NACS 643 Homework #5

Spring 2009

1) Build a Hodgkin-Huxley model neuron by numerically integrating the equations for V, m, h, and n given in chapter 5 of Dayan & Abbott (see, in particular equations 5.6, 5.17–5.19, 5.22, 5.24, and 5.25). Take $c_m = 10\ \text{nF/mm}^2$, and as initial values take: $V = \text{-65 mV}$, $m = 0.0529$, $h = 0.5961$, and $n = 0.3177$. Use an integration time step of 0.1 ms. Use an external current with $I_e/A = 200\ \text{nA/mm}^2$ and plot V, m, h, and n as functions of time for a suitable interval. Also, plot the firing rate of the model as a function of I_e/A over the range from 0 to 500 nA/mm^2. Show that the firing rate jumps discontinuously from zero to a finite value when the current passes through the minimum value required to produce sustained firing.

2) Build a Connor-Stevens model neuron by numerically integrating the equations for V, m, h, n, a, and b given in chapter 6 of Dayan & Abbott (see, in particular, equations 6.1, 6.4, and appendix A). Use $c_m = 10\ \text{nF/mm}^2$, and as initial values take: $V = \text{-68 mV}$, $m = 0.0101$, $h = 0.9659$, $n = 0.1559$, $a = 0.5404$, and $b = 0.2887$. Use an integration time step of 0.1 ms. Use an external current with $I_e/A = 200\ \text{nA/mm}^2$ and plot V, m, h, n, a, and b as functions of time over a suitable interval. Plot the firing rate of the model as a function of I_e/A over the range from 0 to 500 nA/mm^2. How does this differ from what you got for the Hodgkin-Huxley model above?

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