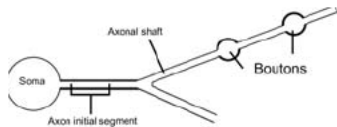


# A Model of Ca<sup>2+</sup> Channel Opening in Response to Action Potential Widening

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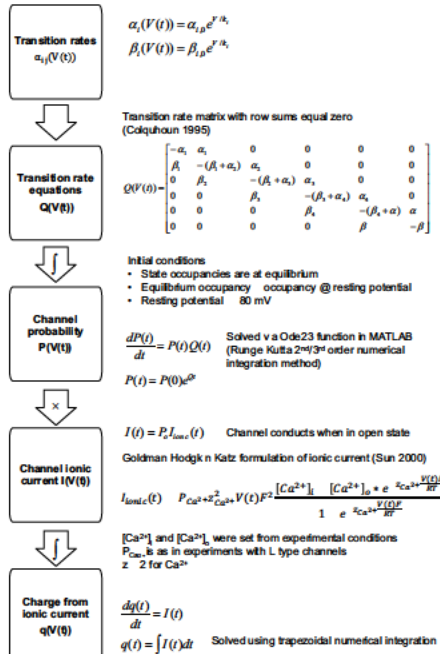
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## Introduction

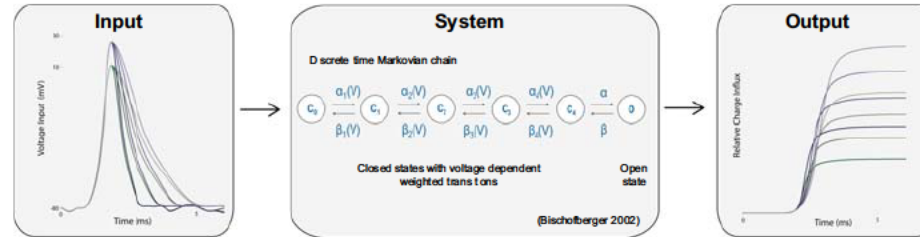


- AP width is directly proportional to AP evoked Ca<sup>2+</sup> influx (Borst and Sakmann, 1998; Bischofberger et al., 2002) at some types of synapses.
- Goal: create a system to study the influence of Ca<sup>2+</sup> channel kinetics on Ca<sup>2+</sup> influx and compare results of the system with experimental data recorded from interneurons in the cerebellum.

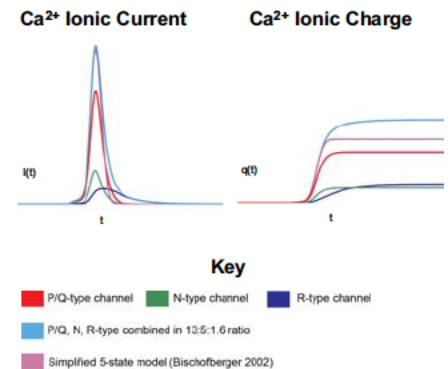
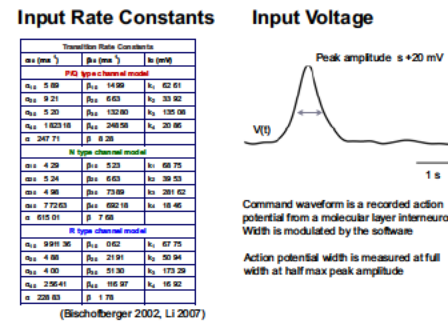
## Method



## Ca<sup>2+</sup> Channel Modeled as a Set of States with Voltage Dependent Transitions

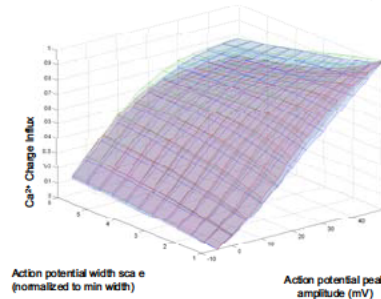


## Single Run

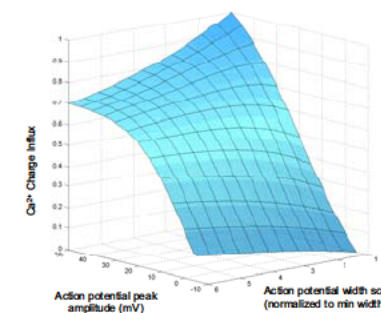


## Multi-Run Summary

### Ca<sup>2+</sup> Influx in Response to Action Potential Width and Amplitude Change



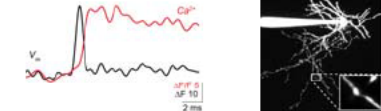
### Combined Model Isolated



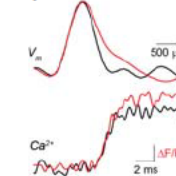
## Results and Discussion

- The results show enhanced Ca<sup>2+</sup> influx when the action potential backend is widened.
- Inputting a 20 mV max amplitude command widened the same percentage as experimental recordings yields a comparable Ca<sup>2+</sup> influx.

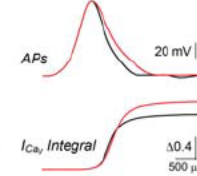
### Bouton Imaging



### Experimental



### Model



## Future Direction

1. Confirm linearity in region of interest.
2. Determine contribution of channel subtype.
3. Perform independent manipulation of peak amplitude and backend width.

## References

1. Bischofberger, J., Geiger, J.R.P., and Jonas, P. (2002). Timing and Efficacy of Ca<sup>2+</sup> Channel Activation in Hippocampal Mossy Fiber Boutons. *J. Neurosci.*, 22, 10593-10602.
2. Borst, J.G., and Sakmann, B. (1998). Calcium current during a single action potential in a large presynaptic terminal of the rat brainstem. *J. Physiol.* 506 (Pt 1), 143-157.
3. Colquhoun, D. and Hawkes, A.G. (1995). A Q Matrix Cookbook. In *Single Channel Recording*, ed. Sakmann, B. and Neher, E., pp. 589-633. Plenum Press, New York.
4. Li, L., et al. (2007). Differential Gating and Recruitment of P/Q, N, and R Type Ca<sup>2+</sup> Channels in Hippocampal Mossy Fiber Boutons. *J. Neurosci.*, 27, 13420-13429.
5. Sun, L., et al. (2000). A model of the L type Ca<sup>2+</sup> channel in rat ventricular myocytes: ion selectivity and inactivation mechanisms. *J. Physiol.*, 506 (Pt 1), 139-58.