# Abstract

The ventral nerve cord (VNC) of *Drosophila melanogaster* governs its limb movements. Descending neurons (DNs) relay commands from the brain to different parts of the VNC, enabling a wide range of complex motor behaviors. Among these, Moonwalker descending neurons (MDNs) are particularly intriguing. Upon activation, MDNs induce backward walking in flies, even in headless flies where connections between DNs are absent. Specifically, MDNs actively elicit cyclic movements of the hindlegs, which drive backward walking. To investigate the circuitry underlying MDN-driven hindleg oscillations, I utilized the recently acquired connectome of the fly's VNC. I constructed a connectome-constrained (CC) network of MDN-specific pathways responsible for hindleg movements and trained this network to reproduce desired leg joint oscillations. Analyzing the network structures revealed insights into the circuitry behind cyclic hindleg movements. The results demonstrated that even the simplest MDN-specific pathways governing the hindlegs can generate oscillations. Furthermore, simulations identified neurons that may play key roles in leg oscillations in flies in vivo. Finally, the results showed that oscillations are not solely generated by a simple balanced excitatory-inhibitory (E-I) neuron pair but rather by a larger circuit that includes this E-I pair.



**Keywords:** Fly backward walking, Moonwalker descending neurons, Connectome-constrained network, Computational simulation.