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A Model of Cell Signaling, Migration and Interaction through PDE Simulations in the Cellular Potts Model

In living organisms, various internal and external signals guide the behavior of cells. The internal chemical signals can be modeled by systems of partial differential equations called reaction diffusion equations. Solving these PDEs within a changing domain such as these cells is known to be a difficult computational problem. I explore computational numerical models that can represent these equations, and the cells they control. Specifically, I will show equations that represent signals influencing cell shape and movement by the proteins Rac and Rho. These equations can then be integrated into an energy-based model (the "Cellular Potts Model") commonly used to represent deformable cells. This allows the cells to move, reshape and interact with their environment. Results will then be presented for the behavior of these cells, as well as the interactions of the model cells with various external signals, such as the interaction of cells with barriers, other cells, or with chemical signals. These results allow us to gain a better understanding of the biology, and the behavior of living cells.