UNIVERSITY OF CENTRAL FLORIDA

CENTER FOR RESEARCH IN COMPUTER VISION

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"Analysis of Fluorescently Labeled Contractile Subcellular Structures: Instantaneous Flow Tracking Applied to Measurements of Cellular Dynamics"

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ABSTRACT

In cell biology, the complex dynamics of cytoskeletal microtubule and F-actin meshworks is a difficult subject of study. Quantitative analysis of fluorescent speckle microscopy (FSM) data sets provides a powerful means to probe molecular mechanism, but resolving speckle motion poses numerous challenges. Fluorescent speckles, sub-resolution cluster of fluorophores, are often faint and unstable, and typically present in only a few images of a time-lapse sequence. Their motions can be entangled and fast-evolving, especially in complex cytoskeleton structures where large numbers of speckles move in an organized fashion in multiple directions as a part of overlapping speckle flows. Recently, we proposed a new method based on graph theory which can be used to establish correspondence between speckles in time-lapse image sequences. Our instantaneous flow tracking (IFT) algorithm computes multiple vector flow fields exploiting the knowledge of the local smoothness as well as regional organization of speckle motion by considering three consecutive frames of an image sequence at a time. Importantly, we apply bi-objective optimization where the maximization of the number of accepted links between speckles competes with the global cost of linking speckles. Here we present the results of this IFT algorithm that, when applied to FSM time-lapse series, can capture the instantaneous state of the rapidly changing, dense, and multi-directional speckle flows often exhibited by cytoskeletal dynamics in living systems.

BIOGRAPHY

Alexandre Matov, PhD is research associate in medicine at the division of hematology and medical oncology at the Weill Medical College of Cornell University in NYC. He develops computer vision algorithms for the quantitative analysis of fluorescent microscopy images of microtubules. Microtubules are essential cytoskeletal protein filaments; they play an important role in key cellular processes, such as cell division, and represent one of the most validated targets in oncology. Dr. Matov is interested in studying the proteins that regulate microtubule dynamics in human to elucidate how their inhibition or overexpression affects the efficacy of chemotherapeutics.