On bioimage informatics and decoding genomes

Eugene W. Myers[1,2]
[1]HHMI Janelia Farm Research Campus, Howard Hughes Medical Institute, Ashburn, United States
[2]Director, Max Planck Institute for Molecular Cell Biology and Genetics (June 2012), Dresden, Germany

We are now at a time when we can systematically alter animals genetically so that any given protein or its expression can be observed in their cells. Combined with new modalities of light microscopy, this allows us to observe molecular mechanisms within the cell, observe the developmental trajectory of growing organs, and to map the cellular anatomy of organisms and organs such as the brain, the heart, or the stem of a plant. All this increasingly requires computation to either extract information or to quantitatively measure an effect in the vast sea of images produced by such explorations. This is creating the growing sub-field of bioimage informatics.

In this talk we introduce the subject to the non-expert with a series of examples from the work of my group. These include (1) the biophysics of cell division, (2) studies of gene expression in individual cells within the worm C. elegans, (3) tracking whiskers in a behaving mouse, and (4) a detailed reconstruction of a fly's brain including the patterning of its development. As time permits, I will give a sample of some of the interesting methods that have arisen from pursuing these projects. Among the highlights are (a) a deformable registration method that reveals glomureli in a consensus built over 100's of brains that cannot be seen in an individual brain, and (b) a neuron tracing algorithm based on Dijkstra's classic shortest path algorithm.