

Theoretical & computational
Neuroscience:

Programming the Brain

(BM 6140)

2-credit

HH model extensions

Limitations of the HH model : Implicit 2-state gating mechanism

Implicitly assumes open \leftrightarrow close gating mechanism

System needs to be broadened into a more generic class of markov models of which above is a simple example

E.g. Open \leftrightarrow transient \leftrightarrow close

|

v

transient-2

Limitations of the HH model : Linearity

$$i = \bar{g}m^i h^j p^k q^l (V - E)$$

m – voltage dependant activation

h- voltage dependant inactivation

p – calcium dependant activation

q- calcium dependant inactivation

But $i \propto V$

But in many cases I varies non-linearly with V

Limitations of the HH model : determinism

Yields a macroscopic deterministic model, no variation

- captures the sum total effect of all the ion channels of a type

But channel activity is stochastic

- we need to be able to model each channel independently and get channel noise or get no, channels in each state to represent variability