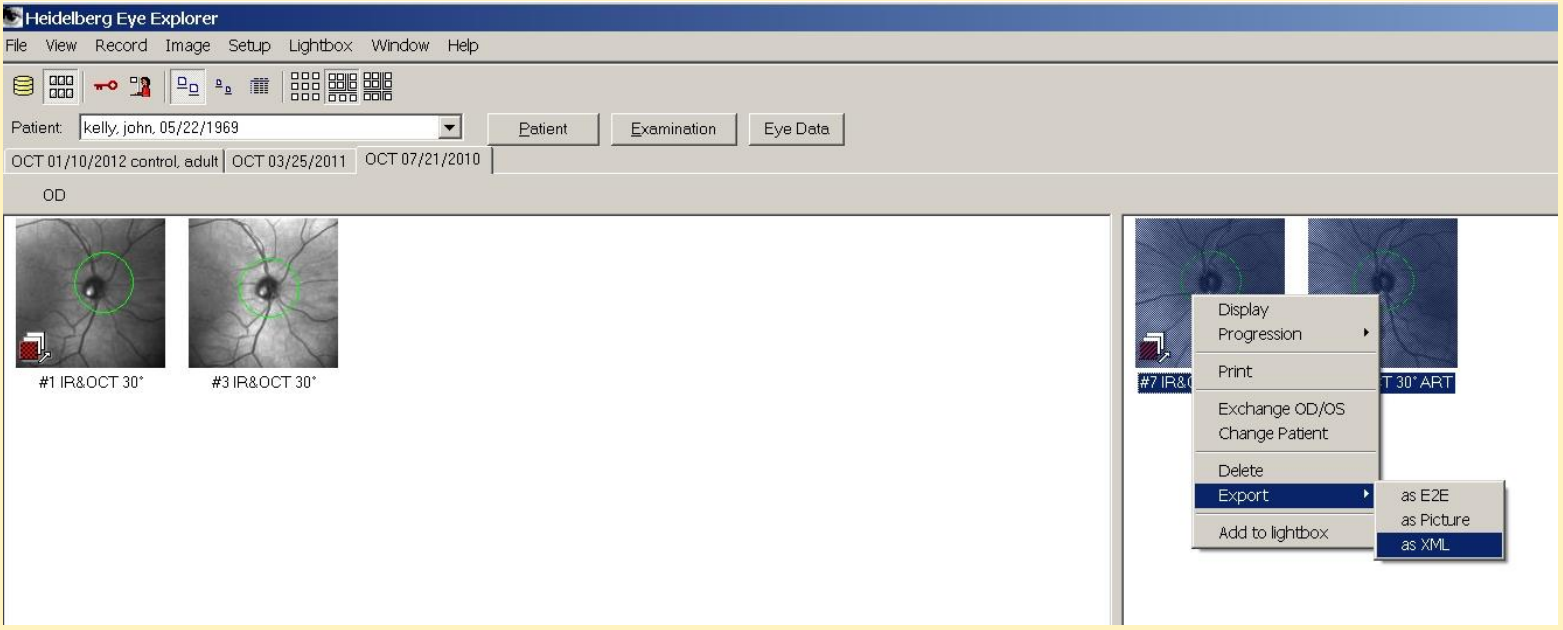
Tutorial

Requirements:
-Windows XP, Vista, Win7, Win10 (32 or 64 bit), monitor with 1920 x 1080 resolution or higher (You likely need admin privileges).

The entire program is stored in a compressed zip file. To install, simply open the zip file, and drag the contents to a folder where you will store the HEYEX export files (or to some folder on another workstation if you want). In this example we will be using the ***C:\ExportFiles*** folder.

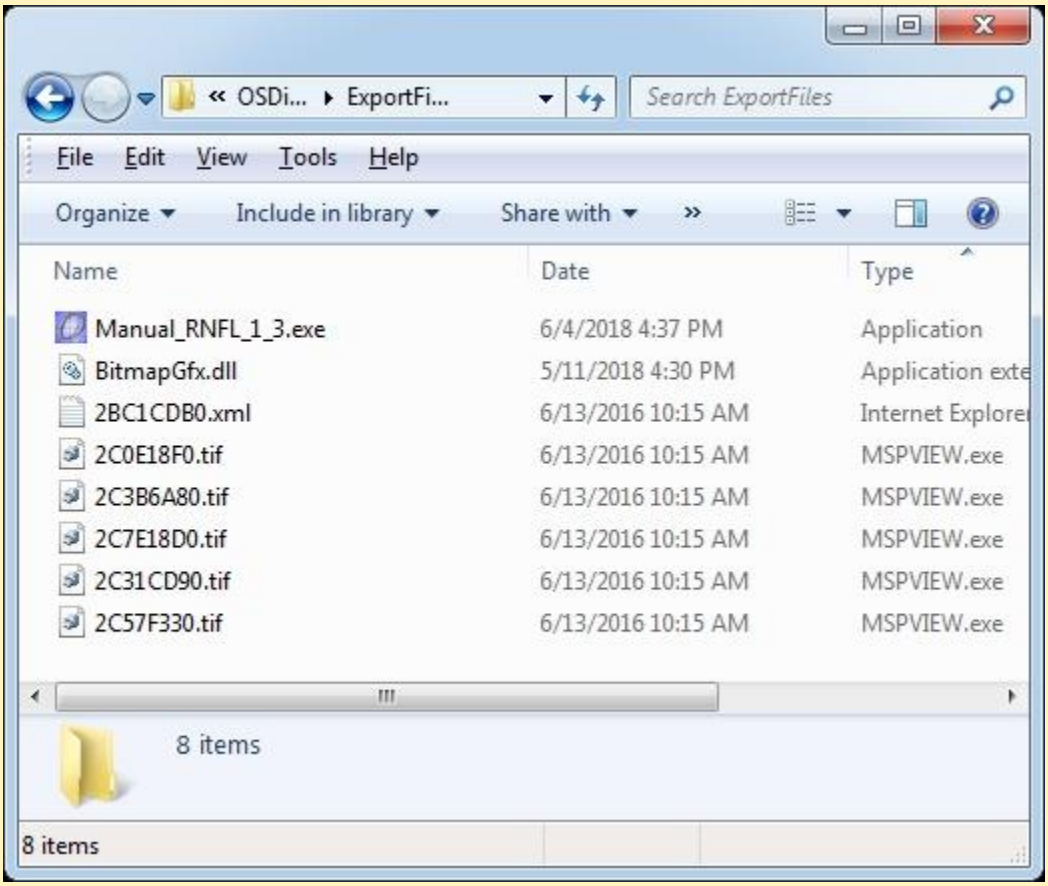
Now open an OCT data set in HEYEX. For instance we will open a set of scans from my left eye. Drag the mouse to select the scans then right-mouse click to export the scans in XML format:



If you don't see the XML option, then turn on the option in HEYEX (See instructions).

The exported files should be placed in the same folder as the app (Manual_RNFL_1_3.exe file). For this example I use the C:\ExportFiles folder, but any folder or flash drive is OK too). You should see a set of *.tif* and *.xml* files in the folder. You can repeat this again for more patients since the program can batch run through all exported files.

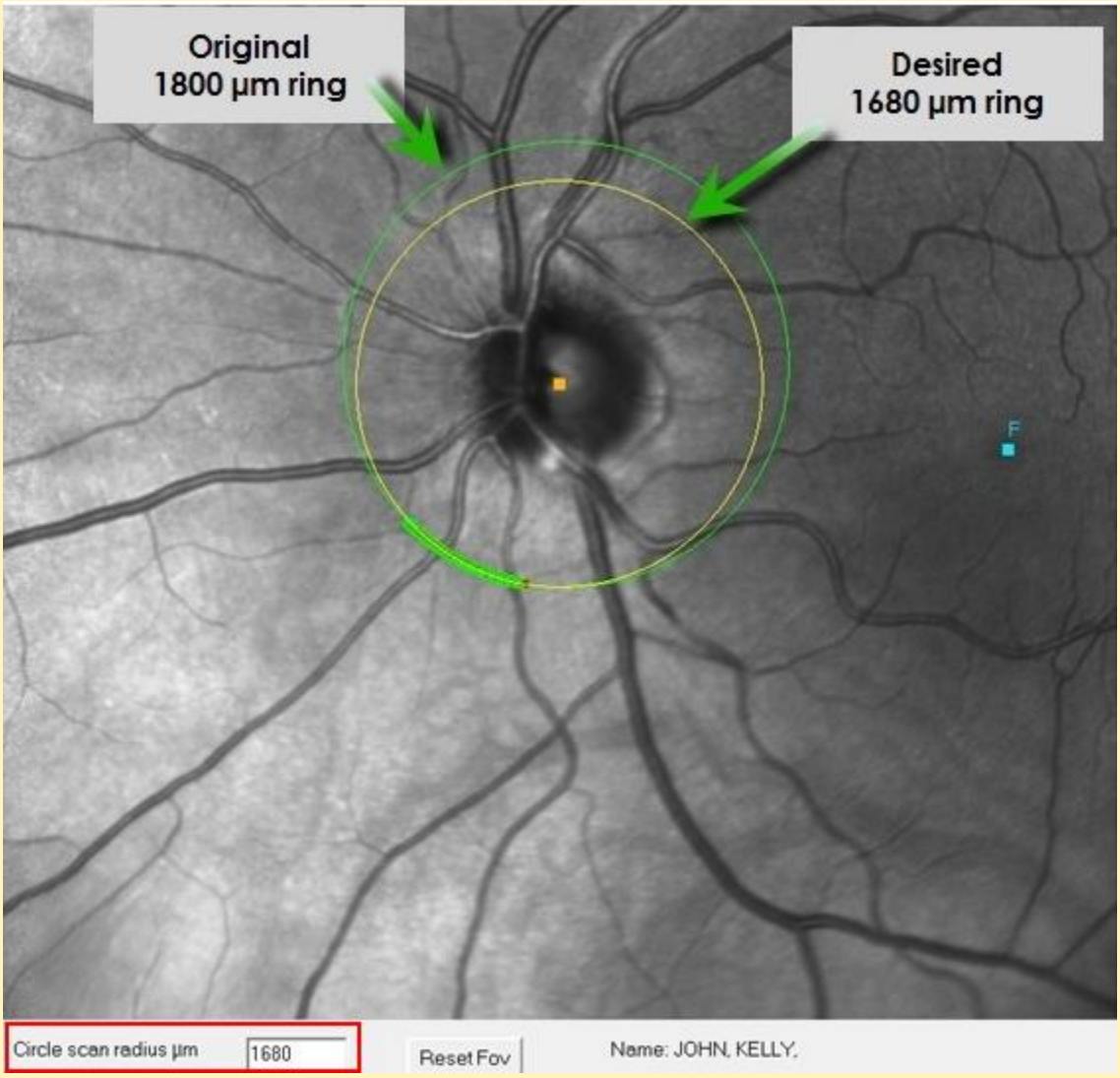
Now double-click the **Manual_RNFL_1_3.exe** to start.



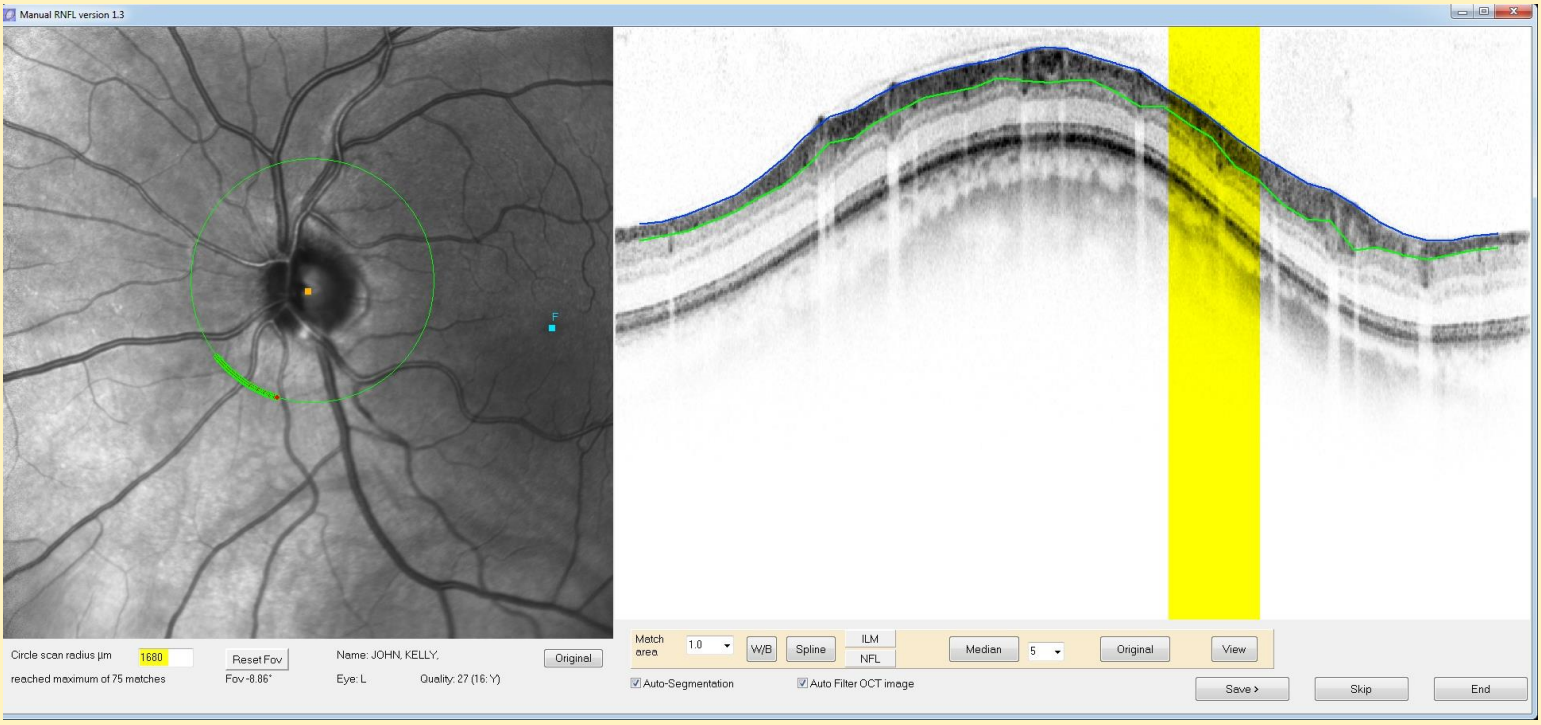
You will see this message if you did not export properly or copy the files. Make sure all exported files are in the same folder as the app.

The program should automatically detect the exported files and immediately start with the first exported scan. Left-click the mouse in the center of the optic disc. Now you will see a yellow square mark this location. While you hold down the mouse button, a yellow circle will be shown to demonstrate the desired circular scan. Right-click the mouse to set the location of the fovea. Now you will see a blue square and "F" mark this location.

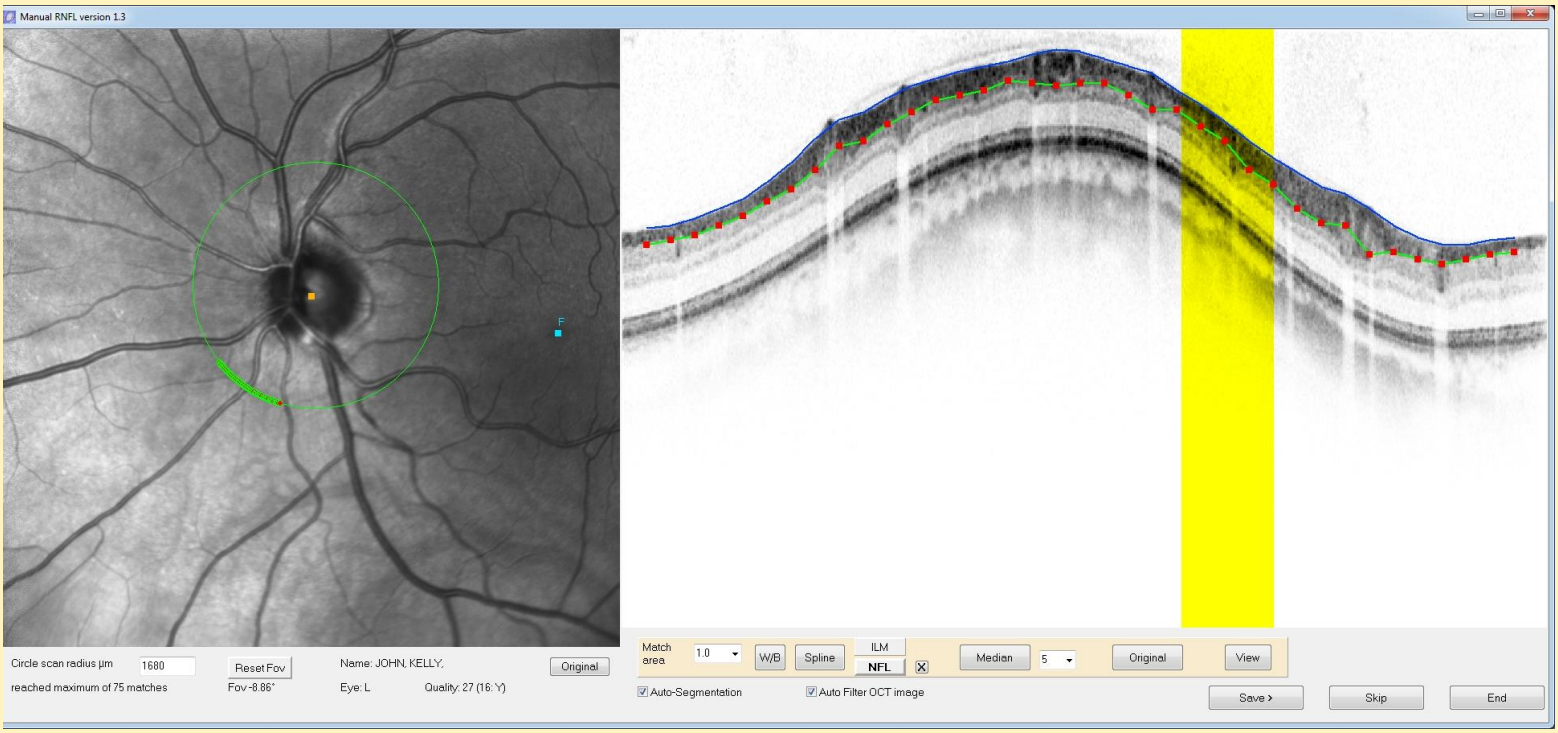
Notice we can set the size of the desired circular scan by entering the value in the box in the lower left (labeled **circular scan radius µm**). The initial value will be the radius of the actual acquired scan (that depends on your refraction). I have a smaller optic disc of 1330 microns. For this example, I scaled the desired scan to 1680 microns, then repeat my left-mouse click on the center of the optic disc to see the smaller ring



Now you see the yellow (desired scan) intersects with the actual scan. Matching areas are shown by the filled circles along the green circle scan. >



The corresponding match locations on the OCT scan are now highlighted in yellow. Because there are many matching locations, three buttons on the lower toolbar will become active ("**Spline**", "**ILM**", and "**NFL**"). These allow for a spline fit of the Internal limiting membrane and the nerve fiber/ganglion cell layer interface. The program will attempt automatic segmentation of the ILM/NFL boundaries (blue and green lines respectively). Click the NFL button (or click the green line) to edit the segmentation. You can click and drag the red position markers to custom fit the RNFL borders. Similarly you can edit the border of the internal limiting membrane by clicking the ILM button (or clicking the blue line).



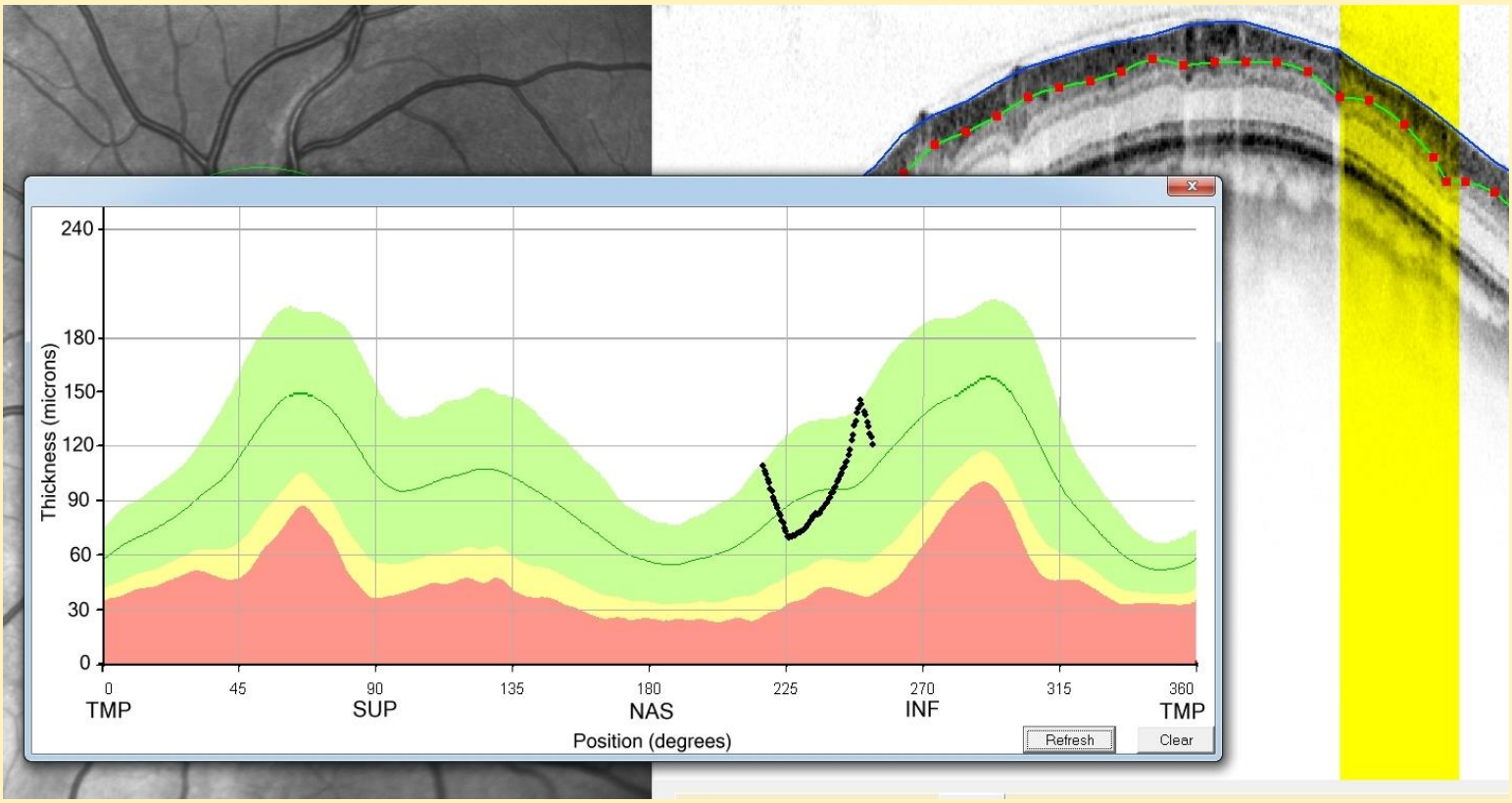
You can click and drag the red position markers to better align your manual segmentation (this process is similar to the manual adjustment in HEYEX software). If you double click on a position marker another position marker will be added next to it. Hold down the delete key and hover the mouse over a position marker to delete it.

What if the automatic segmentation does a poor job? The automatic segmentation is not optimized and therefore is prone to errors. You have several options:

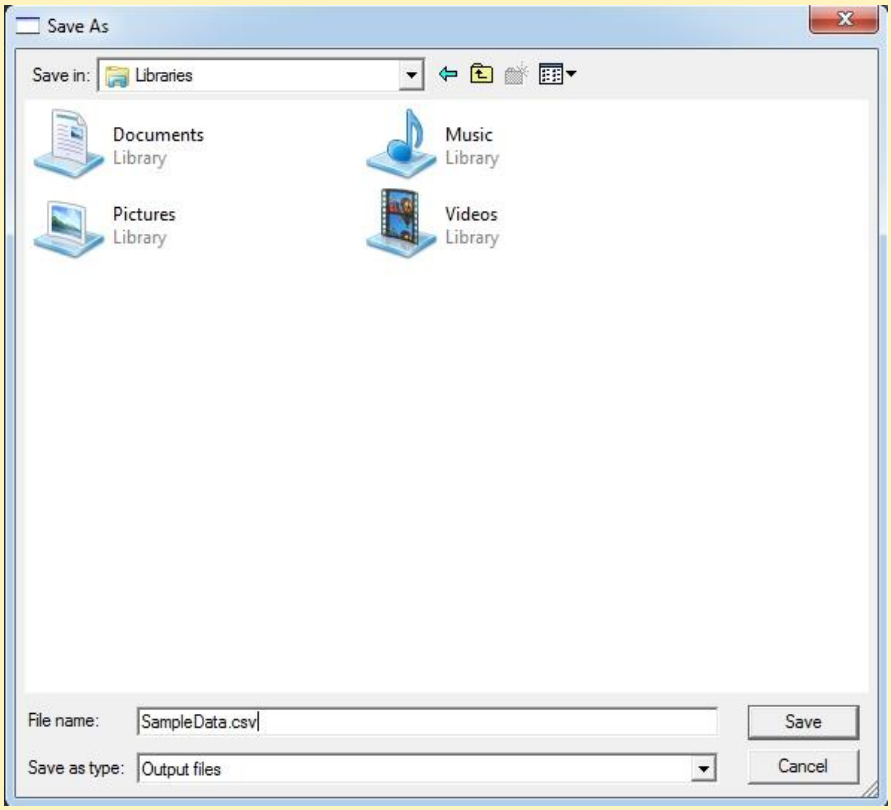
1) Delete the segmentation by clicking the "**X**" next to either the **ILM** or **NFL** button. Then you can manually draw a line along the ILM or NFL borders on the OCT image. The speed at which you draw the line sets a relative resolution. If you make a mistake don't worry, when you are done the program will automatically place position markers when you are done drawing.

2) Right-click and drag on the OCT image to change contrast and brightness (e.g., 'windowing'). After you finish a new segmentation will appear. You can click the "**Original**" button to revert back to the original image.

Now click the View button in the lower right tool panel. You will see the results of your manual segmentation plotted on the normative template (current norms as of Heidelberg Eye Explorer HEYEX viewing module version 5.4.6.0).



As you can see, the RNFL thickness falls in the normal range (glad to see that for my eye!). The data points at the matching location have been adjusted for the position (degrees) by using the currently chosen fovea location. Note that if you right click on the SLO image, the fovea will be relocated and the angle on the template will be automatically updated (Note that HEYEX may use an approximately 8 deg correction). If you change the position markers then click the "refresh" button to update the changes on the graph. If you want to keep the measurements then click the **Save** button. You will be prompted for a name of a text file to store these measurements. You can save it with a .csv extension for automatic opening in Excel or your favorite data analysis package.



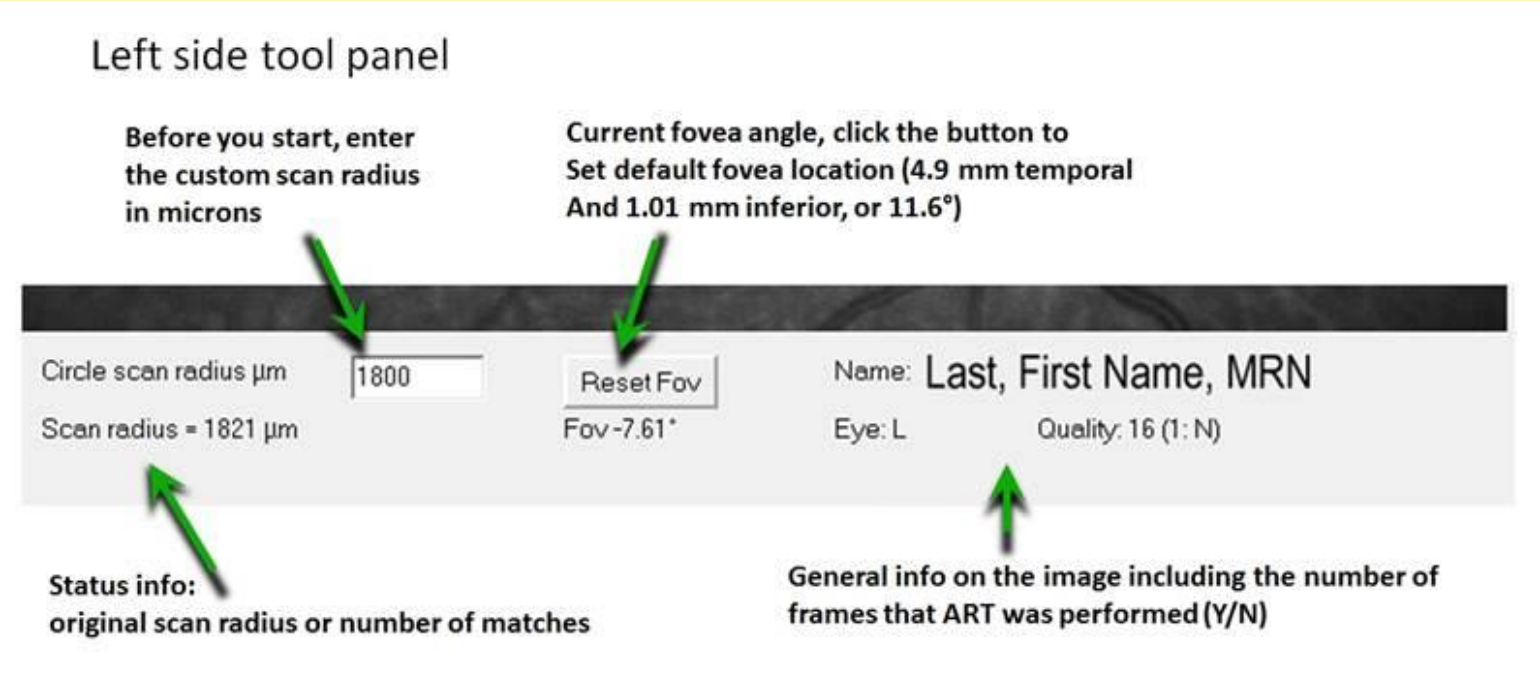
If you don't want to save, then click the "**Skip**" button. Either way (Save or Skip), the program will automatically load up the next exported image for you. You can repeat this process until all exported files are done. Similarly all measurements will be appended to the normative template via the View button and appended to the text file, if saved.

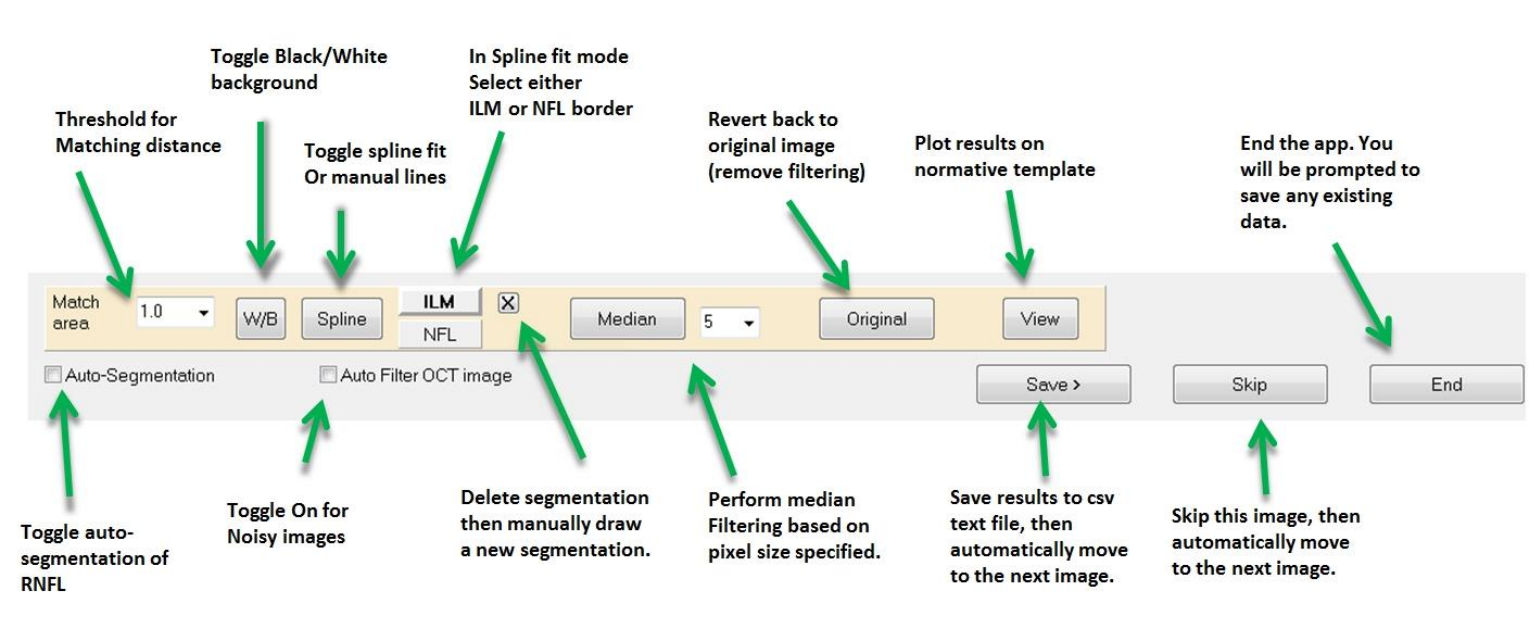
Ok, but what about line scans? Here we do the same process, but since it is a line scan we will have only 1 or 2 matching locations. Now there is no "Spline" button since we don't need it. We have to measure RNFL thickness at 1 or 2 discrete locations. Simply click and drag on each yellow line (the match locations) and a purple line will be drawn. Also you will be updated on the length in the lower tool panel. For example, for a patient image, I have drawn a line on the each match point (RNFL thickness was 41.6 microns on the left line).

Eventually you will finish all the exported images. After the last image you will see the message:

If you click No then the program will end. If you haven't already saved your data, a dialog box will appear to make sure your measurements will be saved. If you click Yes, you will be prompted again to make sure you want to delete all exported files (just the ones in this folder). If you confirm then the files will be deleted and the program will prompt you it is waiting for a new set of HEYEX exported files (see step 1 above).

Here is a review of the tool panel. It should be easy to understand if you work with HEYEX.





Format of the output file

When you click the save button, the program will store the values in an ASCII text file with comma delimited values. That means it can be read by many analysis programs that accept CSV files (like EXCEL, SPSS, etc.)

The fields in order are self descriptive as such:

LastName,
FirstName,
MRN,
Eye,
OriginalRadius_um,
NewScanRadius_um,
RNFL_Angle°,
RNFL_Thickness_um,
Disk_X,
Disk_Y,
Xpix_on_SLO,
Ypix_on_SLO,
Fovea_X,
Fovea_Y,
Fovea_ang°,
Focus,
Quality,
Met_PositionTolerance?