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1) Field of study :	Numerical analysis, mathematical modeling
2) Internship topic :	Numerical analysis of the Poisson-Nernst Planck system of equations. Application to the propagation of a transient signal in neurons.
3) Description :	**Introduction :** This project aims at understanding the specific dynamics of voltage and ionic concentration in several neuronal compartments, using numerical simulations in 2D and 3D domains. From a neuroscience point of view, we aim at investigating how low-amplitude voltage transients propagate within dendritic spines, filopodia and myelinated axons. This is fundamental to investigate various questions such as the invasion of a signal from a neighboring synapse, the propagation speed of a signal, and more generally how the dendritic tree is summing all its incoming inputs. We represent voltage and ionic dynamics using the Poisson Nernst-Planck (PNP) system of equation and solve this problem using the Discrete Duality Finite Volume (DDFV) method [Can]. Standard analysis shows that the accumulation of ions at the membrane creates a boundary layer, which motivates the need for a robust numerical method. **Project :** In the first stage, the student will have to familiarize himself/herself with the Poisson-Nernst Planck system and the DDFV method. In a second step, the student will have to implement the 2D numerical solver starting from an existing code. Then, the student will investigate the effects of modifying specific parameters (such as the neuronal membrane permittivity) on signal propagation. We will study in particular signal velocity and attenuation. There is a possibility of continuing the project with a PhD.
4) Internship level :	Master 2
5) Requirements :	Numerical simulations, Finite volume methods, parabolic system. Some coding skills are welcomed.
6) Duration :	3 to 6 months

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7) Period :	February to July 2024
8) Laboratory :	LJAD
9) Contact :	Stella Krell, stella.krell@univ-cotedazur.fr, Maître de conférences, Laboratoire J.-A. Dieudonné (LJAD/CNRS UMR7351), Université Côte d'Azur, 28, avenue Valrose, 06108 Nice Cedex 2, France. Claire Guerrier, claire.guerrier@univ-cotedazur.fr, Chargée de recherche, Laboratoire J.-A. Dieudonné (LJAD/CNRS UMR7351), Université Côte d'Azur, 28, avenue Valrose, 06108 Nice Cedex 2, France.

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