Castro e Silva and Roque *BMC Neuroscience* 2010, **11**(Suppl 1):P130
http://www.biomedcentral.com/1471-2202/11/S1/P130

BMC Neuroscience

POSTER PRESENTATION Open Access

A three-compartment conductance-based model of the rat olfactory receptor neuron

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From Nineteenth Annual Computational Neuroscience Meeting: CNS*2010
San Antonio, TX, USA. 24-30 July 2010

Reduced compartmental models of single neurons, i.e. models with few Hodgkin-Huxley (HH) type compartments, provide an interesting balance between highly detailed, morphologically realistic models, and abstract, point-like models [1]. Simões-de-Souza and Roque [2] constructed a four-compartment model of the vertebrate olfactory receptor neuron (ORN), which was used in a large-scale simulation of the olfactory system [3]. Their model contains a biochemical compartment, which allows the study of the role of molecular pathways in odor representation. However, the use of this compartment slows down computer simulations of models with many receptor cells and makes the analysis of network behavior more complicated – because of the large number of variables and parameters. In this work, we present a simpler ORN model which does not include biochemical pathways and contains only three HH type compartments. Our model is different from [2] not only because it has one compartment less but also because its passive and active parameters have new values adjusted by a combination of "hand-fitting" with automatic fitting procedures so as to reproduce well experimental results for the rat [5]. The model was constructed in GENESIS [4]. Its three compartments kept the same names used in [2]: soma, dendrite and dendritic knob. The latter two are passive compartments while soma has four voltage-gated ionic currents: high-voltage-activated calcium current, fast voltage- and calcium-dependent potassium current, slow calcium-dependent potassium current, and delayed rectifier potassium current. These ionic currents

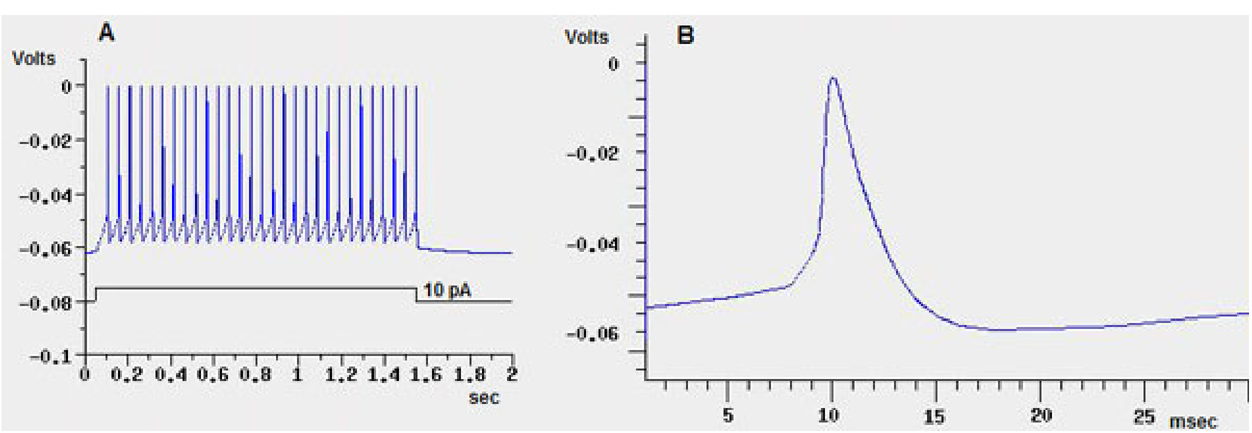

Figure 1 Some simulation results. A. Spike train generated by a 10 pA step current (to be compared with Figure 2B of [5]); **B**. Action potential (to be compared with the inset of Figure 2A of [5]).

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were modeled according to the standard HH formalism with kinetic parameters adjusted as mentioned above. Input stimuli were constant current steps injected directly in dendritic knob to simulate experimental results [5]. Some simulation results are shown in Figure 1. Our reduced three-compartment model may allow faster and more efficient large-scale network simulations of the rat olfactory system.

Acknowledgements
TMCCS was supported by a FAPESP scholarship and ACR is supported by a research grant from CNPq.

Published: 20 July 2010

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doi:10.1186/1471-2202-11-S1-P130
Cite this article as: Castro e Silva and Roque: **A three-compartment conductance-based model of the rat olfactory receptor neuron.** *BMC Neuroscience* 2010 **11**(Suppl 1):P130.