

# **Tissue Engineering Multicellular Models of the Motor Control System for Medicine and Machines**

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Disease or damage that impacts neuromuscular tissues has a severe negative impact on health, mobility, and quality-of-life, motivating the development of tissue engineered multicellular models of the motor control system. We have engineered optogenetic skeletal muscle actuators and shown that light can be used to non-invasively and precisely control muscle contraction, and moreover, that repeated light stimulation "exercise" can program tissue strength, endurance, and regeneration after trauma *in vitro* and *in vivo*. Leveraging these tissues, we have interrogated how exercise programs crosstalk between muscle and other surrounding cells, such as peripheral nerves and vasculature, to better understand how mechanical and biochemical signaling can be manipulated in physiological and pathological states. In addition to applications of this work in disease modeling and regenerative medicine, we will also discuss how we use engineered muscle to power adaptive biohybrid robots that demonstrate a range of functional behaviors such as walking and gripping. This talk will cover the advantages, challenges, and future directions of using tissue engineered model systems to understand and manipulate the mechanics of biological motor control.