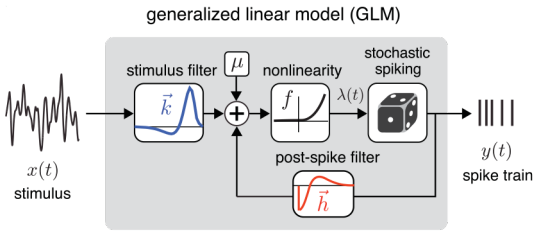
Master's thesis topic:
Combining biophysical and statistical modeling to investigate the roles of ion channels in stimulus encoding

Guillaume Drion, Pierre Sacré



Understanding how specific ion channel conductances affect the input–output behaviors of a neuron remains a challenging task. In particular, the link between ion channel degeneracy (which refers to multiple 'different' mechanisms conveying equivalent function) and the stimulus encoding properties of these ion channels is not well-understood [1].

In this project, we will develop a pipeline that combines numerical simulations of biophysical models (conductance-based models) and estimation of statistical models (point process generalized linear models [2, 3]) to explore the link between variations in ion channel conductances and stimulus encoding. We will illustrate this pipeline on published biophysical models of thalamic neurons and/or spinal cord neurons.

Keywords: biophysical modeling, statistical modeling, point process, generalized linear model.

Contact: Guillaume Drion (gdrion@uliege.be), Pierre Sacré (p.sacre@uliege.be).

[1] E. Marder and J.-M. Goaillard, "Variability, compensation and homeostasis in neuron and network function," *Nature Reviews Neuroscience*, vol. 7, pp. 563–574, July 2006.

[2] W. Truccolo, U. T. Eden, M. R. Fellows, J. P. Donoghue, and E. N. Brown, "A Point Process Framework for Relating Neural Spiking Activity to Spiking History, Neural Ensemble, and Extrinsic Covariate Effects," *Journal of Neurophysiology*, vol. 93, pp. 1074–1089, Feb. 2005.

[3] A. I. Weber and J. W. Pillow, "Capturing the dynamical repertoire of single neurons with generalized linear models," *Neural Computation*, vol. 29, pp. 3260–3289, Dec. 2017.