Pioneer), MRS postdoctoral award, and Science, She Say! Award.

***** ALL ARE WELCOME *****

For enquiries, please contact Ms. Joyce Chan, Department of Biomedical Engineering at 3943 8278