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Models of Vimentin Organization Under Actin Retrograde Flow

Intermediate filaments are elements of the cytoskeleton where their organization determines their functions in cells. In this study, we observe and model the movement of GFP-labeled vimentin fibers after preventing microtubule polymerization with nocodazole to inhibit microtubule related transport driven by molecular motors. Hence, in our data, vimentin is only subjected to actin-driven transport. To model this phenomenon, we assume that vimentin may exist in two states, mobile and immobile, and may switch between the states at unknown rates. In addition, we assume that mobile vimentin may advect from the cell plasma membrane to the nuclear envelope because of actin retrograde flow. We introduce several biologically realistic models using these assumptions. For each model, we use dual annealing to find the best parameter sets resulting in a solution that most closely matches the experimental data. Then the best candidate model is identified using the Akaike Information Criterion. Using the best candidate model, we reconstruct the spatially-dependent profile of the actin retrograde flow, and discuss the biological implications of our results.

Work with S. Etienne-Manneville (Institut Pasteur, Paris), C. Leduc (IJM, Paris) and S. Portet (University of Manitoba)