The models that we solved on the embedded dynamic clamp (eDC) are subclass of membrane model known as Hodgkin-Huxley (HH) models. These look like

 (1)

where *Cm* is the membrane capacitance, *V* is the membrane potential. There are several ionic currents and in HH models these take the form

 (2)

*VR*is the reversal potential and *g* is the maximum conductance. These are model parameters provided by the experimenter. *nk* are the *gating* variables and described by an equation of the form

 (3)

where *n∞* and *τn* are functions of voltage and are also provided by the experimenter. *Istim(t)* is a stimulus provided by the experimenter, for example a step function.

In a hybrid cell, some currents are provided by a real biological cell and some currents are simulated in the DC. In *voltage clamp* mode, the cell membrane voltage is calculated in the DC, used to the command the cell membrane the corresponding current is feed back into the model.

 (4)

where *fscale* scales the cell current to match the conductance required for the hybrid cell. The stimulus might generated in the DC or applied externally or be a combination of both.

In *current clamp* mode the membrane potential is read from the real cell, fed into the model, ionic currents are calculated passed across the cell membrane.

 (5)

For our purposes, integrations can be performed using Euler forward.

 (6)

The gating functions, *n∞* and *τn*, will be provided as table with -100mV≤V≤100mV. Six currents should be adequate, there are never more than 3 gates per current and the gate exponent will always be 4 or less. In HH models, the gates and currents are independent and can be solved in parallel. In later versions of the DC this will not be the case for all currents.