The Summer Undergraduate Research Fellowship (SURF) Symposium
7 August 2014
Purdue University, West Lafayette, Indiana, USA

Analysis of Mechanics and Dynamics of Biopolymers in Living Cells

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ABSTRACT

F-actin polymers in the cytoskeleton provide mechanical strength and deformability to cells. Thus, understanding their dynamic responses to intracellular and extracellular cues is of critical importance for studying the biological and mechanical behaviors of cells. Unfortunately, to date, no computer software can provide researchers with adequate means to measure these responses since *in vivo* F-actin cytoskeleton is quite dynamic and complex unlike *in vitro* actin networks. We aim at developing a tool which would allow researchers to semi-automatically analyze time-lapse microscope images of these F-actin polymers and thus evaluate the length and stochastic dynamics of F-actins (filament elongation, shrinkage and disassembly). Various image processing techniques were used to achieve this objective. First, a high-pass filter was used to enhance contrast of dim images. Then, edges of F-actins of interest (chosen by users) are automatically traced by employing template matching using a set of two-dimensional correlational kernels. Based on the tracking results of multiple F-actins in a single image, distribution of F-actin lengths is calculated. We also tracked the same F-actin across all time frames to compute how fast it grows and shrinks. Using this automated tool, researchers would be able to analyze a higher percentage of their data very efficiently. We plan to improve this tool by minimizing manual inputs from the users.

KEYWORDS

F-actin, biopolymers, in vivo, images, cytoskeleton, filament tracing, rapid automated tracing, time-lapse microscopy, stochastic dynamics, computer vision, image processing, bioinformatics, feature extraction, low contrast, pixels

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