Predicting Endothelial Cell Angiogenic Phenotypes

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• Combining computer modeling with laboratory experiments to identify and classify endothelial cell responses to stimuli
  o Used to predict cell behavior during angiogenesis and help determine physiological responses to drugs
• Image-processing of fluorescence microscopy images of stimulated cells yields information on 56 cellular metrics
  o Cluster analysis on the cells and their measurements identifies distinct cellular phenotypes or states
• Results are used to test a computational-inspired paradigm of cellular states (state machine)
  o Cell states, or phenotypes, are defined through the cluster analysis of the metric results
  o Behaviors yielding transitions between states will be represented with probabilistic functions
  o The model will predict phenotype changes of cells as a result of stimuli
  o Transitions will be visualized with image recognition algorithms that query an established image library
• High performance computing is crucial in this project for processing and analyzing large, high-resolution images and for classification of endothelial cell phenotypes. It also is vital for model implementation, and for performing queries in large image databases.

Results help lay the foundation for predicting and guiding endothelial cell behavior during angiogenesis, which will be vital for therapeutically targeting vascular response in aberrant microenvironments seen in injury and disease.

Image Processing Inputs:
• Fluorescent images
• Growth factor concentrations
• Stimulation durations

State Machine
Example transition function between Phenotype I and II:
\[ \text{actin polarity Ph II} = c_1 \times (\text{actin polarity Ph I})^2 + c_2 \]

Cluster Analysis:
• Identify phenotypes & classify cells

Processing & Model Outputs:
• Phenotype of cell(s) in input image
• Predicted metrics and phenotypes of cells resulting from stimuli conditions and cellular transitions
• Sets of images from database matching predicted cell phenotypes

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