MAT-MIP

MATLAB-based Graphical User Interface for Medical Image Processing

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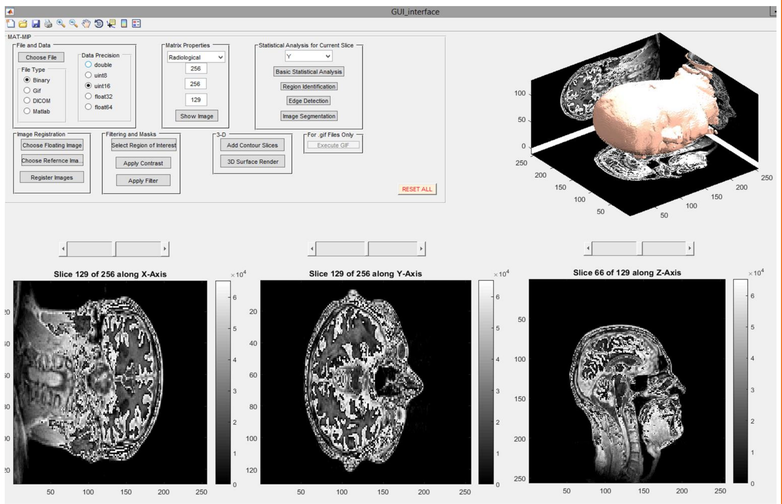
Introduction

The medical field demands the use of many types of imaging systems to collect patients' data and subsequently to perform an accurate diagnosis. Medical imaging systems differ in many ways but all of them require the same tools for processing and analyzing the data collected. The goal of this project is to develop a MATLAB-based graphical user interface (GUI) that reads, displays, and processes a scalar digital volume data according to user's needs and international standards[1].

The Graphical User Interface

MAT-MIP focuses on four main tasks: (1) **importation and exportation** of common file formats (MATLAB, binary, .gif) and an international standard format (DICOM[2]); (2) **bidimensional and tridimensional data visualization** according to international standards[3], including the possibility to choose between the radiological or neurological medical viewing conventions, which are commonly adopted by medical professionals; (3) slice or volume based **statistical analysis**; (4) **image analysis**: rigid transformations, data masking, and filtering, along with performing image registration and fusion.

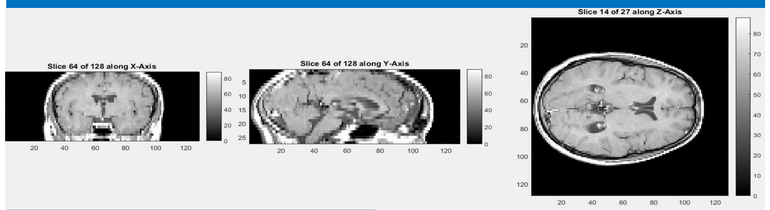
MAT-MIP is user-friendly since no user's coding work is required, and all of the functionalities can be reached through buttons and toolbars that display results in the main interface or open other windows conveniently.



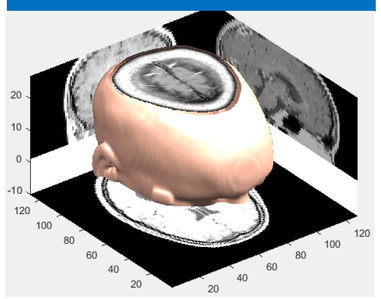
The MAT-MIP interface includes the option (from the top-left to the bottom-right): (1) to choose the desired file, the data-type and the data precision (top-left), (2) to select the medical convention to use for viewing (neurological or radiological), and (3) to insert the data matrix dimensions. The "Show Image" button automatically displays all three orthogonal planar views at the midpoints of each dimensional view. Three sliders allow the navigation through the data in a slice-by-slice manner. Other options are: (4) the statistical analysis toolbox, (5) image registration on select files (left of second row), and (6) selection of a region of interest, image contrast adjustment, and filtering. Finally, (7) the 3D data visualization toolbox allows the visualization of the 3D data either as contour slices or as a 3D surface render, both of which appear in the axis top right corner.

Data visualization

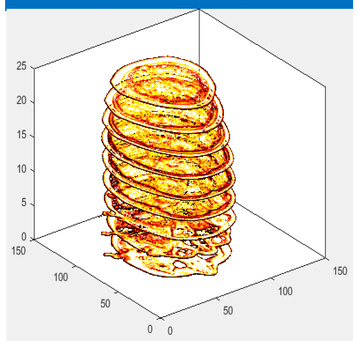
Orthogonal Planar Visualization



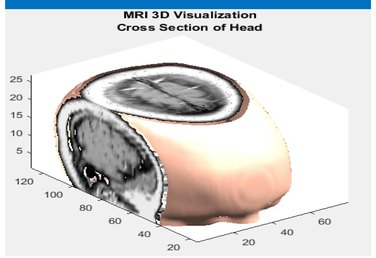
Surface Rendering



Contour Slices



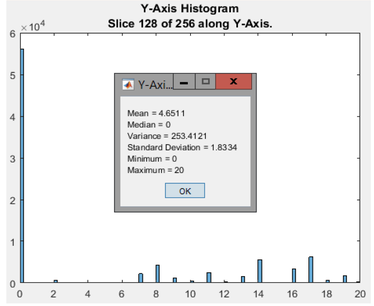
Partial Rendering



The data visualization toolbox includes: (a) orthogonal planar visualization, (b) 2D and 3D contour slice generation, and (c) 3D surface rendering. These tools allow the user to visualize the datasets in different ways for a thorough total analysis of the data.

Statistical Analysis

Region Analysis



The statistical analysis toolbox provides useful tools to perform slice or volume based analysis and to extract and examine region and image statistical properties.

Contrast Adjustment

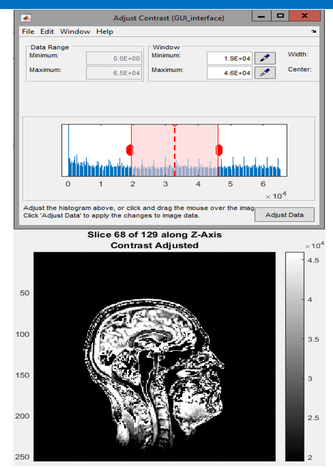
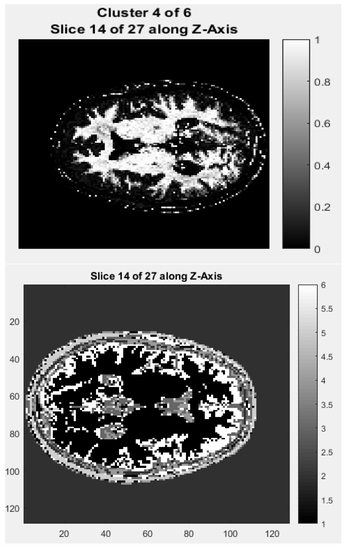
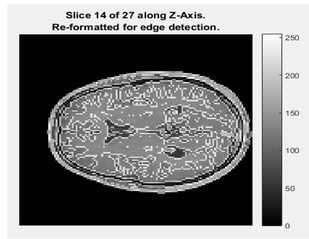


Image Analysis

Clustering



Edge Detection



Region Identification

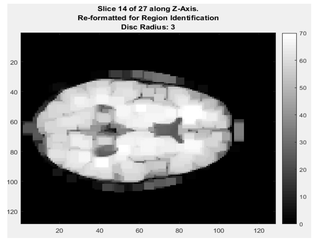
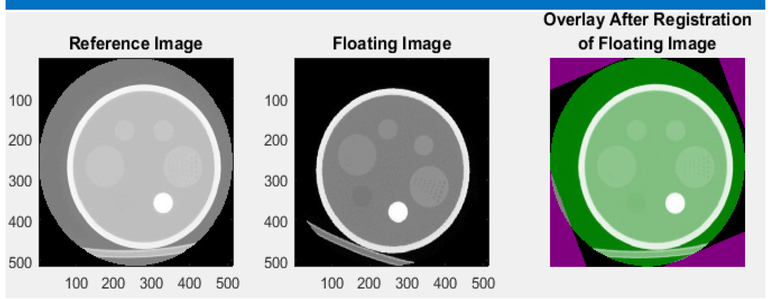


Image Registration and Fusion



The imaging analysis toolbox includes: (a) clustering performed according to two algorithms (k-means and fuzzy c-means clustering), (b) edge detection, (c) region identification, (d) image registration, (e) image fusion, and (f) filtering using the adaptive noise-removal Wiener filter.

Summary and Future Work

MAT-MIP is an user-friendly interface that aims to embody an exhaustive collection of developed or built-in MATLAB tools for medical image visualization and processing. Future works will focus on: (a) selective 3D rendering using image segmentation to isolate particular region(s), followed by similar volume rendering techniques used in the data visualization toolbox; (b) time-based visualization of 4D datasets to observe dynamic properties.

References

[1] Larobina, M. & Murino L. (2014). Medical Image File Formats. *J Digit Imaging (2014) 27:200–206.* doi: 10.1007/s10278-013-9657-9

[2] *DICOM, Digital Imaging and Communications in Medicine.* NEMA, www.dicom.nema.org. Accessed 24 April 2017.

[3] Zhang, Q., Eagleson, R. & Peters. (2011). Volume Visualization: A Technical Overview with a Focus on Medical Applications. *T.M. J Digit Imaging 24: 640.* doi:10.1007/s10278-010-9321-6