Modelling microtubule dynamic instability: microtubule growth, shortening and pausing

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Microtubules (MTs) are protein polymers found in all eukaryotic cells. They are crucial for many cellular processes including cell movement, cell differentiation, and cell division. In performing these functions, they go through random periods of relatively slow polymerization (growth), followed by very fast depolymerization, an event referred to as a catastrophe. This "slow" growth" and "fast" shortening is unique to MTs, and is referred to as dynamic instability. Aside from growth and shortening, some experimental studies suggest that MTs may also undergo periods of pausing, and the reasons for this are largely unknown. Here, we propose a model for MT dynamics which accounts for growth, shortening, nucleation (the event that initiates formation of MTs), and MT pause. Using numerical simulations, we examine how the behavior of MTs change, depending on whether or not a pausing state is considered. We compare our results with the experimental literature.

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