# Theoretical approaches to actin filament dynamics

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**Abstract**

Dynamic control of the actin network in eukaryotic cells plays an essential role in their movement, but to date our understanding of how the network properties are controlled in space and time is still rudimentary. For example, how the cell maintains the pools of monomeric actin needed for a rapid response to signals, how the filament length distribution is controlled, and how the actin network properties are modulated by various bundling and severing proteins to produce the mechanical response is not known. In this talk we focus on the development and analysis of mathematical models, which enable us to investigate the temporal evolution of the filament length distribution and the effect of the nucleotide composition on the dynamics of actin filaments in vitro. We discuss recent results on the relevant time scales for establishment of a time-invariant length distribution. According to these results there are very long-lived intermediate length distributions that are not exponential. Moreover, we set up a master equation for the biochemical processes appearing at the actin-filament level and simulate the corresponding dynamics by generating numerical realizations through a Monte Carlo scheme. Statistical analysis of ensembles of generated realizations provides the moments of the various distributions of interest. Various challenges in this direction concerning the complexity of the Monte Carlo scheme are addressed and an analysis of the statistically derived moments in the framework of simplified analytic models and correlated random walks is discussed.