CFM for 2-D Brain Image Segmentation

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I. Introduction

This toolkit provides the segmentation of 2-D brain images using the Charged Fluid Model (CFM). It has been tested in a large number of brain MR images for the segmentation of the ventricle, brain tumors, and skull stripping on T2-weighted and PD-weighted MR images. It requires an initialization step to place a contour in the ROI to start the algorithm. The cure evolution is automatically terminated when all fluid elements are stopped at the boundaries of interest. You are free to modify the source code of this toolkit for your own. Note that you are not allowed to remove the names in this collection and release the modified code to a public domain. Please feel free to let us know any comments on this issue. Enjoy!

II. Usage

1. How to execute it?

A. Run “runj.bat”, and you will see a popup window for selecting input image data.

B. After the image is loaded and shown, use “Select” to click on the original image to duplicate an image on the right.

C. Use “CFM” and move the cursor to the duplicated image. You will see a contour for you to start the algorithm. You can change the shape of this contour by selecting either “circle” or “square” on the left panel. By using the right and middle buttons, you can increase and decrease the size, respectively.

D. You can set the value of beta by sliding the bars or directly type a number in the text field. Remember to click the “Submit” on the left bottom panel to accept the change. There are two filter kernels for users to choose.

E. Move the contour inside the ROI and click on the left button. You will see the yellow contour is superimposed by the image. Click the “Start” on the

left panel of the window to start the segmentation process. It will automatically terminate when all fluid elements are stopped.

F. You can temporary stop the process by clicking “Pause”, and let go by clicking it again. The segmentation process can be terminated by the end use by clicking the “Terminate”.

G. You will see the contour changes to red when the segmentation process is done.

2. How to recompile it?

A. Run “runl.bat” to generate a list of all java files with "list.txt".

B. Run “runc.bat” to compile based upon the list file.

III. Class Hierarchy

This section summarizes the main classes written in Java for this toolkit and the corresponding description.

Charge : The basic element of the *ChargedFluid* class. It contains the charge, position, and electric fields for each fluid element. The *Charge* is created at the beginning of each evolution procedure and dies when the procedure is completed.

ChargedFluid : A class for storing the *Charge* class using the *LinkedList* class. The *Charge* classes corresponding to fluid elements are not stored in spatial order during curve evolution. To obtain the concrete contour using the *Polygon* class, a contour tracing algorithm is used to reorganize the sequence of *Charge* classes in the *LinkedList* class.

FastFourierTransform : This class is dedicated to the numerical computation of DFT using the FFT algorithm. It provides the forward and backward transforms in 1-D and 2-D with the length of input data equal to an integer power of two.

Matrix : The main class of the package. It stores the input image intensity data for computation and display, and generates the *Poisson* class. This class controls the entire processing procedures.

Poisson : A class dedicated to the electric potential computation using the FFT-based FSP method to numerically solve Poisson's equation. It controls the evolution procedures consisting of charge distribution and front deformation.