

TURNING CDMAM: USER'S MANUAL.

To install this plugin, simply copy the file "Turning_CDMAM.class" into the "plugins" folder. This folder is automatically created after the installation of ImageJ, under the "ImageJ" folder. You will need to restart ImageJ to use this plugin. After restarting, open the menu option "Plugins" and you will see a new option, "Turning CDMAM".

Preconditions:

1. You need a CDMAM image open with ImageJ (Ver 1.38 or higher). Do not worry about the format: DICOM, TIFF, JPEG, etc. The plugin works with the memory map of the computer, not with the stored file.
2. The CDMAM image MUST be in the position showed in figure 1. Vertical and with the logo in the upper left corner.

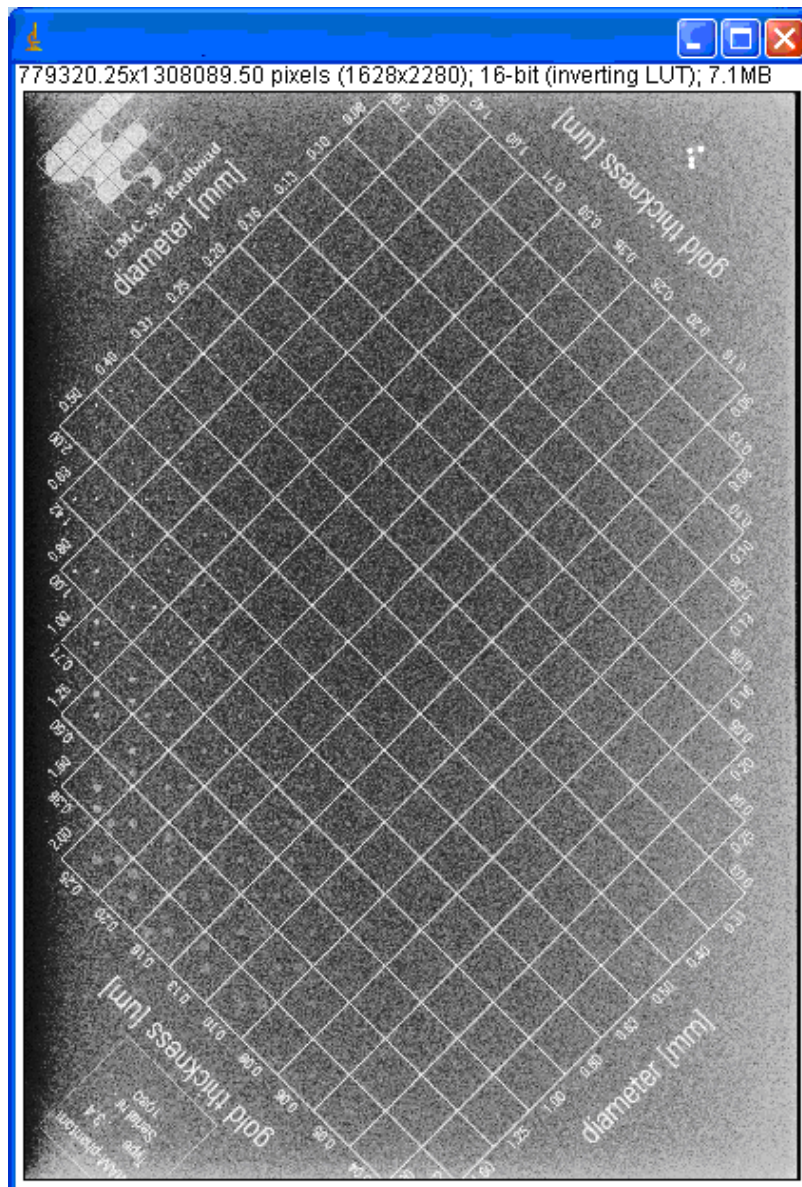


Figure 1

3. The image should cover with a low tolerance (less than 10%) the phantom. If your image is bigger than the CDMAM by 10-15% (as figure 2), you must crop the image to fit it with the CDMAM image.

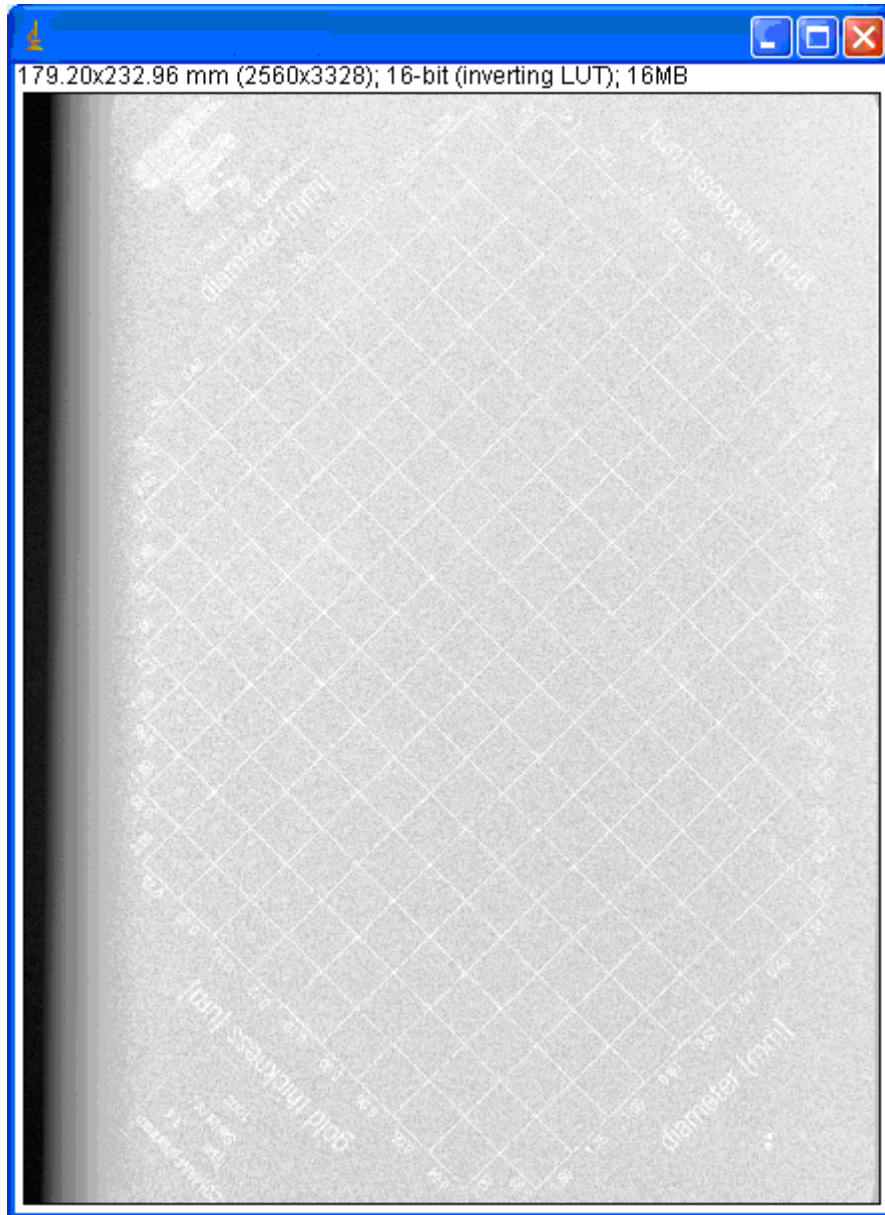


Figure 2

You can do it with the “Crop” function of ImageJ. Select a ROI with the option “rectangle” (figure 3) in the toolbar. This ROI must fit the CDMAM image. Now, select the menu option “Image” and, inside it, the option “Crop”. The selected ROI will fit the window.

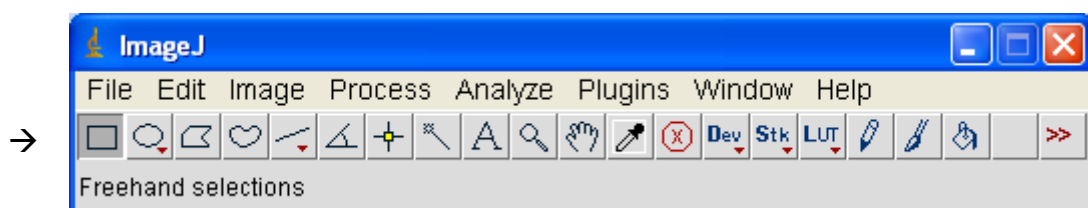


Figure 3

The algorithm works with or without any kind of image preprocessing. You do not need to improve the image quality to obtain a correct result. It can be used RAW images directly from the detector.

Screen showed in figure 4 will appear when the plugin starts:

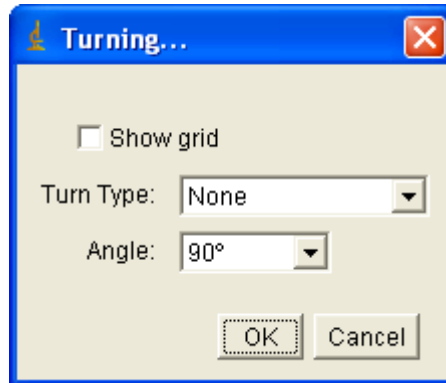


Figure 4

- ✓ If you do not mark or select anything, the program does nothing.
- ✓ If you mark “**Show grid**”, you can see in a new window the calculated grid over the original image. So, you can check the quality of the algorithm we use to match the grid, measuring the distance between the calculated crossing points and the actual ones. Usually, this value is not bigger than two pixels (usually is not “always”, of course).
- ✓ “**Turn type**” selects the method is going to be used to rotate the disks. The “Rhombus” option turns each cell as a whole rhombus around its central point. The “Four of diamonds” option creates a little rhombus around each disk in a cell (so, each cell looks like a “four of diamonds” playing card) and turns these little rhombuses inside each cell.
- ✓ “**Angle**” selects the rotation angle (90°, 180°, 270°, Random; always clockwise). Random means that the turn inside each different cell will be random (in steps of 90°, starting with 0°).

This version of the plugin does not turn the rhombuses that form the grid contour. We used this version mainly to evaluate if the algorithms themselves were not visible for experts, and experts remember very well the position of the disks in the grid contour. If you need to turn the upper row of the contour, use the plugin “Turn_extreme_CDMAM”. The plugin works similarly, but is not so proved and robust, because it evaluates the upper left edge of the phantom to find out the most external cells of the grid, and this edge of the phantom is usually very complex (with alphanumeric information, logotypes, background changes, etc.) A great level of this kind of structures can reduce our accuracy finding out the grid.

One tip more. If the image has a big gradient of light in any direction, our algorithms still work properly, but the results are very obvious for any observer. We have defined two ROIs inside each cell (see figures 5 and 6). If the difference between the mean

value of the pixels inside each ROI is greater than 2%, the manipulation is visible and this image could not be used to run out our test.

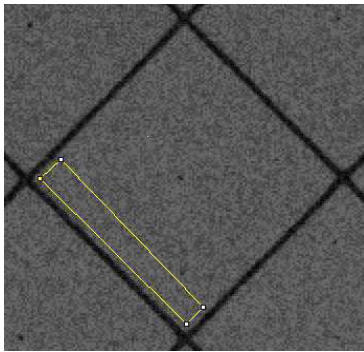


Figure 5

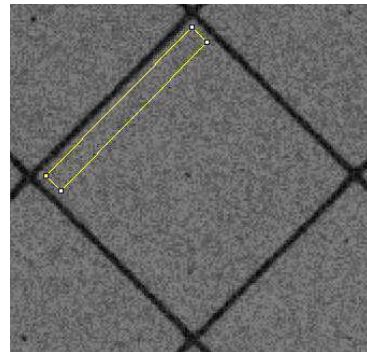


Figure 6

This limitation is a strong one related to the observer perception characteristics. Look at figure 7 and figure 8 to see an image with an obvious rotation.

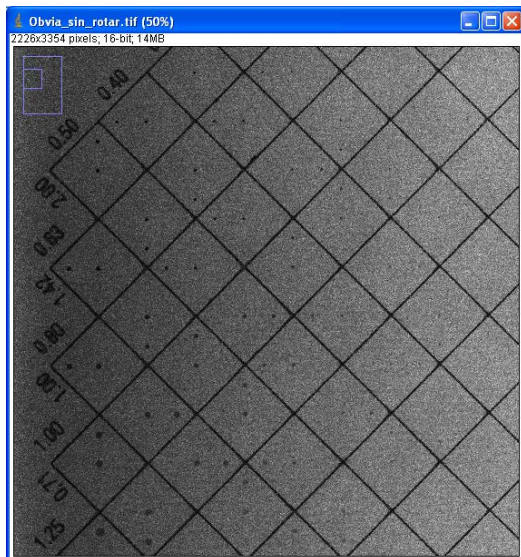


Figure 7. Original one

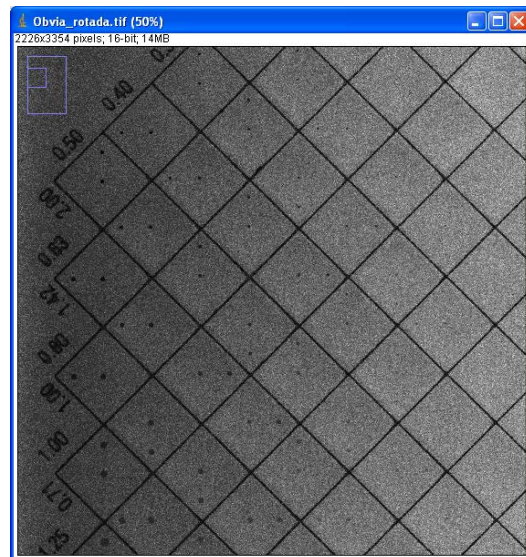


Figure 8. Obviously rotated

Main reference:

1. Gabriel Prieto, Margarita Chevalier, Eduardo Guibelalde. *A CDMAM image phantom software improvement for human observer assessment*. Elizabeth Krupinski (Ed) Digital Mammography. Springer, Berlin, pp. 180-187 (2008)

Please, refer to this web page as: Gabriel Prieto, Margarita Chevalier, Eduardo Guibelalde. "Turning CDMAM". Department of Radiology, Faculty of Medicine. Universidad Complutense. Madrid. SPAIN. https://www.ucm.es/gabriel_prieto/turning-cdmam

For any question, please, email to gprietor@med.ucm.es

Thank you very much.