## Tables

**Table 1.** Variables

| Variable | Description | Initial value |
|---|---|---|
| $V_S$ | transmembrane potential at the soma | -4.6 mV |
| $V_D$ | transmembrane potential at the dendrite | -4.5 mV |
| $h$ | $K^+$ channel activation gating variable | 0.9990 |
| $n$ | $Na^+$ channel inactivation gating variable | 0.001 |
| $s$ | $Ca^{2+}$ channel activation gating variable | 0.009 |
| $c$ | $Ca^{2+}$ activated $K^+$ channel activation gating variable | 0.007 |
| $q$ | $K^+$ AHP channel activation gating variable | 0.010 |
| $c_{Ca}$ | $Ca^{2+}$ concentration | 0.200 |
| $S$ | NMDA synaptic conductance weighting factor | 0.6 |
| $W$ | AMPA synaptic conductance weighting factor | 0.5 |
| Currents: lower case ($i$) in current per unit membrane area. | | |
| $I_S, i_S$ | total transmembrane current at the soma | |
| $I_D, i_D$ | total transmembrane current at the dendrite | |
| $I_{S,leak}, i_{S,leak}$ | transmembrane leakage current at the soma | |
| $I_{D,leak}, i_{D,leak}$ | transmembrane leakage current at the dendrite | |
| $I_{Na}, i_{Na}$ | transmembrane $Na^+$ current | |
| $I_{KDR}, i_{KDR}$ | transmembrane $K^+$ DR current | |
| $I_{KAHP}, i_{KAHP}$ | transmembrane $K^+$ AHP current | |
| $I_{KC}, i_{KC}$ | transmembrane $Ca^{2+}$-activated $K^+$ current | |
| $I_{Ca}, i_{Ca}$ | transmembrane $Ca^{2+}$ current | |
| $I_{syn}, i_{syn}$ | total transmembrane synaptic current | |
| | | |
| $I_{DS}^{in}$ | intracelluar dendrite-to-soma current | |
| $I_{DS}^{out}$ | extracellular dendrite-to-soma current | |
| | | |
| $V_S^{in}$ | intracellular potential at the soma | |
| $V_D^{in}$ | intracellular potential at the dendrite | |
| $V_{DS}^{out}$ | extracellular dendrite-soma potential difference | |

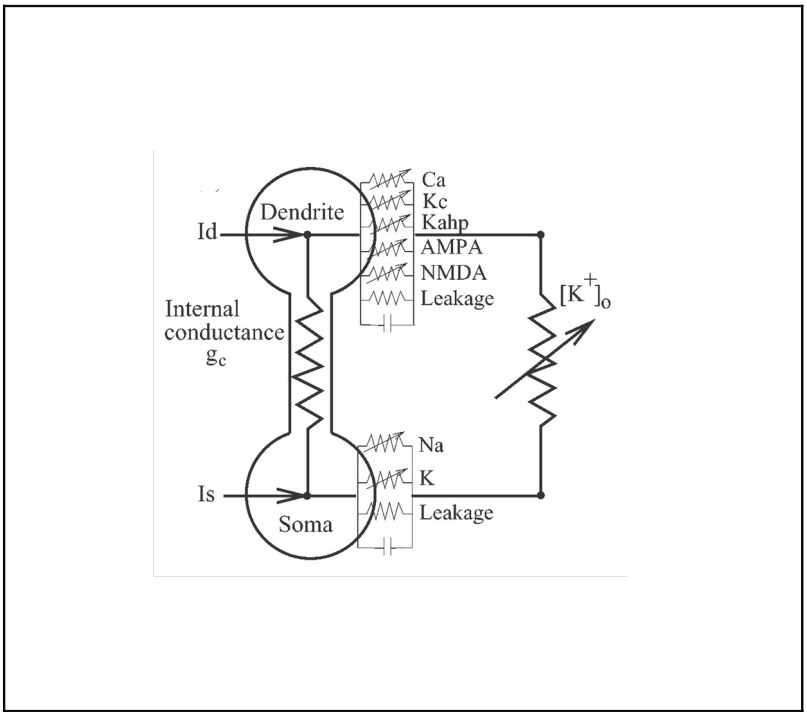
**Table 2.** Parameters

| Parameter | Description | Value |
|---|---|---|
| $A$ | total membrane area | $6 \times 10^{-6}$ cm$^2$ |
| $p$ | soma area/total membrane area | 0.5 (unitless) |
| $c_m$ | membrane capacitance | 2.1 $\mu$F/cm$^2$ |
| $g_c$ | intracellular conductance | 3.0 mS/cm$^2$ |
| | | |
| $g_L$ | leakage conductance | 0.1 mS/cm$^2$ |
| $g_{Na}$ | $Na^+$ channel conductance | 30.0 mS/cm$^2$ |
| $g_{KDR}$ | $K^+$ (delayed-rectifier) channel conductance | 15.0 mS/cm$^2$ |
| $g_{KAHP}$ | $K^+$ AHP conductance | 0.80 mS/cm$^2$ |
| $g_{KC}$ | $Ca^{2+}$ -activated $K^+$ channel conductance | 15.0 mS/cm$^2$ |
| $g_{Ca}$ | $Ca^{2+}$ channel conductance | 10.0 mS/cm$^2$ |
| $g_{NMDA}$ | NMDA channel synaptic conductance | 0.030 mS/cm$^2$ |
| $g_{AMPA}$ | AMPA channel synaptic conductance | 0.0045 mS/cm$^2$ |
| | | |
| $V_{app}$ | externally applied potential | 0 to -50 $mV$ |
| $I_S^{inj}$ | injected current at the soma | 0 mV |
| $I_D^{inj}$ | injected current at the dendrite | |
| | | |
| Reversal potentials with respect to reference potential of -60 $mV$ | | |
| $V_{Na}$ | | 120 $mV$ |
| $V_{Ca}$ | | 140 $mV$ |
| $V_K$ | $[K^+]_0 = 3.5\ mM$ | -38.56 $mV$ |
| $V_L$ | | 0 $mV$ |
| $V_{syn}$ | | 60 $mV$ |
| Extracellular resistances | | |
| $R_{TD}^{out}$ | extracellular resistance between the top plate and the dendrite | |
| $R_{SG}^{out}$ | extracellular resistance between the soma and ground | |
| $R_{DS}^{out}$ | extracellular resistance between the dendrite and the soma | 7936.5 $k\Omega$ |

| | | |
|---|---|---|
| $R$ | $R_{TD} = R_{SG} = R$ | $12 \times R_{DS}^{out}$ |

**Figure 1.**

**A.** Pinsky-Rinzel model of a single neuron.




*Re-do to match Figure 1B. Also remove [K].*

**B.** A single Pinsky-Rinzel neuron under the effect of an externally applied field.

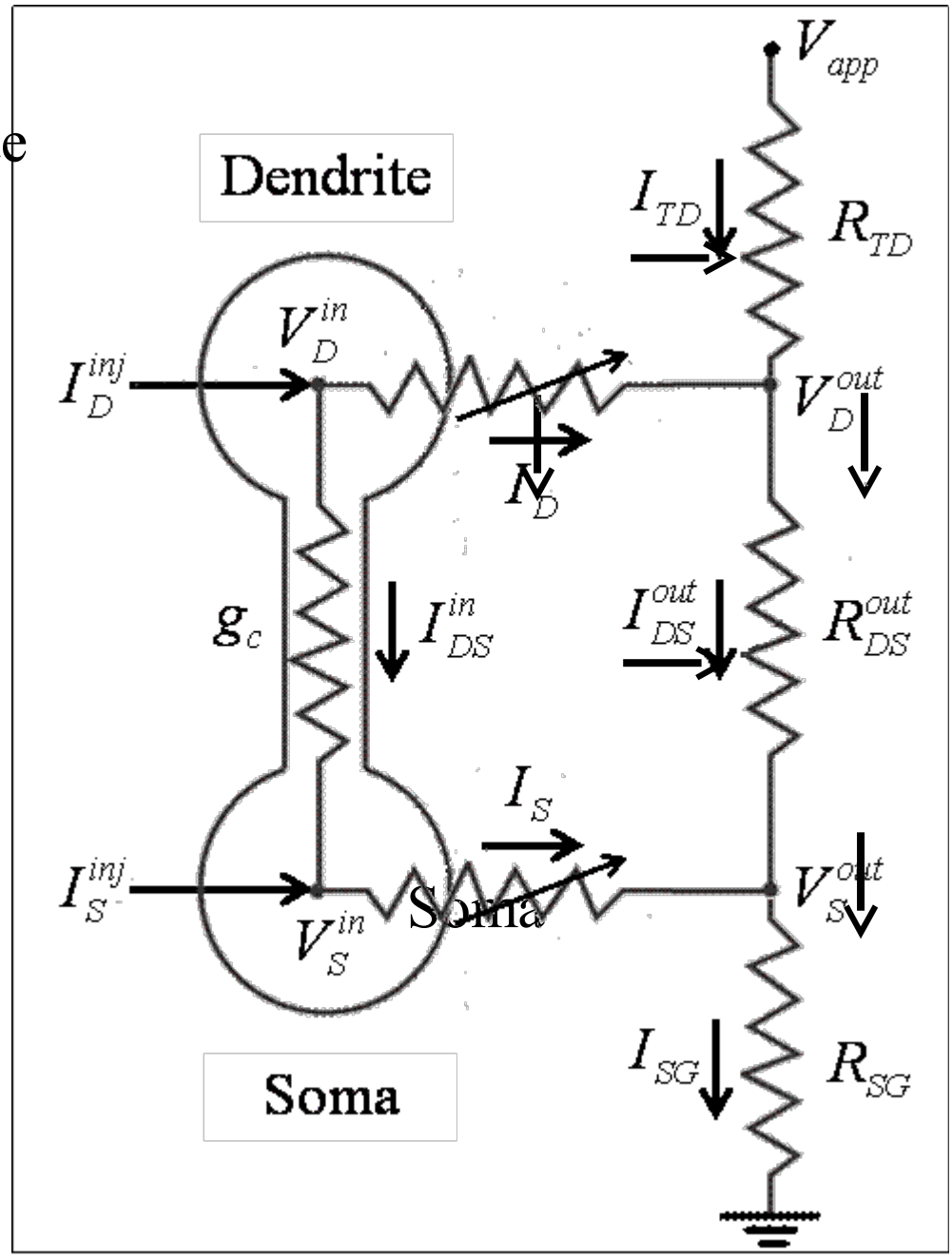


**Figure 2.** Model of Pinsky-Rinzel arranged in a one-dimensional chain and embedded in an extracellular resistive grid. Each neuron is connected synaptically with its nearest-neighbors.

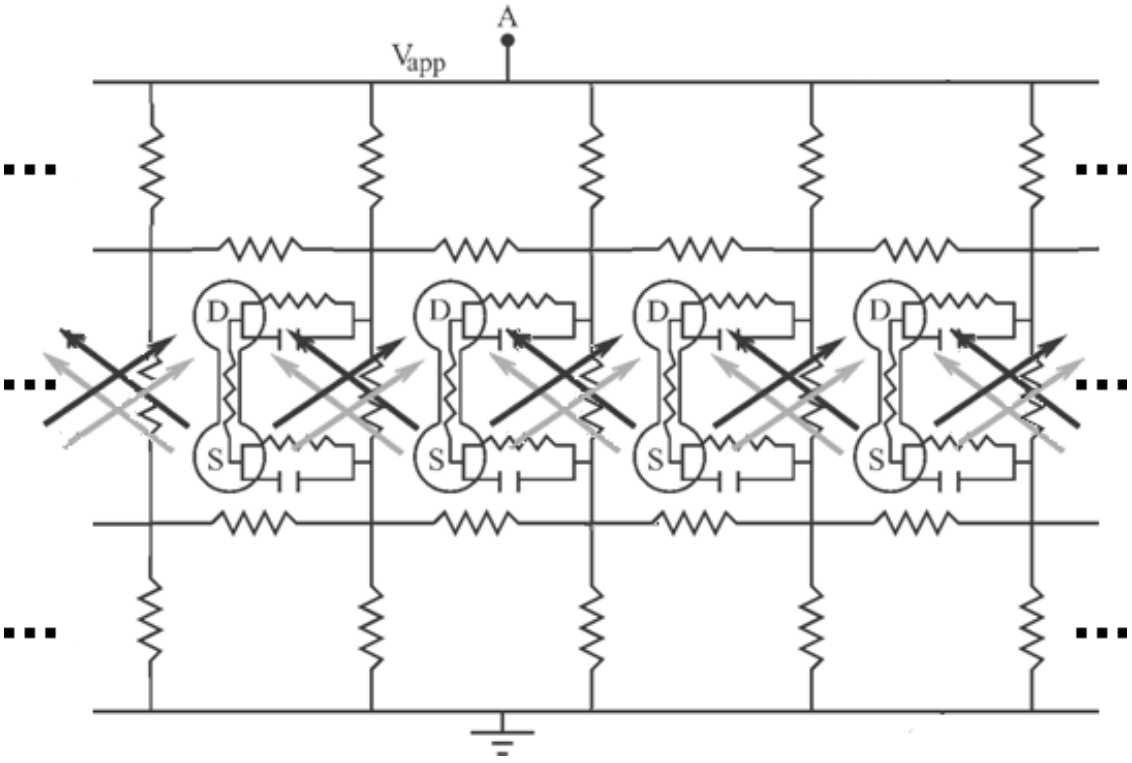
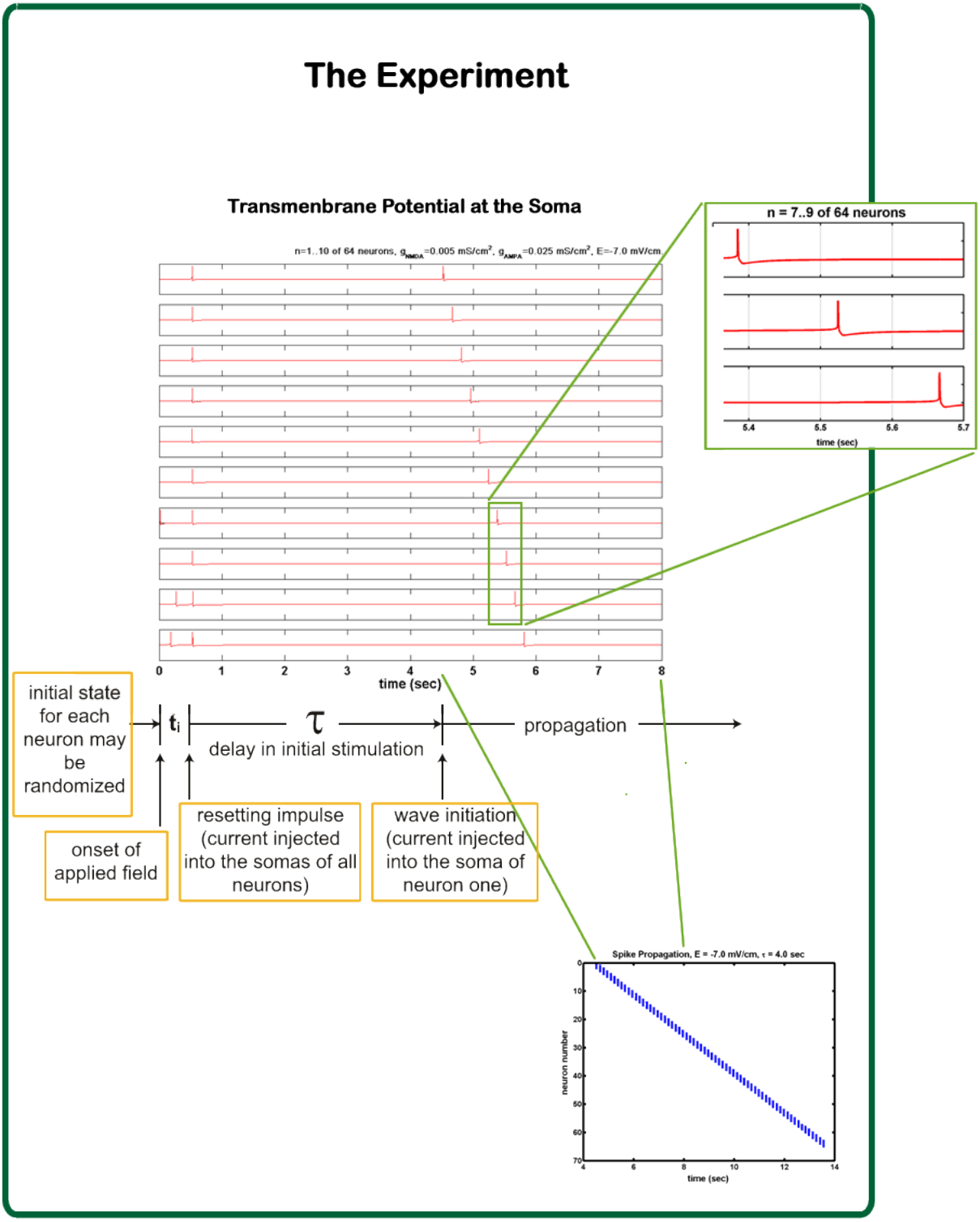


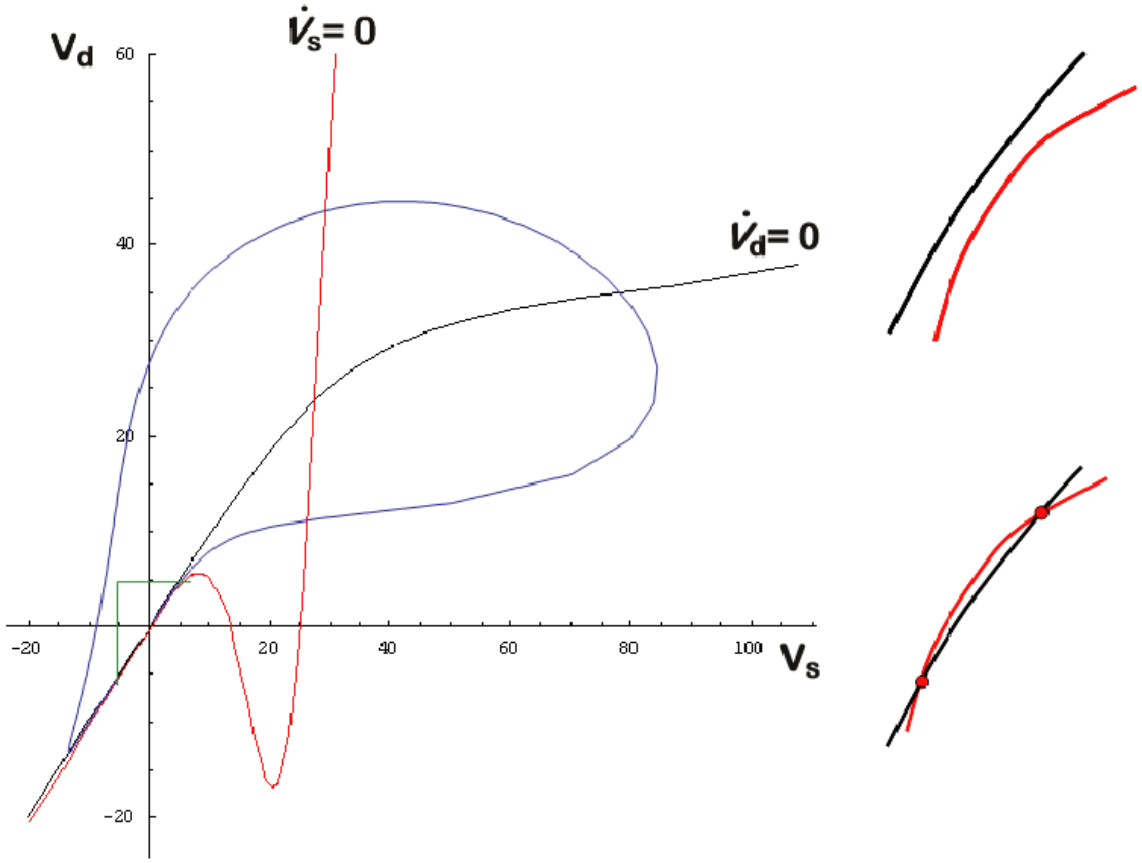
**Figure 3.** Timeline of a computational experiment.

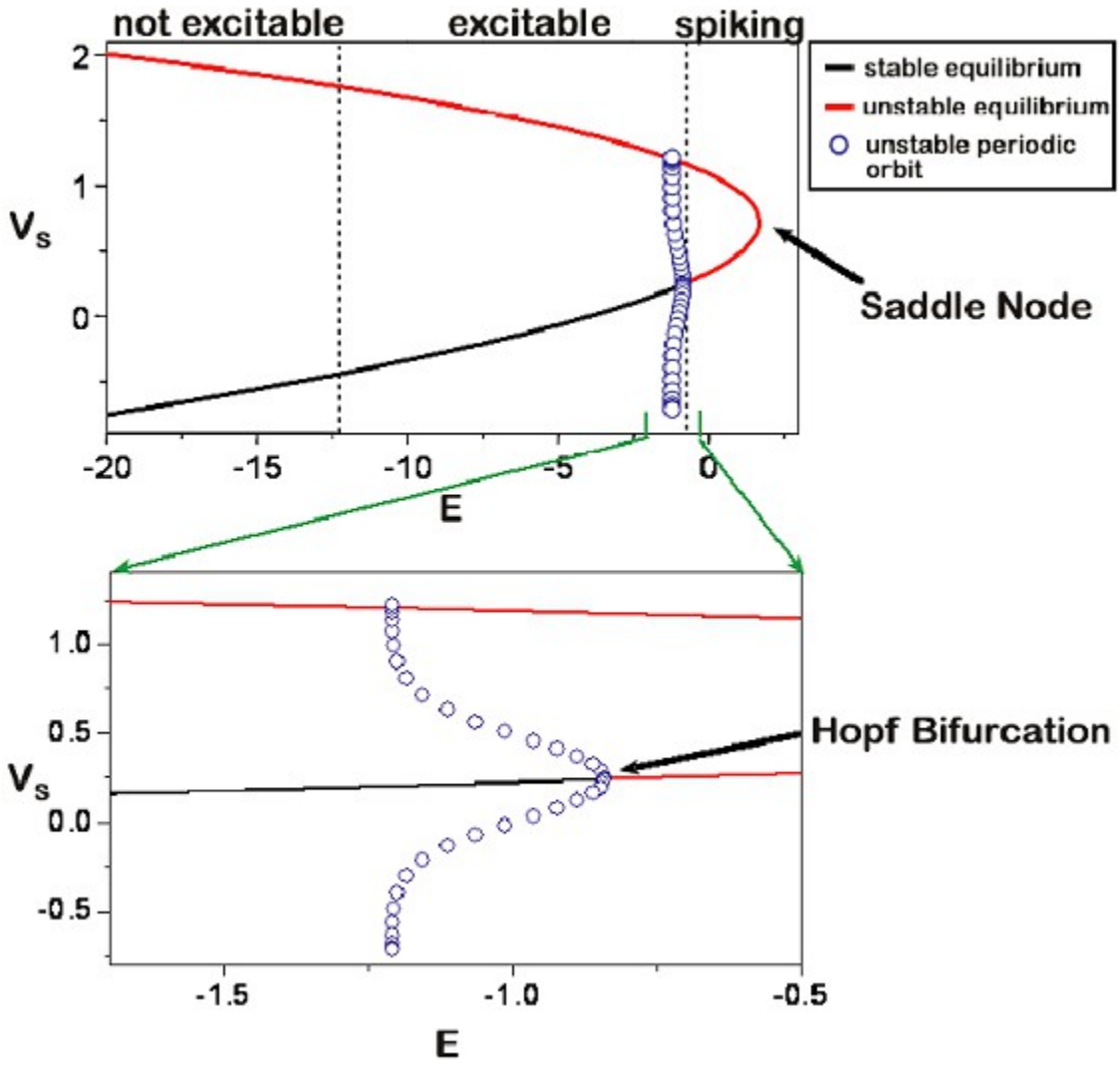


*Re-do as a full page figure.*

**Figure 4.** Dynamics of the single neuron model.

*Redo with grey scale.*



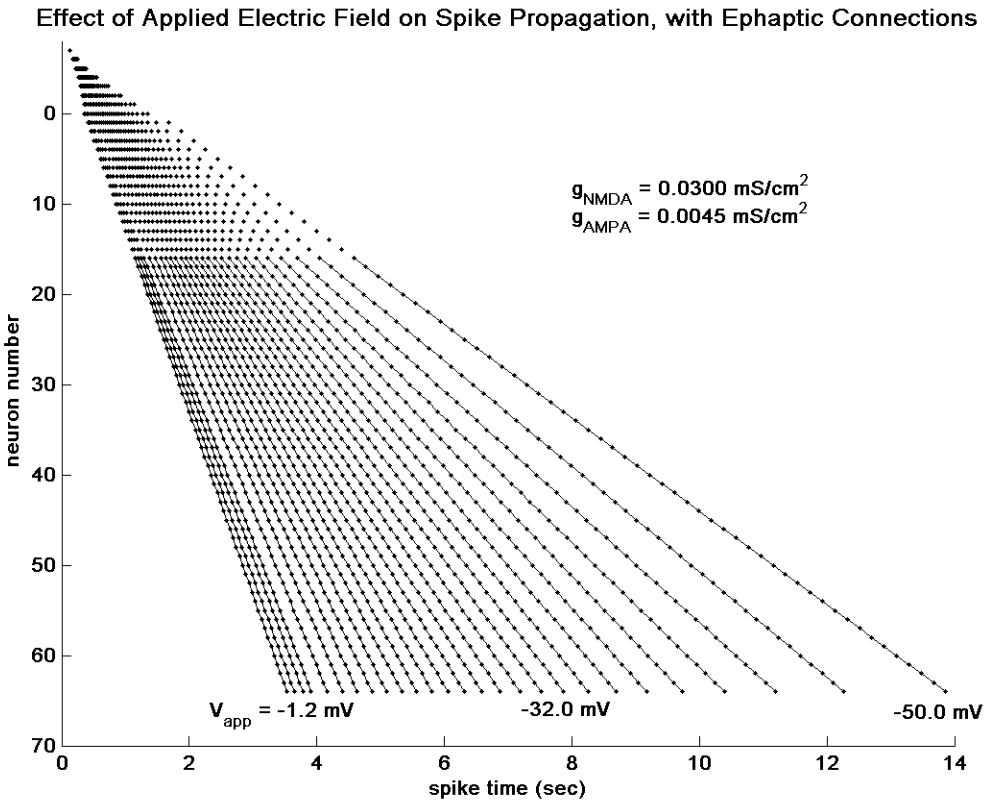

not excitable
excitable
spiking
stable equilibrium
unstable equilibrium
unstable periodic orbit
Saddle Node
Hopf Bifurcation
$V_s$
E
2
1
0
-20
-15
-10
-5
0
1.0
0.5
0.0
-0.5
-1.5
-1.0
-0.5

**(No Figure 5)**

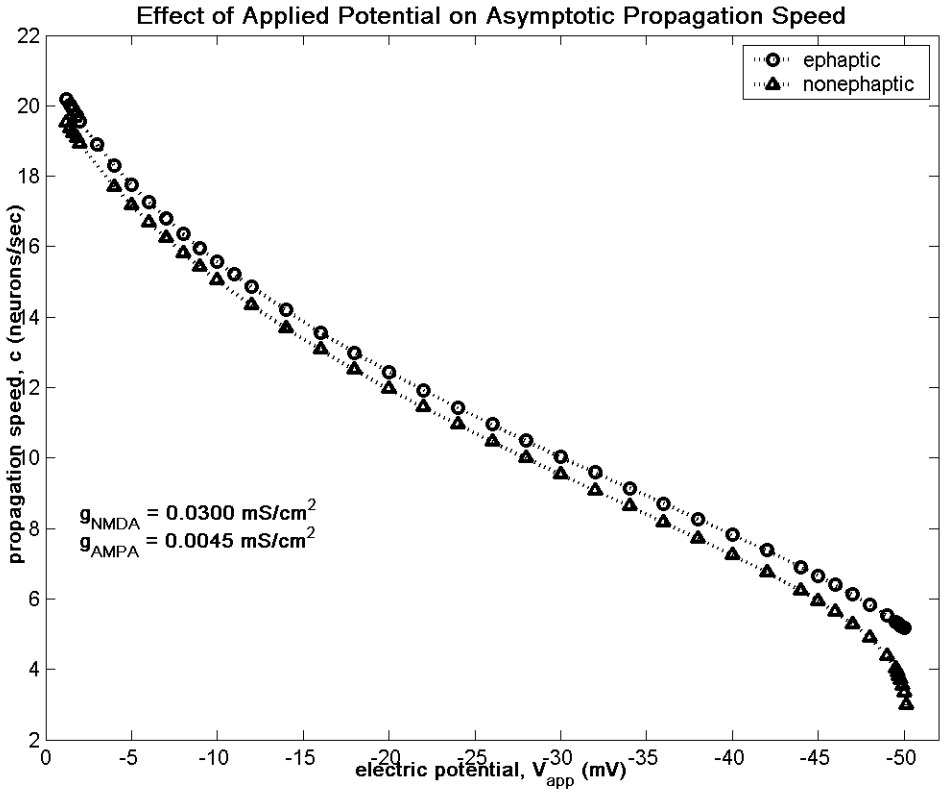
**Figure 6.** Example of traces of membrane potential at the soma at various applied potentials. **A)** At low applied potential where spiking activity was observed. **B)** At medium suppressive applied potential strength where propagation was observed. **c)** At high applied potential where propagation was completely terminated.

*Wait for final data.*

**Figure 7.** The effect of an applied electric field on propagation speed.




**A.**




*Need to edit and point out* $V_1^*$ and $V_2^*$.

**B.**

**Figure 8.** The effect an applied electric field on spike wave propagation near the point of suppression, with and without ephaptic connection among neurons.

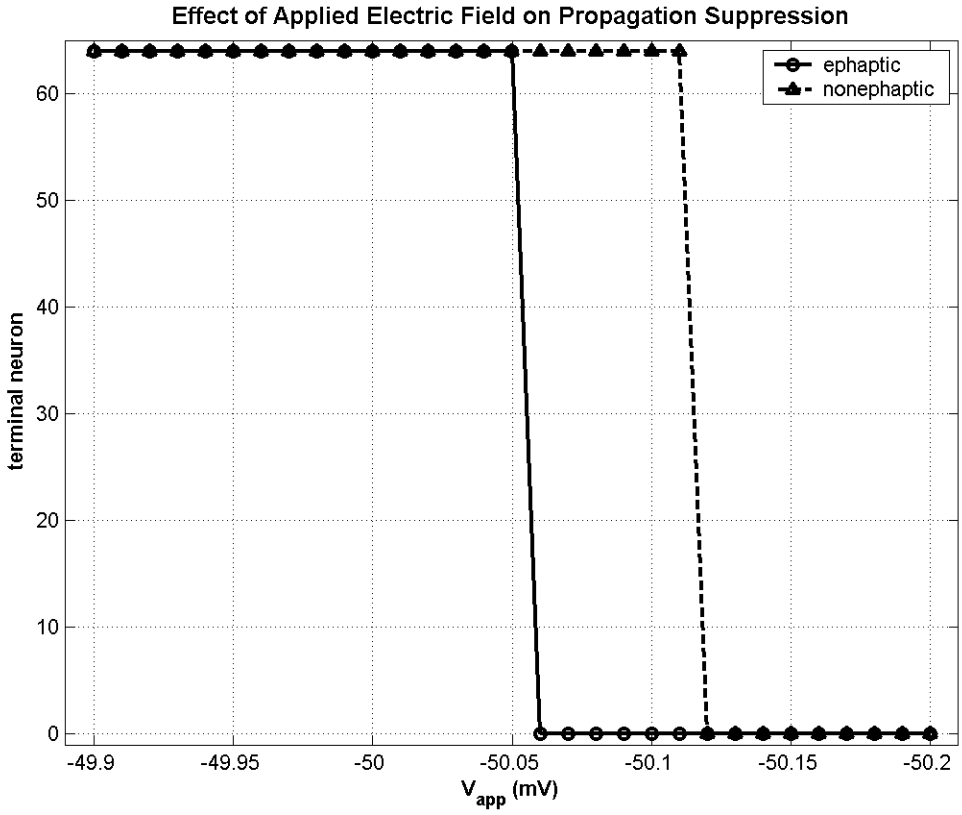
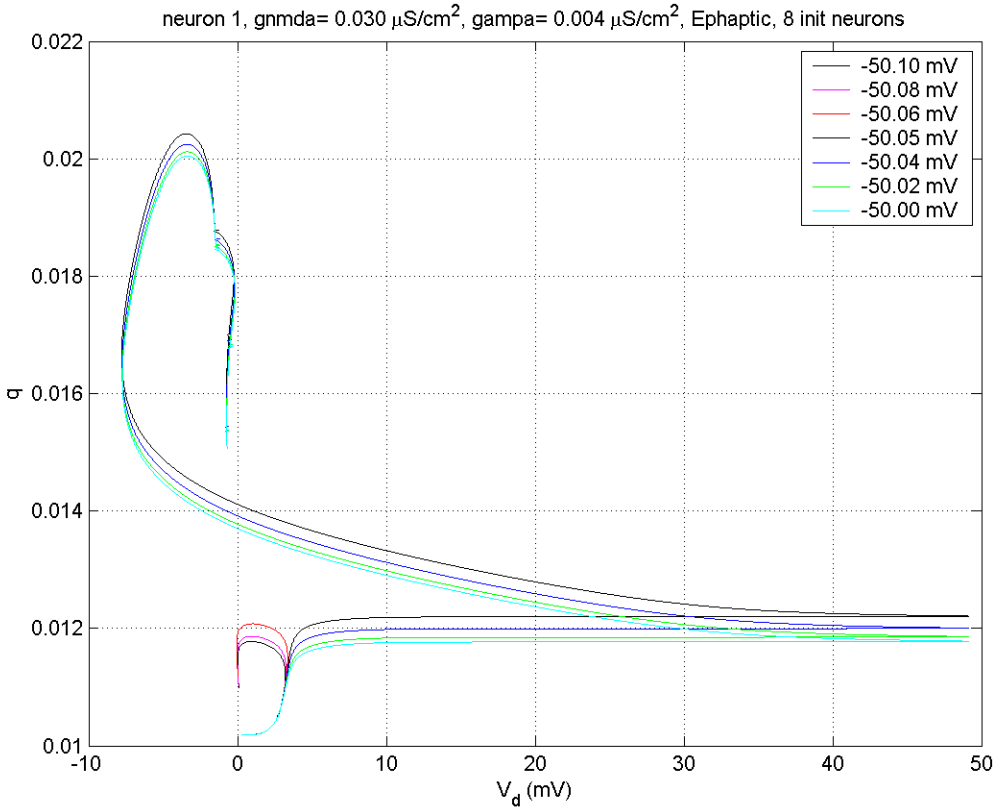
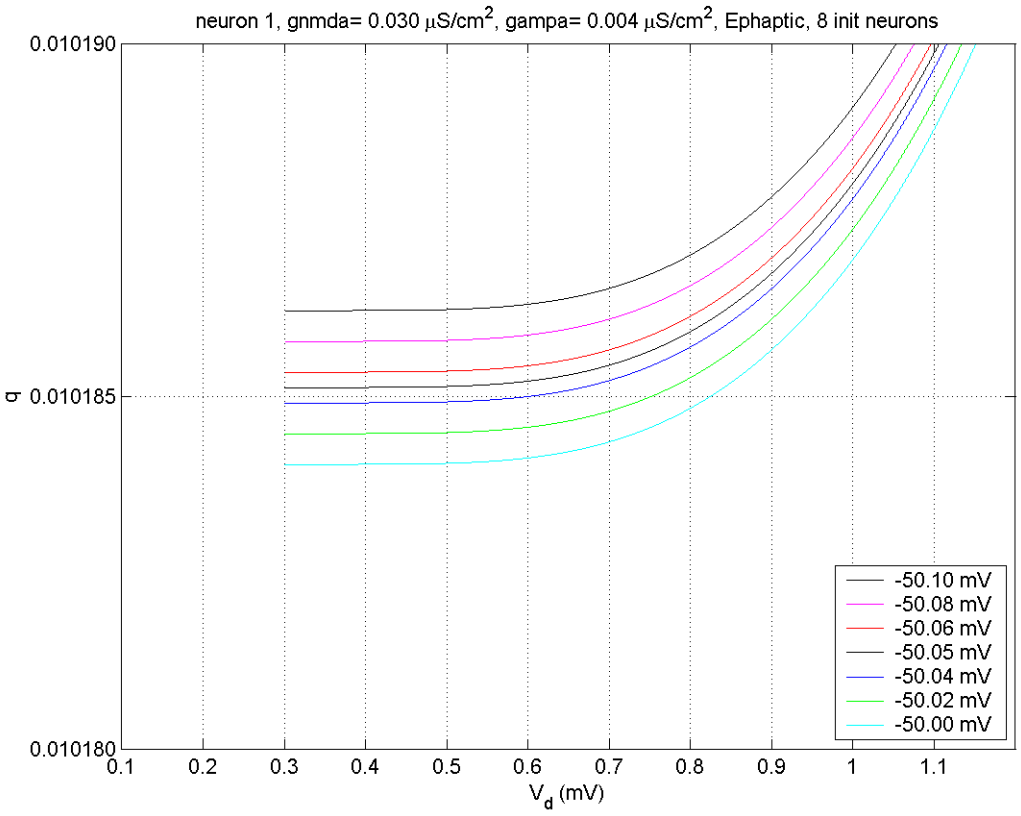


**Figure 9.** Phase-plane analysis of spike-wave propagation near suppression

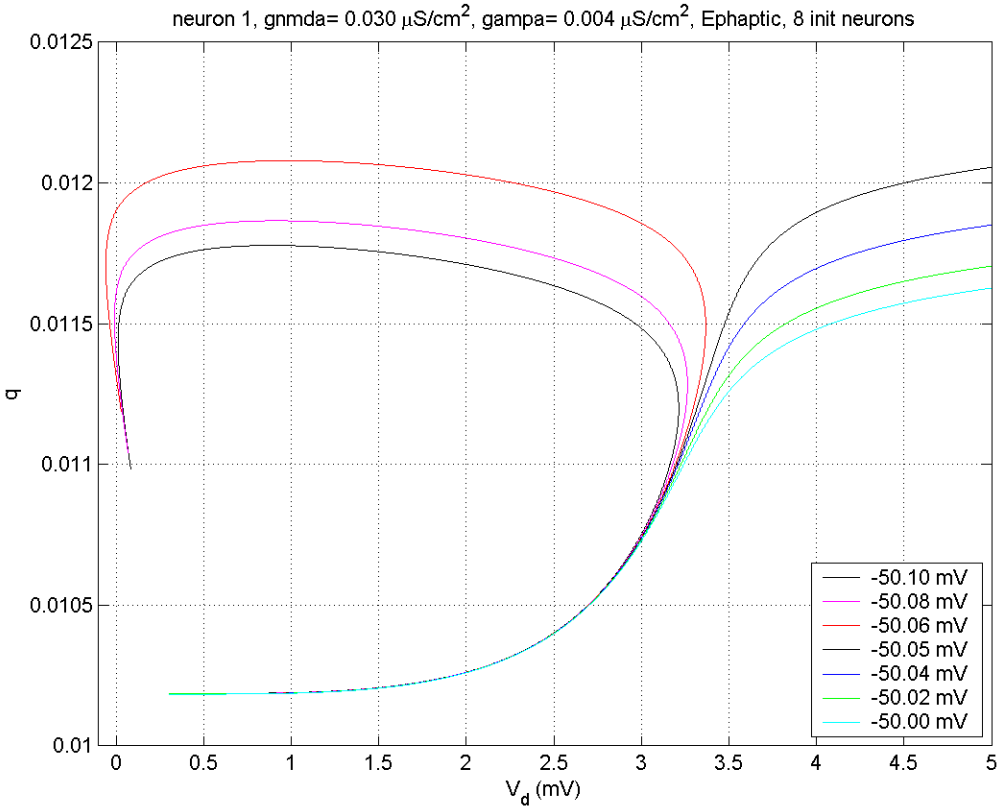
**A.**



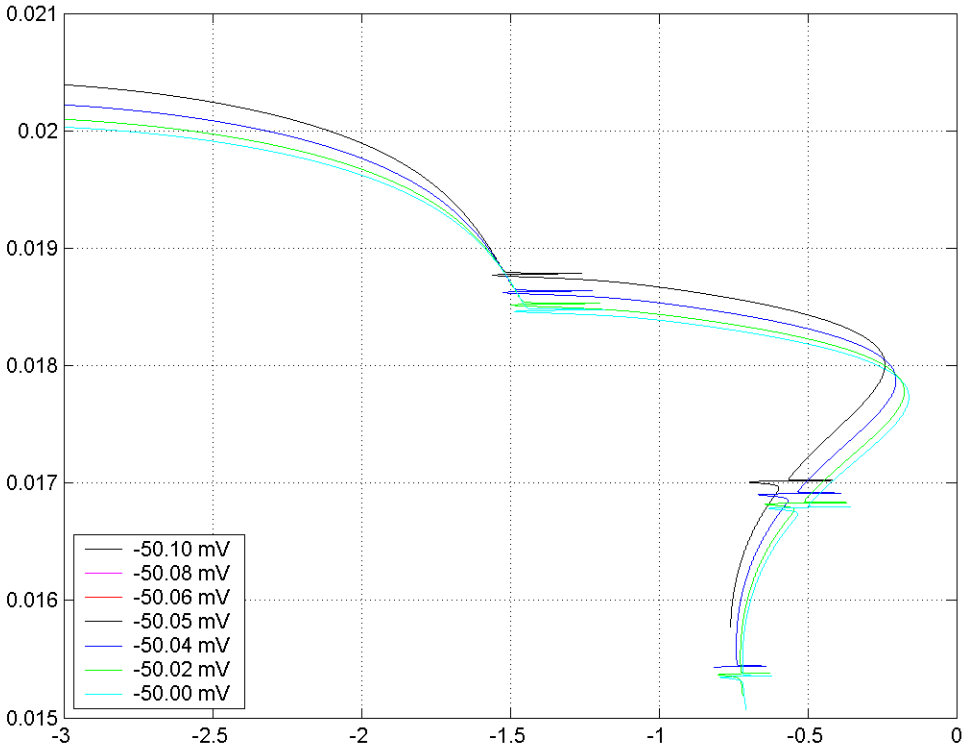

This diagram shows the trajectories of the q-V as a function of applied potential V_top. Spike-propagation occurs when V_top is -50.05 mV or less negative. Spike-progation is suppressed when V_top is –50.06 or more negative. Several areas of the diagram are expanded in details.




**B.** At equilibrium, the trajectories are ranked in order according to the applied potential V_app.


neuron 1, gnmda= 0.030 μS/cm2, gampa= 0.004 μS/cm2, Ephaptic, 8 init neurons
0.0125
0.012
0.0115
0.011
0.0105
0.01
q
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Vd (mV)
-50.10 mV
-50.08 mV
-50.06 mV
-50.05 mV
-50.04 mV
-50.02 mV
-50.00 mV

**C.** At the




**D.** Trajectories for propagation are expanded at the region when neuronal activity is retuning to equilibrium. This figure displays the effects of backward synaptic connection and ephaptic interaction.