The Department of Electrical and Computer Engineering

Announces the

Final Defense of Dissertation

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Date: September 16, 2019
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Location: Winston Chung Hall 315

Title: Video Bioinformatics: Human Embryonic Stem Cell Analysis with Machine Learning

Abstract: Human Embryonic Stem Cell (hESC) have a great potential for regenerative medicine to provide treatments for Parkinson's disease, Huntington's disease, Type 1 diabetes mellitus, etc. Consequently, hESC are often used as a model in the biological assay to study the effects of chemical agents on the human body. Video analysis plays an important role for biological assays in the field of prenatal toxicology and stem cell differentiation. This thesis introduces machine learning techniques for detection, segmentation and classification for hESC analysis. For the detection, a bio-driven algorithm was used to detect cell regions in hESC images. Cell region detection is essential in stem cell focused analysis. It can prevent background information from contaminating the analysis and put more emphasis on processing the cell region. For the segmentation part, a bio-inspired method was proposed for bleb extraction and analysis over time. Bleb formation is a strong health indicator of the stem cell undergoing chemical reactions. Therefore, it is significant to biologist to analyze the formation process over time. For the classification, a deep learning structure was built with both labeled and unlabeled hESC data to classify the six common classes in stem cell images. The six classes are: 1). cell clusters, 2). debris, 3). unattached cells, 4). attached cells, 5). dynamically blebbing cells, and 6). apoptotically blebbing cells. Various results are provided on real video datasets collected using a phase contrast microscope and a Nikon Bio-station.