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Large-Scale Cell Tracking in Time-Lapse Microscopy Images for Stem Cell Engineering and Discovery

Dr. Zhaozheng Yin
July 14th Thursday, 9:30 to 10:30 am
Venue – Computer Science Building – Room 327

Abstract -

Vision-based object detection and tracking techniques play an important role in a broad range of civilian and military applications such as industry inspection, surveillance and battlefield awareness. In this talk, I will introduce a new tracking system that is able to track dense object populations (hundreds to thousands) and determine their spatiotemporal histories over extended period of time (days to weeks). This system is being tested in biomedical research that directs the migration and proliferation of stem cells to meet research and clinical demands on tissue engineering.

Major challenges to existing tracking techniques, in dealing with stem cells in microscopy images, are caused by the special microscopy imaging process and the complexity of cell behaviors (shape deformation, object occlusion and cell mitotic events). To address these difficulties, I first establish a scientific understanding of phase contrast microscope's optical properties for modeling its image formation process. A linear imaging model is found to well explain the phase contract imaging system. Using this model, I formulate a quadratic optimization function with sparseness and smoothness regularizations to restore artifact-free microscopy images. The removal of artifacts allows for obtaining high quality object segmentation by simply thresholding the restored image. Then we apply data association algorithms on segmented object candidates and solve the problem of object tracking by using linear programming.

After presenting the challenges and excitements of this new application area of large-scale cell tracking, at the end of this talk, I will discuss the role of object tracking in related research topics including crowd behavior recognition and identification, disaster relief, collaborative and active tracking in a sensor network.

Biography – Zhaozheng Yin is a project scientist in the Robotics Institute at Carnegie Mellon University, where he coordinates the Cell Image Analysis consortium as a technical leader. His research interests spread in the fields of Computer Vision, Pattern Recognition, and Image/Signal Processing. In particular, he has been working on robust, efficient single or multi-camera visual information processing for segmenting, detecting, tracking objects, and describing their behaviors, with applications on biomedical imaging, surveillance, multimedia and video/image scene understanding.

Yin received his BS degree in Automatic Control from Tsinghua University, MS degree in Electrical and Computer Engineering from University of Wisconsin-Madison, and Ph.D. in Computer Science and Engineering from Penn State University in 2009. He was a postdoctoral fellow in the Robotics Institute at Carnegie Mellon University from 06/2009-06/2011. He received the best doctoral spotlight award in CVPR2009 and he was in the finalist of young scientist award in MICCAI2010.