A Single Cell Network

The simplest net is a single cell that feeds back on itself. We use a reduced Hodgkin-Huxley formulation of the cell and model the synapse via a delayed, scaled, chopped copy of the action potential. More precisely, we solve

$$\begin{aligned} v'(t) &= -g_{Na} m_\infty^3(v)(0.8-n)(v-V_{Na}) - g_K n^4 (v-V_K) - g_L(v-V_L) \\ &\quad - I_{stim} - g_s(\max(V_T, v(t-d)) - V_T))(v-V_{syn}) \\ n'(t) &= \alpha_n(v)(1-n) - \beta_n(v) n \end{aligned}$$

where g_s is the magnitude of the synaptic conductance, d is the synaptic delay, and V_T is the synaptic threshold.