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Motor Protein Transport on Cytoskeleton Networks

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Molecular machines, known as motor proteins, walk along configurations of filamentous proteins which make up the cytoskeleton of a cell. These motor proteins, for example kinesins, are responsible for transporting a variety of cargoes within the cell. The arrival of the cargoes at specific locations within the cell are imperative for the successful execution of various cellular processes, including cell division. Although much detail is known about the different proteins that are able to transport certain cargoes, the exact processes that influence the distribution of these cargoes throughout the cell are still unclear. Whilst theoretical models may provide further insights into intracellular processes, there is an absence of such models describing the dynamics and diffusion of motor proteins throughout the interior of cells. In light of this, the aim of this talk is to explore possibilities for analytical modelling of the motion of motor proteins within the context of a cell. To begin this exploration, the Langevin dynamics of a single motor protein transporting a cargo as it progresses along different configurations of a single filament will be considered. The mathematical challenge posed by modelling this process in a similar manner for more intricate filament configurations will then be addressed through a combination of a dynamical field theoretical formalism with a networking theory employed in polymer physics (see e.g. [1]). The talk will be concluded with a glimpse of how the formalism may allow for the extension of the model to describe transport over a density of filaments that one might expect to find within a cell.

[1] S. F. Edwards, "A field theory formulation of polymer networks," J. Phys. Fr., vol. 49, pp. 1673–1682, 1988.

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