

COMPUTATIONAL PROJECT

Computational Neuroscience (*academic year 2022-2023*)

Problem

Write the equations of the Izhikevich for simulating Regular Spiking (RS) and Chattering (CH) neurons in two different MATLAB functions. Then, organize the functions in order to:

- (a) Simulate the model and plot the shape/trend of membrane potential V_{mem} as a function of the amplitude of the current clamp (dc stimulation). Consider the two working conditions, of under-threshold and supra-threshold.
- (b) Determine for the two models the correspondent voltages threshold V_{TH} .
- (c) Derive the gain function of the two models, by applying dc current pulses with different amplitudes. In which class the two neurons can be identified? Are the developed models able to code low-frequency neuronal activity? Are significant differences in the behavior of the two neurons?
- (d) Evaluate again the gain function by considering a noisy stimulation (hint: add a Gaussian noise to the current pulses) and discuss the achieved results compared to the ones obtained in (c).

No model parameters are provided. Use and read the necessary literature to find a reasonable pool of values and cite in the report the used references.

General Rules

1. Project must be delivered within 3rd March 2023, by sending an email to paolo.massobrio@unige.it;
2. The maximum score of the project is 2/30 (to add to the written exam);
3. To evaluate the project, a report (max 2 pages, written in English) must be submitted containing the answers to the questions and any approximations/hypotheses made. In addition, it is mandatory to submit the code developed to guarantee the reproducibility. The code must be readable and properly commented.
4. For solving the project, all the teaching materials used during the lectures as well as references that can be found in the scientific literature are admitted.