Optimization of the Wilson-Cowan Model with Data from Optogenetically Controlled Gamma Oscillations

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Abstract. The Wilson-Cowan model is a well-known mean-field approach to modelling large neuronal circuits. It can be used to analyse the properties of fast oscillating circuits in hippocampus provided enough experimental data are available. Still, this model has several significant limitations, including lack of synaptic time lag, second-order behaviour etc. We seek to improve modelling of gamma-oscillatory circuits with Wilson-Cowan-derived models by (1) using transfer functions and parameter optimization to achieve more natural behaviour and (2) exercising precise control over oscillatory circuits in acute brain slices using optogenetics.

Keywords: neuronal circuits, gamma oscillations, optogenetics, Wilson-Cowan model.