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Optogenetic stimulation of a meso-scale human cortical model PRASHANTH SELVARAJ, ANDREW SZERI, UC Berkeley, JAMIE SLEIGH, Waikato Clinical School, HEIDI KIRSCH, UC San Frnacisco — Neurological phenomena like sleep and seizures depend not only on the activity of individual neurons, but on the dynamics of neuron populations as well. Meso-scale models of cortical activity provide a means to study neural dynamics at the level of neuron populations. Additionally, they offer a safe and economical way to test the effects and efficacy of stimulation techniques on the dynamics of the cortex. Here, we use a physiologically relevant meso-scale model of the cortex to study the hypersynchronous activity of neuron populations during epileptic seizures. The model consists of a set of stochastic, highly non-linear partial differential equations. Next, we use optogenetic stimulation to control seizures in a hyperexcited cortex, and to induce seizures in a normally functioning cortex. The high spatial and temporal resolution this method offers makes a strong case for the use of optogenetics in treating meso scale cortical disorders such as epileptic seizures. We use bifurcation analysis to investigate the effect of optogenetic stimulation in the meso scale model, and its efficacy in suppressing the non-linear dynamics of seizures.

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