User Guide CBCT Calibration Code

**Introduction to the different matlab files:**

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StandardCalc.m:

This is the main entry point for the script. In order to run the script, open this file in Matlab and click run. Once the script is open, it will as the user to select the directory of DiCOM files the user's local disk.

Selecting a directory of DiCOM files will allow the user to view the scans in the user interface (UI) of the code. The user interface contains buttons sliders that allow the user to do several things. The following is a list of the relevant items in the UI with a brief description of each:

* Display (right hand side of the UI): A view of the current DiCOM slice of the directory
* Slider Bar (upper left): Allows user to scroll through the DiCOM slides by dragging the slider
* View Buttons (below slider): User can change the orientation of the scans as desired by clicking any of the view buttons
* Calibration: Begins the Hounsfield unit calibration
* Change Image Set: Select a different DiCOM directory
* Radius: Allows the user to test out the distance between two points on the scan to know what radius they should select
* Select Pixel: Obtain the coordinate location of any pixel on the display
* Threshold Test:
* Mark 1 and Mark 2: Allow the user to select the beginning and ending DiCOM slices to be in their region of interest (ROI). These marks must be selected before using any of the functions
* Grayscale value measurement: Obtains an average value and a distribution of grayscale values for the selected ROI
* Hounsfield Unit Measurement: Used after calibration. Allows the user to get an average value as well as a distribution of Hounsfield units for a ROI

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DICOM2Volume.m:

This script iterates through each DiCOM file and constructs an array that contains directory of each format in an ordered fashion.

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Generate3dMatrixCBCT.m:

This script takes input from the DICOM2Volume script and constructs a three-dimensional array where each index represents a voxel and contains the grayscale value of the represented voxel.

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CircularAVG.m:

This script returns the average value pixel for the area of pixels defined by an X,Y and R location. This function averages values based on a given radius, all values within the radius will be averaged. This script also returns a distribution of all pixel values in the ROI.

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ModelView.m:

The purpose of this function is to allow the user to visual a region of interest in three-dimensions. This script takes a three-dimensional array which is used to generate Matlab Isocaps. The user may adjust what values of Grayscale values are in view by adjusting the slider at the top left of the UI.

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HUcalc4.m:

This is a standalone script that enables the user to easily calculate the predicted HU of HaPe standards based on percent-mass and the effective energy of the scanner.

**CALIBRATION**:

In order to calibrate the images using the standards, user should adjust the slider until the first standard is visible in the viewer, then the user should hit "Mark 1" to tell the program this is the first slice of interest. Then the user should adjust the slider until the last slice where the lowest density standard is visible. The user should then click "Mark 2." The user is now ready to start the calibration process. The user should click "Calibrate Using Standards." The program will then verify the first and last slices have been selected. For each of the standards, the program will provide a cursor for Region of Interest selection. The following process will be repeated for each of the three (or four) standards. Starting with the least dense standard, the first click will zoom in on the region of interest, while the second click will select the center of the area. The display will then move to the slice that was selected with "mark 2" command. After the region of interests are selected for the least dense standard, Matlab will prompt the user to enter a radius to be used for selecting region of interest. The user will then be prompted to scroll and select mark 1 and mark 2 for the next standard. Once this process has been completed for each standard, the program will show the user a sample rescale slope and intercept plot using the average values along with grayscale distributions for each standard. If this is acceptable, the user may opt to continue with the calibration process or restart. By continuing, Matlab will activate a parallel processing command, generate Gaussian distributions based on the grayscale values for each standard, and calculate 500,000 different rescale slopes and intercepts. These values will be saved and must be used when taking measurements with distributions.

**MEASUREMENTS:**

After calibration, the user may take a measurement by clicking the Hounsfield Unit Measurement button. Before this is done, the user must select the first and last slide to average over. This is done by clicking "Mark 1" and "Mark 2". Once this is done, the user must select the DiCOM directory in which the DiCOM files are stored. That file folder will open, and the user must select the .csv file titled “RS\_LIN\_VALS\_test.csv”. Then the display will show the first "Mark" and allow the user to select the center of the first circle to be average. The UI will then put the second "marked" slide into the view, the user will then select the center of the second circle. Once marked, the script will prompt the user to enter the radius of the circle. A graph will be displayed with the distribution of calculated HUs for the ROI and give an average value and standard deviation of the distribution.