

Segmentation of Breast MR Images via ITK Routines

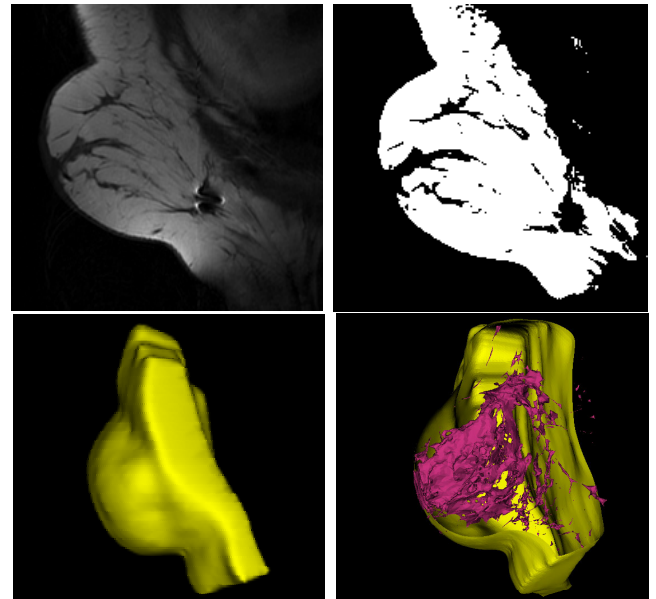
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Introduction: Segmentation of medical images is a challenging task. Numerous methods have been proposed and implemented in recent years. However, a definitive single approach to solve the problem of segmentation for the large variety of image modalities does not exist. Insight Segmentation and Registration Toolkit (ITK) is an open-source software system released recently that supports the Visible Human Project.[1] It is an object-oriented software system for image processing and employs leading-edge segmentation and registration algorithms in two, three, and more dimensions. However, the public software provides callable routines only. It does not provide graphics, visualization, or a segmentation code. ITK provides a basic set of algorithms that can be used to develop and customize a full segmentation application. We have implemented a variety of semi-automatic and automatic segmentation routines as well as preprocessing algorithms provided by ITK. This implementation allows interactive adjustments of algorithm parameters. The consequences of such adjustments are immediately available via an intuitive GUI incorporating the ITK segmentation routines. These routines are applied to help delineate breast tissue components related to alternative imaging strategies being investigated.

Methods: The interactive GUI facilitates the input of the original medical image dataset. The user selects an ITK filter from a pull-down menu and a selection pallet of available parameters associated with that filter is presented. The parameters are tweaked until the user is satisfied. Subsequent filters can be applied in similar fashion until the final segmentation result is obtained. Our work has focused primarily upon Discrete Gaussian Filter, Gradient Magnitude Filter, Binary Threshold Filter, and Region Growing Segmentation algorithms. Within the popular region growing arena several options have been implemented such as Connected Threshold, Confidence Connected and Isolated Connected Threshold Filters. The Tcl/TK intuitive GUI takes full advantage of the VTK graphics engine and couples the C++ ITK routines. The system currently operates on Microsoft Windows platform. However, there are no inherent restrictions to other platforms.

Results: A 41 slice MR scan of 256*256 was collected for a breast image. The upper left image displays an original MRI slice of breast dataset prior to segmentation process. The upper right image shows the result after application of the Binary Threshold Image Filter provided by ITK. Lower left image shows 3-D surface geometry composed of binary thresholded images. Lower right image shows the clipped surface geometry revealing glandular ducts inside the breast. Coupling the ITK segmentation algorithms, associated parameter controls, and our intuitive GUI, we can dynamically tune the images to extract desired features of anatomical structures such as ducts, fat tissues, glands etc. Multiple intermediate images can be created each branching off to different subsequent filters. This ability permits rapid evaluations and comparisons of segmentation pathways.



Conclusions: Segmentation of medical images is a challenging task. Insight Registration and Segmentation Toolkit is specifically designed for medical images and the source code along with a CMAKE utility was recently made available for a variety of OS platforms. By customizing different segmentation algorithms provided by ITK, it is possible to segment breast images to delineate fatty tissues, glands and ducts. With our interactive GUI, a user can harness the power of semi-automatic and automated image-processing algorithms without being an image processing expert. The user can also introduce problem-specific information to the segmentation task.

References: [1] <http://www.itk.org/index.htm> Insight Segmentation and Registration Toolkit Home Page, (11/10/03).

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