Cell-to-Cell Coupling: a Unifying Approach

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Abstract

In this paper, we consider an interconnections model between biological units, called cells. The interconnections can be of various types, such as gap junctions, synapses or ephapses. The cells themselves can be of different types such as neurons or glia. We thus outline an approach to tackling the problem proposed in Chawla.

Motivated in part by Alvarez-Maubecin et al. [2000], in early 2023, the author had proposed the problem of developing a general theory of heterocellular coupling Chawla. In this brief note, we present an outline of how to proceed to solve this problem.

The first task is to create a general model of a cell that generalizes at minimum the following two cell types: a whole neuron and a glial cell. The next task is to create a general model of an interconnection that generalizes at minimum the following three interconnection types: a gap junction, a synapse and an ephapse.

The next step is to simulate this model in MATLAB. Specializing to the case of neuro-glial gap junction based coupling, to compare the simulation output with standard literature. Finally, specializing to the case of axon-axon ephaptic coupling, to compare the simulation output with previously obtained (independent) simulation results Chawla [2017], Chawla et al. [2019]. These comparisons would then serve as validation for the theory developed.

References

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