

DICOMToolbox

A GUI-based program for viewing, cleaning, and interacting with DICOM images
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Overview

The goal of DICOMToolbox is to provide a GUI-based tool to view and interact with DICOM images. This includes viewing images and tags (DICOM Viewer), editing tag data (DICOM Tag Editor), and redacting (i.e., blacking out) private identifiable information (PHI) from the image (DICOM Redactor), which is common in clinical ultrasound images.

Legal

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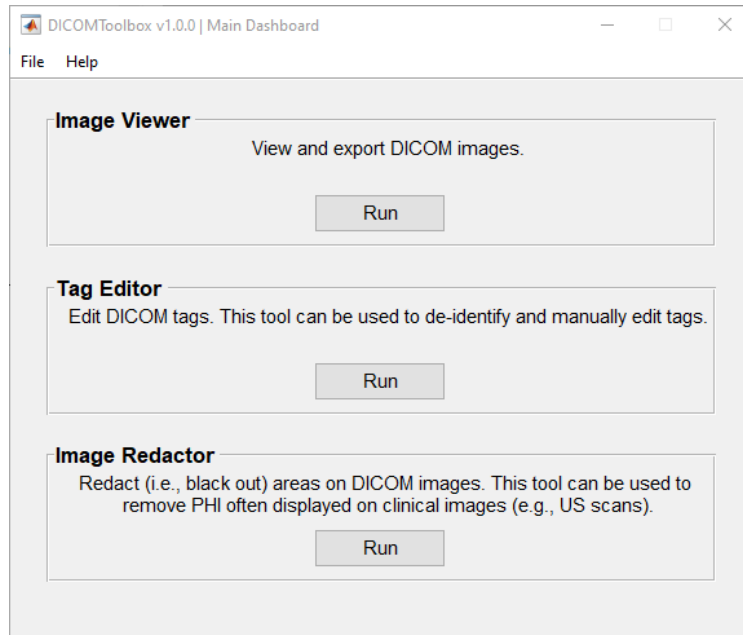
To view a copy of the license, please visit: <https://creativecommons.org/licenses/by-nc-nd/4.0/legalcode>.

Responsibilities of the User

This program was written and extensively tested by Rebekah Lawrence, PT, PhD. However, there is no guarantee that the program is error-free both in terms of usability and accuracy. Consequently, it is the sole responsibility of the user to verify the accuracy of all results, including but not limited to the de-identification of medical and research data in accordance with institutional policies and state and federal law.

Main DICOMToolbox Dashboard

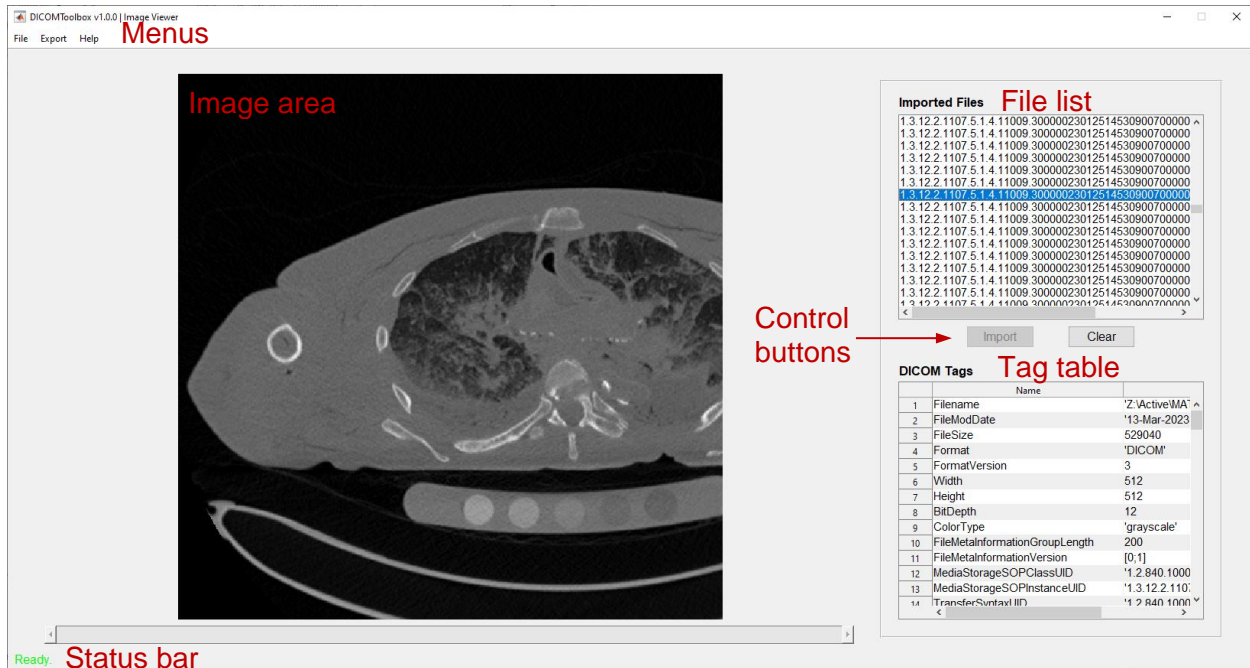
DICOMToolbox is run from a main dashboard, which gives access to the individual models (i.e., Image Viewer, Tag Editor, Image Redactor) by clicking on the appropriate *Run* control button.



DICOM Image Viewer

The goal of DICOM Viewer is to provide a quick method for viewing DICOM images and their tags. Still and CINE images can be exported in more common formats (e.g., .jpg, .png, .tif, .avi, .mp4). This module does not all for any form of image editing.

Graphical User Interface



The graphical user interface (GUI) of the Viewer module contains the following elements:

1. **File List:** Contains a list of the imported DICOM image file(s).
2. **Image Area:** Contains the DICOM file selected from the file list.
3. **Tag Table:** Contains the DICOM tags of the file selected from the *File List*.
4. **Control buttons**
 - a. **Import:** Allows the user to select DICOM files to import (same as File → Import).
 - b. **Clear:** Clears (i.e., resets) the program without closing the DICOM Viewer module (same as File → Clear).
5. **Status Bar:** Displays program status, user instructions, and processing progress.
6. **Menus**
 - a. **File**
 - i. **Import:** Allows the user to select DICOM files to import (same as clicking the *Import* control button).
 - i. **Clear:** Clears (i.e., resets) the program without closing the DICOM Viewer module (same as clicking the *Clear* control button).
 - ii. **Exit:** Closes the DICOM Viewer module.
 - b. **Export**
 - i. **Image:** Exports a user-specified image file (.jpg, .png, .tiff) of the image displayed in the *Image Area*.
 - ii. **Video:** Exports a user-specified video file (.avi, .mp4) of the image displayed in the *Image Area*.
 - c. **Help**

- i. About: Contains information about the program.
- ii. Help Documentation: Opens a PDF of the help documentation.
- iii. License Information: Contains information about the license under which DICOMToolbox is released.
- iv. Citing DICOMToolbox: Contains information about how to cite DICOMToolbox.

Running the Program

Import Images

Import DICOM images by either:

1. Clicking the *Import* control button.
2. File → Import.

Viewing Images

Once images are imported, an image can be viewed in the *Image Area* by selecting it from the *File List*. If the file is a cine (i.e., contains individual image frames), use the slider bar at the bottom of the *Image Area* to scroll through individual frames within the selected file. The DICOM tags for the selected image file are displayed in the *Tags Table*.

Exporting Images or Videos

DICOM files can be exported to standard image (.jpg, .png, .tif) or video (.avi, .mp4) files by navigating to File → Export → Image or video (as appropriate). A window will appear asking the user to specify the export destination, filename, and file type.

Clearing the Program

Clear the program by either:

1. Clicking the “Clear” control button.
2. File → Clear.

Closing the Module

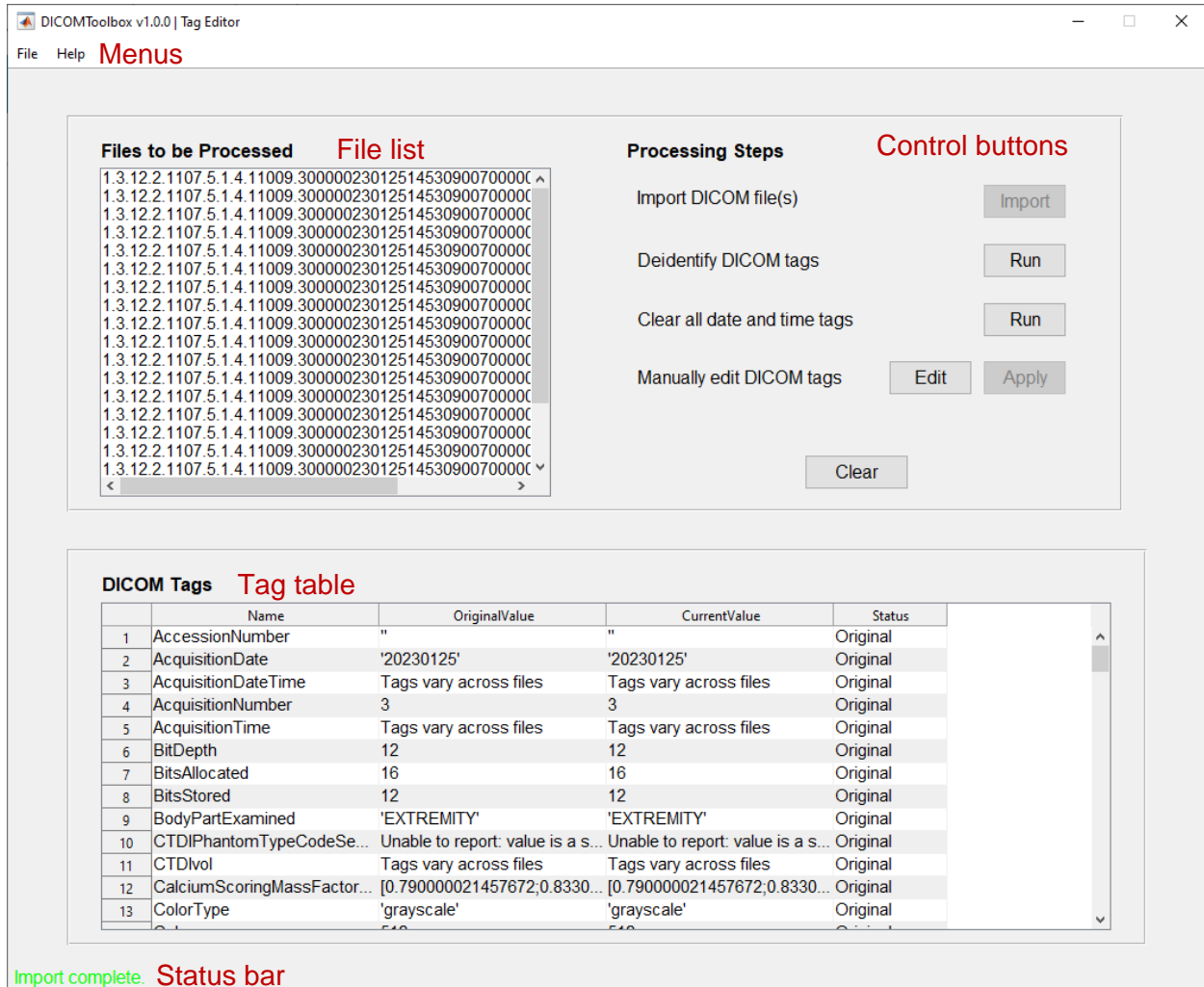
Close the DICOM Viewer module by either:

1. File → Exit
2. Clicking on the “x” in the upper right corner of the window.

Once the DICOM Viewer module is closed, the main DICOMToolbox window will reappear.

DICOM Tag Editor

The goal of DICOM Tag Editor is to edit the data stored to DICOM tags (i.e., attributes). Tags can either be de-identified using a straightforward implementation of MATLAB's [dicomanon function](#), or manually edited.



Graphical User Interface

The graphical user interface (GUI) of the Tag Editor module contains the following elements:

1. **File List:** Contains a list of the imported DICOM image file(s).
2. **Tag Table:** Contains a summary of all of the DICOM tags detected within the files listed in the *File List*.
3. **Processing Steps control buttons:** The buttons in this area allow the user to do a number of important actions:
 - a. **Import:** Allows the user to select DICOM files to import (same as File → Import).
 - b. **Deidentify DICOM tags:** Implements MATLAB's [dicomanon function](#) to remove confidential medical information from the tags. UIDs are overwritten.
 - c. **Clear all date and time tags:** Clears all tags that have the words “Date” and “Time” (case insensitive).

- d. Manually edit DICOM tags: Allows the user to select and manually edit specific tags by interacting with the *Tag Table*.
- e. Clear: Clears (i.e., resets) the program without closing the DICOM Tag Editor module (same as File → Clear).
- 4. Status Bar: Displays program status, user instructions, and processing progress.
- 5. Menus
 - a. File
 - i. Import: Allows the user to select DICOM files to import (same as clicking the *Import* control button).
 - ii. Clear: Clears (i.e., resets) the program without closing the DICOM Viewer module (same as clicking the *Clear* control button).
 - iii. Exit: Closes the DICOM Viewer module.
 - b. Help
 - i. About: Contains information about the program.
 - ii. Help Documentation: Opens a PDF of the help documentation.
 - iii. License Information: Contains information about the license under which DICOMToolbox is released.
 - iv. Citing DICOMToolbox: Contains information about how to cite DICOMToolbox.

Running the Program

Import Images

Import DICOM images by either:

1. Clicking the *Import* control button.
2. File → Import.

Once the images are imported, filenames are displayed in the *File List* and a summary of all the tags is displayed in the *Tag Table*.

1. Column #1: tag name
2. Column #2: the original tag value
3. Column #3: the current tag value
4. Column #4: the status of the tag as follows:
 - a. “Original” – displayed if the current tag value is the same as the original value.
 - b. “Deidentified” – displayed if the tag value was changed in a previous implementation of *Deidentify DICOM tags*.
 - c. “Manually edited” – displayed if the tag was manually edited by the user.

Note that many DICOM tag values contain nested structure variables, which are challenging to view in a table format. For example, PatientName is a structure with fields of “FamilyName”, “GivenName”, “MiddleName”, “NamePrefix”, and “NameSuffix”. Tags of this nature are displayed as “Unable to report: value is a structure”.

Additionally, the value of some tags likely vary across imported images (e.g., AcquisitionTime). Therefore, a single value cannot be displayed in the *Tag Table*. Tags of this nature are displayed as “Tags vary across files”.

Deidentifying DICOM Tags

DICOM tags can be deidentified by clicking the “Deidentify DICOM Tags” *Run* control button. The program uses a straightforward implementation of MATLAB’s [dicomanon function](#) to remove confidential medical information from the tags. It also replaces UIDs while maintaining DICOM file validity. Note that this process does not scrub all tags containing dates and times. To be sure these variables are also cleared, click the “Clear all date and time tags” *Run* control button. It is the responsibility of the user to verify that all identifiable information has been removed. If necessary, manually edit DICOM tags to remove any additional data. If it doesn’t already exist, a StudyDescription tag will be added to the file so that notes about the scan can be added to facilitate data tracking while maintaining confidentiality.

Modified files will be exported to a subfolder named “TagEdit” created within the directory specified during the import process. The original files are never overwritten.

Manually Edit DICOM Tags

DICOM tags can also be manually edited. To do this, first click on the *Edit* control button. This will make the “CurrentValue” column of the *Tag Table* editable. Edit a tag by selecting the current value, make the desired modification, then press enter. The table cell will be updated but the file will not be changed until the *Apply* control button is clicked. An error message will appear if the text entered is invalid (based on the requirements of the DICOM file format) or an issue occurred while writing the edited file.

Modified files will be exported to a subfolder named “TagEdit” created within the directory specified during the import process. The original files are never overwritten. The modified images retain the same pixel values the original image. If necessary, redact identifiable information from the image itself using the *DICOM Redactor* module.

Clearing the Program

Clear the program by either:

1. Clicking the “Clear” control button.
2. File → Clear.

Closing the Module

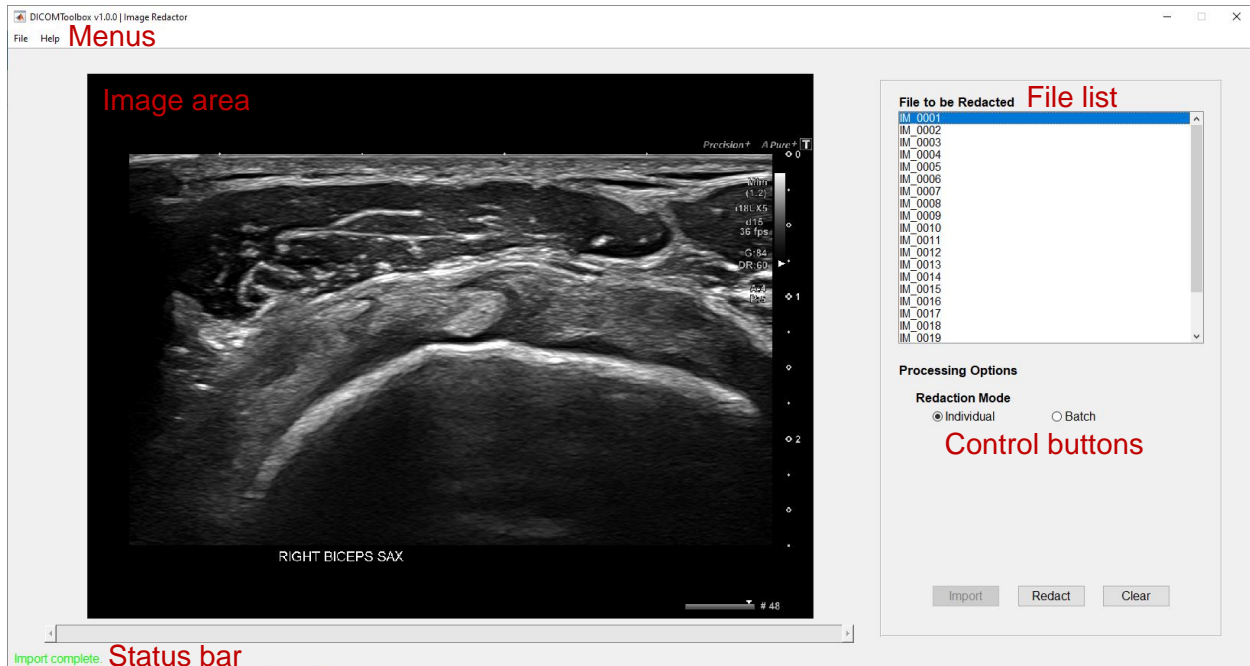
Close the DICOM Viewer module by either:

1. File → Exit
2. Clicking on the “x” in the upper right corner of the window.

Once the DICOM Tag Editor module is closed, the main DICOMToolbox window will reappear.

DICOM Redactor

The goal of DICOM Redactor is to redact (i.e., black out) information often displayed on medical images (e.g., clinical ultrasound images).



Graphical User Interface

The graphical user interface (GUI) of the Tag Editor module contains the following elements:

1. **File List:** Contains a list of the imported DICOM image file(s).
2. **Control buttons:** The buttons in this area allow the user to do a number of important actions:
 - a. **Import:** Allows the user to select DICOM files to import (same as File → Import).
 - b. **Redaction mode radio buttons:** Allows the user to select whether they want to redact images in either *Individual* or *Batch* mode (see details below).
 - c. **Redact:** Allows the user to draw a redaction rectangle on the image displayed in the *Image Area*.
 - d. **Clear:** Clears (i.e., resets) the program without closing the DICOM Redactor module (same as File → Clear).
3. **Status Bar:** Displays program status, user instructions, and processing progress.
4. **Menus**
 - a. **File**
 - i. **Import:** Allows the user to select DICOM files to import (same as clicking the *Import* control button).
 - ii. **Clear:** Clears (i.e., resets) the program without closing the DICOM Viewer module (same as clicking the *Clear* control button).
 - iii. **Exit:** Closes the DICOM Viewer module.
 - b. **Help**
 - i. **About:** Contains information about the program.
 - ii. **Help Documentation:** Opens a PDF of the help documentation.

- iii. License Information: Contains information about the license under which DICOMToolbox is released.
- iv. Citing DICOMToolbox: Contains information about how to cite DICOMToolbox.

Running the Program

Import Images

Import DICOM images by either:

1. Clicking the *Import* control button.
2. File → Import.

Once the images are imported, filenames are displayed in the *File List* and a summary of all the tags is displayed in the *Tag Table*.

Redacting Images

DICOM images can be redacted in one of two modes using the *Redaction Mode* control buttons (individual or batch).

Individual

Only the file currently selected from the *File List* will be redacted based on a user-defined redaction triangle. To redact an individual file, ensure the *Individual* radio button is selected under the *Processing Options* area. Then, select the file to be redacted from the *File List* and click the *Redact* control button. Use the mouse cursor, which has changed into a small crosshairs, to select the region of the image to be redacted. Once selected, a message box will appear asking if the user approves the redaction. If no, the user can replace the redaction rectangle. If yes, the image will be written with the selected redacted. Only one redaction rectangle can be drawn at a time. Therefore, if more than one region of the image requires redaction, repeat the above process until all regions are redacted.

Batch

All images listed in the *File List* will be processed at once. An important assumption of this process is that all images of the same dimension (i.e., width and height) require the same redaction. To redact in batch mode, ensure the *Batch* radio button is selected under the *Processing Options* area. The program will first query the dimensions of all images. Then, the user will be prompted to use the mouse cursor, which has changed into a small crosshairs, to select the region of the image to be redacted. Once selected, a message box will appear asking if the user approves the redaction. If no, the user can replace the redaction rectangle. If yes, the process will repeat until redaction rectangles are defined for all unique image dimensions. Only one redaction rectangle can be drawn at a time. Therefore, if more than one region of the image requires redaction, repeat the above process until all regions are redacted.

Modified files will be exported to a subfolder named “Redacted” created within the directory specified during the import process. The original files are never overwritten. The redacted images retain the same DICOM tags as the original image. If necessary, edit tags using the *DICOM Tag Editor* module.

Clearing the Program

Clear the program by either:

1. Clicking the “Clear” control button.
2. File → Clear.

Closing the Module

Close the DICOM Viewer module by either:

1. File → Exit
2. Clicking on the “x” in the upper right corner of the window.

Once the DICOM Tag Editor module is closed, the main DICOMToolbox window will reappear.