

## **BME 42-731 / ECE 18-795 Project Assignment #3**

### **Image Segmentation Using ITK**

Assigned on Mar-24-2010,  
*Due on Apr-14-2010 in class*

#### **A. Overview**

The main goal of this project is to introduce the image segmentation functions provided by ITK. An overview of ITK is prepared by our TA and attached to the end of this file.

Specifically, the project is implemented by using MAT-ITK, a MATLAB interface to ITK. The total score for this project assignment is 80 points.

#### **B. Instructions**

##### **B.1 Image data**

You need to download the image data using the following link

[http://ccdl.compbio.cmu.edu/BME42\\_731/segmentationImageData.zip](http://ccdl.compbio.cmu.edu/BME42_731/segmentationImageData.zip)

The data set is divided into two parts. The first part consists of two static images we used before (60x\_02.tif, Blue0001.tif). The second part is a time-lapse image sequence of mitochondria transport within Drosophila segmental nerves.

##### **B. 2. Image segmentation**

###### **B.2.1 Segmentation of static images**

Apply the three segmentation algorithm chosen by your group to the two static images. (20 points)

###### **B.2.2 Segmentation of image series**

Apply the three segmentation algorithm chosen by your group to the time-lapse image sequence and generate movies to visualize your segmentation results. (20 points)

##### **B.3. Theoretical background**

Give an outline of the theoretical background for each of the three algorithms chosen by your group. Feel free to use any references that are relevant. (40 points)

For B.2 and B.3, it is expected that you will research the document provided by the ITK project. Whenever applicable, it is also expected that you will use image morphology operations to further improve the segmentation results.

### **C. Report format**

There is no page limit to the report.

Page size: letter

Line space: single

Page margins: no less than 1 inch

Font size: 12 points for the main text; 10 points for listed references

### **D. Submission of MATLAB codes**

This course has its registry in CMU Blackboard (<http://www.cmu.edu/blackboard/>). We will use the “Digital Dropbox” tool for submission of MATLAB codes.

### **Reference**

[1] Website of the ITK project: <http://www.itk.org>

[2] T. S. Yoo, Insights into Images, A. K. Peters, 2004.

# Introduction to ITK

Andy Chen

ITK (Insight Segmentation and Registration Toolkit) is an open-source, cross-platform system that provides developers with an extensive suite of software tools for image analysis. Since ITK is originally written in C++, MATITK is written, allowing users to access certain ITK algorithms in MATLAB.

To use MATITK, you should copy “matitk.dll” to the desired location, launch MATLAB and set search path of MATLAB or change current directory to the location of “matitk.dll”. For help, you can type `matitk(?)` in MATLAB’s command window.

Generally, MATITK includes three categories of algorithms, such as: filtering, segmentation, and registration methods. You can type `matitk('f')`, `matitk('s')` and `matitk('r')` respectively to understand the algorithms in each category.

To use one method in MATITK, you need to input in the following format:

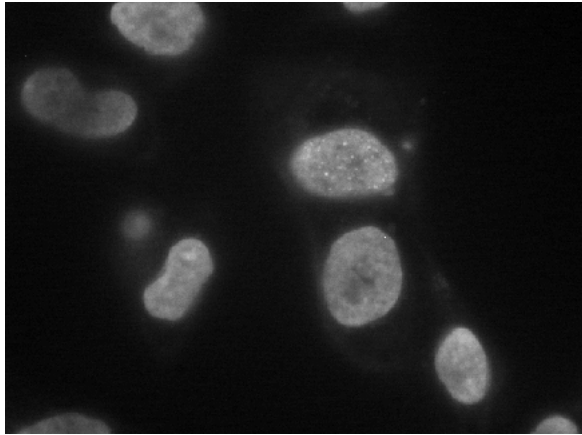
```
matitk(operationName,[parameters],[inputArray1],[inputArray2],[seed(s)Array],[Image(s)Spacing])
```

1. operationName, specifies the implemented ITK method to be invoked.
2. parameters, specifies the required parameters of the ITK method to be invoked.
3. inputArray1 and inputArray2, specify the input image volume. They must be three dimensional and contain double, float, unsigned char or signed integer data type elements. In the case where a second image volume is not required for the method being invoked, provide [] as the fourth argument.
4. seedsArray arguments specify the seed points (in MATLAB coordinate system) in the following order:  $[x_1, y_1, z_1, x_2, y_2, z_2, \dots, x_n, y_n, z_n]$ . Because it is three dimensional, the number of elements in seedsArray should be a multiple of three. In the case where seeding is not required for the method being invoked, provide [] as the fifth argument.
5. The last optional argument specifies the spacing of the supplied image volume. The performance of certain ITK methods may be affected by the spacing. If this argument is omitted, an isotropic spacing of [1,1,1] is assumed.

As you may see above, input data must be 3D, so when you need to process a 2D image, you have to first convert it to a 3D data before using MATITK. Here, I will give an example for nuclei segmentation in a 2D image:

```
% load image and get the size of this image
filename = 'Blue0001.tif';
Img = double(imread(filename));
imgSz = size(Img);
```

```
% show original image
figure; imagesc(Img); colormap gray; axis off; axis equal;
```



```
% in order to use matitk, we have to use 3D data
% so we first build a 3D volume of two layers, and each layer
% contains the original image
D = zeros(imgSz(1),imgSz(2),2);
D(1:imgSz(1),1:imgSz(2),1) = Img(1:imgSz(1),1:imgSz(2));
D(1:imgSz(1),1:imgSz(2),2) = Img(1:imgSz(1),1:imgSz(2));

% implement segmentation using Otsu's method
b = matitk('SOT',[max(D(:))], double(D));
figure; imagesc(squeeze(b(:,:,1))); colormap gray; axis off; axis
equal;
```



For details of MATITK usage, please see: <http://www.sfu.ca/~vwchu/matitkusage.html>