Equipoise Toolbox Preliminary User Guide

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A. Summary

The Equipoise Toolbox consists of a set of image processing tools that can be used with ImageJ, a powerful, open-source image manipulation program that runs on Windows, MacOS X, and Linux operating systems. Image J contains a broad range of tools for acquisition and processing of images from digital devices such as cameras.

ImageJ allows for extensible programming through a Java-like macro language and a "plugin" architecture. Thorough documentation, examples, and tutorials are available through the ImageJ home website at:

    http://rsb.info.nih.gov/ij/

Equipoise Toolbox consists of tools implemented using both macro and plugin facilities. Its user interface relies on a further plugin, the "ActionBar", that was implementd and made available by Jerome Mutterer of the University of Strasbourg. ActionBar is described at:

    http://imagejdocu.tudor.lu/doku.php?id=plugin:utilities:action_bar:start

Equipoise Toolbox is a work-in-progress that is, by design, both unfinished and user-extensible. It makes use of existing plugins and macro commands that are available at the ImageJ home website. In particular, principal components analysis (PCA) utilizes an implementation authored by M. D. Abràmoff [M. D. Abràmoff, Y. H. Kwon, D. Y. Ts'o, H. Li, E. S. Barriga, and R. Kardon. A spatial truncation approach to the analysis of optical imaging of the retina in humans and cats. Proc IEEE International Symposium on Biomedical Imaging 2004 2:1115-1118, 2004]. Because Equipoise Toolbox is 100% open-source and community supported, it is hoped that users will adapt or extend it. No license is required to use or distribute it.

B. General usage notes

1. Installation

ImageJ must be present and installed on the user's computer before Equipoise Toolbox may be installed. Installation of ImageJ will create an ImageJ folder that in turn contains subfolders containing various essential and optional components. In particular, its "macros" and "plugins" folders are utilized by Equipoise Toolbox.

All components of Equipoise Toolbox are contained in a single zip archive ("Equipoise_Toolbox.zip") that is distributed by CD or by email from the author upon request. Questions regarding use may be emailed to Bill Christens-Barry, who may have time to respond.

The Equipoise Toolbox archive expands to a folder named "Equipoise Toolbox" that contains several subfolders. The name of each of these subfolders indicates where the items contained within them (both files and subfolders) are to be installed within the top level ImageJ folder. Installation of Equipoise Toolbox entails copying the _contents_ of each of the subfolders of Equipoise Toolbox to the so-named subfolders of the toplevel ImageJ folder. Please note that the subfolders of "Equipoise Toolbox" names "plugins" and "macros" are not themselves copied into the top level ImageJ folder; rather, their contents are copied.

Once installed, quit ImageJ if it is running and relaunch it. Once it has launched, the main ImageJ window and the Equipoise Toolbox "tool bar" window will appear, and are ready for use.

2. Use of Equipoise Toolbox tools

The Equipoise Toolbox tool bar consists of a set of operations that perform routine or specialized operations upon images and sets of images, especially those of interest in spectral imaging of cultural heritage materials.

Note that some of the tools in Equipoise Toolbox act on images that have already been opened; others direct the user to select the files (or directories) that are to be processed. Some tools produce new output files in locations and with names specified by the user. Others simply modify images that have already been opened. In no case does Equipoise Toolbox write over or modify an existing file. NB: please note that when quitting ImageJ, the user must decide whether to save changes to pre-existing files. If the user chooses to save changes without altering a different filename to be used, the original file will be overwritten.

Each tool in Equipoise Toolbox is invoked by the user by clicking on its icon in the tool bar. Several of the tools allow the user to optionally hold down a modifier key while clicking the tool icon; use of modifier keys allows the user to choose among several variants behavior of that tool.

The tool bar has a 3 x 10 (rows x columnms) layout. The top row contains icons for tools 1 - 10, the second row contains icons for tools 11 - 20, and the bottom row contains icons for tools 21 - 30. In the following description, tools may be referred to by number or by name.

Tools are loosely organized, from left-to-right, according to when they are typically used during processing. Tools toward the left are used early in the process of manip[ulating sets of specctral images; those toward the middle are most useful during the main processing stage; those toward the are geared more toward routine ImageJ environemntal operations.

3. The Tools

[Column 1]
Tool 1: Create a flattened "stack" of 16-bit monochrome images from a folder of ".DNG" files. The user is prompted to choose a folder that contains a sequence of spectral files and a folder that contains the corresponding "flats" files. Note that the names of these files must share a common root and must end in sequential 3-digit integers, beginning with "001". The output is a single 16-bit TIFF "stack" file having a name based on the root of the input filenames.

Tool 11: Convert a folder of images to an 8-bit stack image. Loss of precision occurs. No output is saved.

Tool 21: Convert a folder of images to a 16-bit stack image. No output is saved.

[Column 2]
Tool 2: Split an RGB image into 3 gray images, one per color channel. No output is saved.

Tool 12: Convert an 8-bit image (including a stack image) to 16-bit form. No output is saved.

Tool 22: Convert a 16-bit image (including a stack image) to 8-bit form. No output is saved.

[Column 3]
Tool 3: Linearly scale the intensity values of an image so that it spans the full range available. Accepts 8-bit and 16-bit monochrome images. No output is saved.

Tool 13: Linearly scale the intensity values of an image so that it spans a user selected range. Accepts 8-bit and 16-bit monochrome images. A panel for setting lower and upper thresholds is opened. After the user sets these thresholds and clicks "OK" in a dialog, the operation takes palce and the threshold panel closes. No output is saved.

Tool 23: Perform a local normalization of a 16-bit image (or stack), using a user-specified neighborhood size. This operation "whitens" data, as is often done before principal component analysis is performed. No output is saved.

[Column 4]
Tool 4: Convert a 3-slice monochrome stack into an RGB image. No output is saved.

Tool 14: Create an RGB image from slices 8 (red), 5 (green), and 2 (blue) of a monochrome stack. Note that the particular bands that are used is based on the order in which we acquire (and thus number) images in our standard spectral sequence.

Tool 24: Combinatoric RGB. From a monochrome stack containing N > 2 slices, a new RGB stack is created, in which each slice is created from a distinct subset of 3 slices of the original stack. This stack contains one RGB image created from different combinations of 3 slices. This stack is saved as a huge ".avi" video image (there are N!/((N-3)!*3!) slices).

[Column 5]
Tool 5: Perform principal component analysis (PCA) upon the active monochrome image stack. Each slice is pre-whitened by the tool. PCA utilizes the BIJ-PCA plugin (see: http://webscreen.ophth.uiowa.edu/bij/pca.htm). Several new output images are created, but no output is saved.

Tool 15: Tile-wise PCA. From a monochrome stack containing N>2 slices, a new RGB stack in which each slice is created from PCA on a subregion ("tile") of the original stack. A sliding window is used to This stack contains one RGB image created from the 3 dominant principal components determined for that tile. The user specifies how large each tile is to be and how far it is "stepped" for each calculation. The user must ensure that no tile overlaps the window boundaries, i.e that the size and step is commensurate with the image size. For small step sizes, the output image can be very large. This stack is saved as a huge ".avi" video image.

Tool 25: Combinatoric PCA. From a monochrome stack containing N > 2 slices, a new RGB stack is created, in which slices represent PCA analyses on distinct subsets of slices of the original stack. This stack contains one RGB image created from different combinations of 3 slices. This stack is saved as a huge ".avi" video image. (there are N!/((N-3)!*3!) slices)

[Column 6]
Tool 6: Textual transcription I: Create a transcription text window with tab-delimited columnn headings used in transcription analysis. No output is saved.

Tool 16: Textual transcription II: Record the upper left and lower right corner coordinates of a user-drawn rectangle in the transcription text window. The ImageJ rectangle ROI tool (leftmost tool in ImageJ's tool palettte) must be active and the rectangle ROI selected by the user before using this tool No output is saved.

Tool 26: Textual transcription III: Save a transcription text window as a file in a user-selected location.

[Column 7]
Tool 7: Convert all open windows to a stack. No output is saved.

Tool 17: Delete the active slice from the stack.

Tool 27: Display the previous stack slice. No output is saved.

[Column 8]
Tool 8: Convert the active stack to individual images. No output is saved.

Tool 18: Add a new slice to the active stack after the displayed slice. No output is saved.

Tool 28: Display the next stack slice. No output is saved.

[Column 9]
Tool 9: Make the main ImagJ window always stay frontmost ("stay-on-top") in the display. No output is saved.

Tool 19: Swap the G 9green) and B (blue) channels of an RGB image. No output is saved. Note that the user must keep track of which original data is in which channel, as multiple uses of the tool has much in common with the shell game. If the <alt> or <shift> key is held while launching the tool, different color channels are swapped (experimental).

Tool 29: Turn off the stay-on-top behavior of the main ImagJ window. No output is saved.

[Column 10]
Tool 10: Globally disable distance scale of images, so that coordinates are given in pixels. No output is saved.

Tool 20: Create a new "macro" text window. No output is saved.

Tool 30: Make the main ImageJ window active and frontmost. No output is saved.