# *Neural Control of Dexterity: From Behavior to Single-Cell Activity*

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## Abstract

Humans exhibit exceptional finger dexterity, enabled by specialized neural mechanisms. Despite extensive research on dexterous control, the distinct contributions of different neural structures to flexion and extension remain unclear. In this talk, I will share findings from several studies. *First*, I will present evidence that finger independence during extension is significantly more limited than during flexion across various force levels and digit combinations. This limitation persists even after accounting for passive mechanical coupling, suggesting that the primary constraint on extension dexterity arises from central neuromuscular control rather than peripheral biomechanical factors. *Second*, I will discuss cortical mapping results, which reveal that finger flexion relies on broader premotor and motor areas, while both flexion and extension share descending tracts from the primary motor cortex. *Third*, I will introduce an artificial neural network model that replicates behavioral patterns in both healthy individuals and stroke patients, generating strong testable predictions about dexterous control mechanisms and providing novel insights into the recovery of the residual network. *Finally*, I will present preliminary data from two non-human primates, demonstrating the cerebellum's direct involvement in aspects of finger dexterity and highlighting the complexity of corticomotoneuronal (CM) cell activity, particularly the interplay between excitatory and inhibitory influences in shaping dexterous control.

## Bio

Firas Mawase, PhD, is an Associate Professor at the Technion – Israel Institute of Technology. His work spans both basic and clinical neuroscience, including investigations of neural circuits underlying fine motor control, stroke rehabilitation, and non-human primate studies. He earned his PhD in Biomedical Engineering from Ben-Gurion University and subsequently completed a postdoctoral fellowship at the Johns Hopkins School of Medicine, where he specialized in motor learning, stroke recovery and neuromodulation. In 2018, he established his own lab, where he continues to explore the neural mechanisms underlying motor function and develop novel rehabilitation strategies for individuals with motor impairments.