Module 0: Introduction Biological Image Analysis with the Bioimage Analysis "Toolbelt"

Scott T. Acton

Virginia Image and Video Analysis (VIVA), Charles L. Brown Department of Electrical and Computer Engineering
Department of Biomedical Engineering
University of Virginia, Charlottesville, VA 22904

Objective of Tutorial

- Define emerging techniques (some more established than others) for analyzing biological images
- Emphasis on Segmentation and Tracking of cells
- Provide Matlab code examples that
  - Demonstrate concepts
  - Allow you (or your student or your colleague) to immediately apply fairly complex image analysis methods to your data

Outline

- Module 1:
  - Active contours for segmentation
  - Active contours for tracking
- Module 2:
  - Scale space for segmentation
- Module 3:
  - Graph theoretic segmentation of filamentous objects
  - Graph cuts for segmentation
- Module 4:
  - Particle filters for tracking

Bioimage Analysis Toolbelt

- Written in Matlab with some routine in C/C++
- Runs on PC and Macintosh platforms
- http://viva.ee.virginia.edu/toolbelt.html

Basic Directions

- Each zipped file is a directory with code and a sample data set

1. Unzip the directory
2. Open Matlab and change to that directory
3. If a file named "compile.m" exists, type:

compile (at the Matlab prompt)

*and press enter... I don't need to say that, do I?!

(This file will automatically compile any C/C++ code – installation of compilers may be necessary for your machine. You may have to run "mex –setup" if you've never used mex before. You may need help getting this started if you're not the programming geek type!)

Basic Directions

4. If you are using a PC, type

example

To run the example code.

On a Mac, type

examplemac

Tools on the Toolbelt

- Active contour segmentation through the Active Model Toolbox (AMT) – parametric active contour segmentation for 2D and 3D data; plus initialization by PIG!
- Active contour tracking: using snakes to track cells in 2D videos
- Diffusion: anisotropic diffusion for enhancing and segmenting biological images; SRAD for signal-dependent noise

Tools on the Toolbelt

- Neuron Segmentation: a graph theoretic method for segmenting filamentous objects in 3D
- Particle filter tracking: tracking cells with a Monte Carlo approach
- Kalman filter tracking: using the KF to track cells in a constant velocity model

Caveats and Additions

- Many of the tools in the toolbelt need
  - Matlab's image processing toolbox
- The neuron segmentation tool needs
  - Matlab's bioinformatics toolbox
  - A 3D Viewer – We recommend Hanchuan Peng's V3D: www.vaa3d.org
- The GVF implementation in the active contour segmentation tool is due to Dr. Jerry Prince's lab, used with their permission

Acknowledgements

- The code and tutorial would not be possible without…
- Current and former students including Nilanjan Ray, Bing Li, Yongjian Yu, Saurav Basu, Adam Goobic, Drew Gilliam, Jing Cui, Qian Sang, Mike Stuecheli, Suvadip Mukherjee, Andrea Vaccari, Andrew Segall
- Collaborators including Klaus Ley, Barry Condron, Dipti Mukherjee, John Hossack, Joebob Havlicek, Al Bovik