Actin Disassembly Mediated by Severing, Debranching, and Hydrolysis[1]

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For cells to respond effectively to their environment, the actin cytoskeleton must both assemble and disassemble rapidly in the presence of external cues. A great deal of theory has been focused on assembly, but disassembly has so far received less attention. The talk will describe two theoretical treatments of actin disassembly resulting from debranching, severing, and ATP hydrolysis. 1) The dynamics of *in vitro* actin polymerization caused by filament branching or severing. Via a combination of stochastic-growth simulation and analytic theory, we show that highly branched structures such as those found near the edges of cells cannot persist in steady state. Early in polymerization, highly branched structures form, but disassemble over time leaving very few branched filaments. This causes an overshoot in light scattering intensity as a function of time. Inclusion of the effects of ATP hydrolysis shows that hydrolysis causes an overshoot in the amount of polymerized actin which can be observed in pyrene fluorescence experiments. 2) The interaction between severing and annealing in disassembling a model lamellipodial actin network. The network is treated as a periodic array of crosslinked actin filaments which sever randomly. The lamellipodial actin density drops abruptly as a function of distance from the membrane in the absence of annealing. When annealing is included, the drop is more gradual, and at a critical value of the annealing rate the thickness becomes infinite. It is shown that lamellipodial disassembly is controlled by two characteristic times: the time that a single subunit remains in the network, and the time that it takes for actin polymerized at the membrane to move to the edge of the lamellipodium.