Drosophila Phototransduction Simulator

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If you use this code please cite the papers [1] *and* [2].

Abstract

This code contains detailed modelling of the single photon response, the quantum bump, of fly photoreceptors. All known components participating in the primary phototransduction process are taken into account, and estimates are given for the both the physical and the chemical parameters. The same model can be used for multiphoton response, i.e. in the case of higher light intensity stimuli. The model successfully reproduces the experimental results for the statistical features of quantum bumps (average shape, peak current average value and variance, the latency distribution, etc), *arrestin* mutant behaviour, low extracellular Ca cases, etc. The TRP channel activity is modelled using the Monod-Wyman-Changeux (MWC) theory for allosteric interaction. The model can combine deterministic and stochastic approaches and allows for a detailed noise analysis. The computational model was coded in Matlab using the Parallel Computing Toolbox, which allows computations on multicore computers and computer clusters. An appropriate graphic user interface was developed which gives very convenient and instructive presentation of the parameters used in the modelling and could easily be expanded to other G-protein coupled cascade processes.

The main file is "Drosophila_Phototransduction.m" which when you run it opens the GUI. The GUI contains the preloaded values for parameters and should be mostly self-explanatory in combination with the paper [1]. It is possible to run stochastic and deterministic models for single and multiple runs. The output consists of a table for some average values and three graphs (for the average quantum bump, latency times distribution and peak current distribution). It is possible to produce some other plots currently commented out in gui_averageQBall.m and gui_singleQB_multi.m files.

time: time period in ms you want to simulate (e.g. 120)
tstep: time step in ms for numerical solution (<=0.1)
flagM/G/P/D/T: to set deterministic mode (0) or stochastic mode (1) for each step of the cascade

In the stochastic mode QBs are filtered with (100Hz) low pass filter. Averaging: QBs aligned by their half bump rise and fall times as in S. R. Henderson, H. Reuss and R. C. Hardie, *J. Physiol*. **524**, 2000, pp. 179–194, which was used as a source of experimental values.

Any additional questions (but please note that the support for the software can NOT be guaranteed): k.nikolic@imperial.ac.uk

References

1. Nikolic K, Loizu J, Degenaar P, Toumazou C: "A stochastic model of the single photon response in Drosophila photoreceptors", Integrative Biology, 2010, Vol:2, Pages:354-370.
2. Nikolic K, Loizu J, Degenaar P: "Computational Modelling of the Drosophila Phototransduction Cascade", Biophysical Journal, Vol:98, Issue 3, Supplement 1, January 2010, Page 495a