

"Seizure" Parameter Optimization

Seizure Step 1: Using a genetic algorithm for 150 generations (or until error falls under 0.01) across 50 parallel runs, minimize an objective function set up to 1) minimize the largest Lyapunov exponent of the cortical LFP 2) minimize the Lempel-Ziv complexity of the cortical LFPs and 3) maximize the correlation between raw the cortical LFP and the cortical LFP bandpass filtered between 2 and 8 Hz (to ensure the cortical LFP is dominated by oscillations in this frequency range, which is typical for spike-and-wave seizures across mammalian species)

Of the resulting parameter configurations, selected one which produced a cortical LFP resembling a roughly 3-Hz spike-and-wave seizure

Seizure Step 2: Using a genetic algorithm for 50 generations across 50 parallel runs, minimize an objective function set up to 1) ensure that cortical LFP dynamics at 25%, 50%, and 75% of the full seizure "dose" (with 5% jitter around each "dose" in each run) do not produce stable fixed point dynamics, and 2) ensure that the 100% seizure "dose" produces a strongly periodic, low-complexity cortical LFP dominated by 2-8 Hz oscillations, and whose power spectrum maintains a minimal Euclidian distance from the power spectrum of the 3 Hz spike-and-wave cortical LFP generated by the parameter configuratoin selected in Seizure Step 1

Selected a paramater configuration which produced no stable fixed points for any seizure "dose," and which could produce both 3-4 spike-and-wave dynamics and 6-8 spike-and-wave dynamics as a function of "dose" as the "seizure" parameters

Fig. 6-figure supplement 3: We here show the workflow for the use of genetic optimization to derive model parameters for the generalized spike-and-wave seizure state of the mean-field model, starting from the parameters for the wake state of the model.