Building Virtual Patients in-silico

Building Virtual Patients in-silicoSPINAL CORD AND MOVEMENT LABORATORYMOHAN RAGHAVANwww.iith.ac.in/~mohanrLife cycle of medical devices and therapeutics are critically dependant on generation of evidence of safety and efficacy for regulatory compliance. Often this turns out to be a limiting factor draining a large number of man-hours, money, time and the resultant cost of lost opportunity. FDA estimates that the development of virtual physiologies and virtual patients will play a significant role going forward in accelerating medical device development pipelines [1]. Our lab works on building large multiscale models and simulations of the spinal cord, muscles and skeleton to achieve movement using biological mechanisms across scales. NEUROiD, the in-silico movement platform [2] built in our lab allows the construction of hybrid neuro-musculoskeletal models. The platform enables co-simulation of neural and musculoskeletal elements using a neural simulator NEURON [3] and a musculoskeletal simulator OpenSim [4].

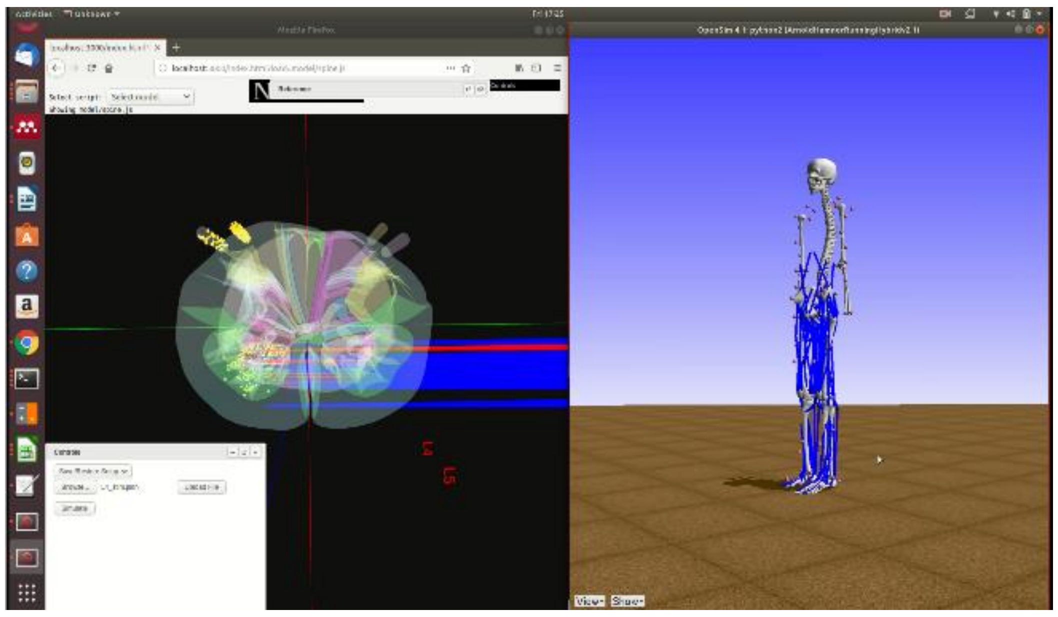

Figure 7: Screenshot from the NEUROiD in silico movement platform with the spinal cord controller(left) and the lower limb musculoskeletal model (right)

We build in-silico models of lower and upper limbs that can move when electrically stimulated at the level of the spinal cord.

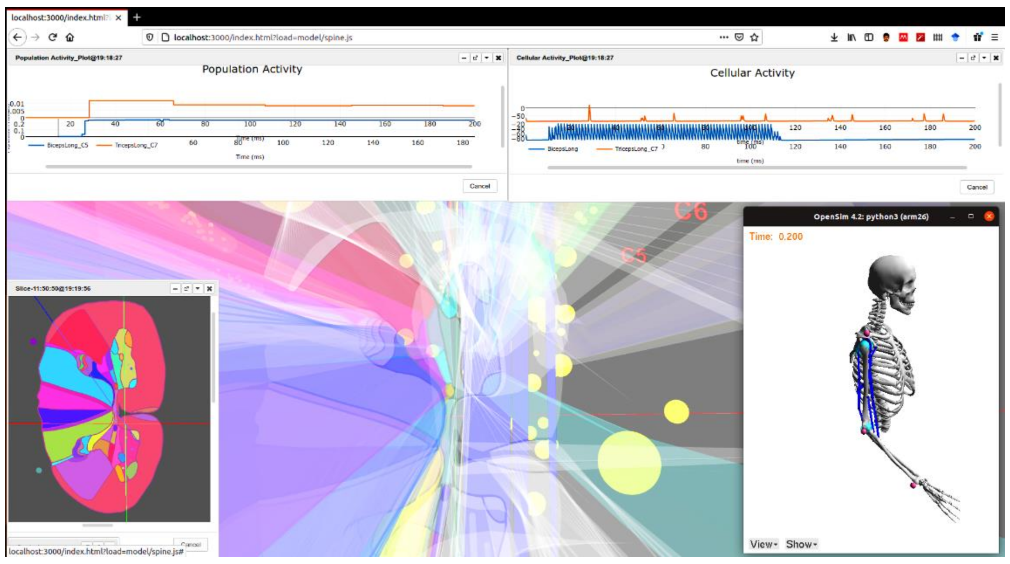

Figure 8: A screenshot from NEUROiD in silico movement platform with the spinal cord controller (centre), slice view (left) and the upper limb musculoskeletal model (right). Traces of electrical activity may be seen on the top panel.

Neuroanatomy and physiology of ion channels, neurons, synapses, circuits and tracts are modelled in a hierarchical and modular manner. Using these models, we demonstrate the distribution of various degrees of freedom in movement that are controlled by circuits along with the rostrocaudal extent of the spinal cord [5]. In-silico simulation experiments in our models demonstrate broad similarities with microstimulation experiments. We believe that these technologies will be invaluable as a virtual patient or physiology in the development of spinal cord electrical stimulation therapies for pain and rehabilitation.

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