Tracking microtubule groups with deep learning and optical flow

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Microtubules often from groups at high density, which are able to glide in the same directions on Kinesin coated glass surface. At higher density of microtubules, they tend to move together (snuggling) to avoid collision and overriding of microtubules. As a result, microtubule groups emerge motion patterns showing straight, curved or wave like trajectories [1].

This research aims to analyze the condition of phase transition of the motion patterns of microtubules by deep learning which will bring new advancements in the field of molecular robotics. As a first step, we have developed an order parameter analysis workflow which consists of the U-Net like Fully Convolutional Neural Network (FCN) for noise filtering, Sparse Optical Flow (SOF) for tracking and SOF cluster for cluster matching among frames.

In this workflow, at first we trained the parameters using videos generated by the latest version of microtubule gliding assay simulation system [2], and then applied them on real experimental video data for evaluation. The workflow could drastically accelerate its performance by GPU with CUDA parallel programming.

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