Biochemistry

REPRODUCTION OF QUANTITATIVE MICROTUBULE DYNAMICS USING MONTE CARLO SIMULATIONS

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Eukaryotic cells contain a microtubule cytoskeleton. The main functions of microtubules are to provide cell structure and cell organization. The most remarkable feature of these polymeric structures is their capacity to undergo a process called dynamic instability. Dynamic instability is the ability of a microtubule to constantly switch between cycles of polymerization and depolymerization. During mitotic cell division for instance, dynamic instability is essential to position the chromosomes in the metaphase plate to allow even distribution of the chromosomes between the two daughter cells. Although dynamic instability is widely observed both *in vivo* and in *in vitro* experiments, its mechanism and regulation is not well understood. To address this problem we created a Markov chain Monte Carlo simulation model. The parameters in this model are the availability of free GTP-tubulin dimers in the cytosol and the ability of that GTP to be hydrolyzed. These two variables are thought to be the most important actors in dynamic instability. Using

both instant diffusion and lattice diffusion, our model reproduced qualitative aspects of dynamic stability for very large ranges of initial conditions. Further analysis of our model demonstrated an ability to reproduce more subtle behaviours of microtubules with a few adjustments of the initial conditions.