Learnable analysis module for subcellular, time lapse microscopy assays

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Introduction
A new generation of subcellular, versatile, and fast microscope and fluorescent probe systems has enabled the visualization of subcellular and molecular events in live cell time-lapse microscopy. We have previously developed a subcellular object detection algorithm that can achieve highly accurate and robust performance in live cell time-lapse microscopy. The learning module consists of a generalized algorithm architecture and a teaching user interface for algorithm optimization. The interface allows the user to optimize the algorithm configuration using a drawing tool on images without any image processing knowledge.

We validated the performance of the learning module using time-lapse image sets from an FM dye-based assay of synaptic vesicle recycling, as well as synthetically created time-lapse image sets. Tests were conducted comparing the new learnable method performance to the validated non-learnable algorithm. We found that the learnable methods can achieve better results than the validated version that is proven to provide significant improvements in synaptic detection sensitivity and specificity, synaptic localization and timeliness accuracy for both normal and simulated noise conditions over other methods.

Results
A new generation of microscope and fluorescent probe technologies has enabled...