

Document name: **SOP\_VAMPIRE\_ANNOTATION\_TOOL**

Title: **VAMPIRE-Annotation Tool**

Author: **Ilaria Pieretti**

Version: **1.0**

## **1.0 Background:**

VAMPIRE (Vascular Assessment and Measurement Platform for Images of the Retina) is an international collaboration developing a software suit for efficient semi-automatic analysis of digital retinal images in clinical research. The project is coordinated by two leading groups, Dundee and Edinburgh. The VAMPIRE suite includes interfaces for annotating images, e.g., tracing regions or marking locations in digital retinal images. This is essential to allow clinicians to generate ground truth against which to compare the results of VAMPIRE algorithms. The process of comparing automatic and manual answers is called *validation*.

## **2.0 Purpose:**

The purpose of this document is to describe the procedure that the user must follow when using "VAMPIRE Annotation Tool: OD, Fovea, Junctions, Widths".

This Tool allows the manual annotation of the following retinal features:

- Optic Disc: small blind spot on the surface of the retina where the fibers of the retina leave the eye and become part of the optic nerve. It is the only part of the retina that is insensitive to light.
- Fovea: region of the retina with maximum density of photoreceptors.
- Junction: bifurcation of the blood vessels.
- Width: caliber of the blood vessels.

Attached to this document there is a video with a demo of the "VAMPIRE Annotation Tool: OD, Fovea, Junctions, Widths".

## **3.0 Procedure:**

### **3.1 User identification**



On the main screen top left side enter your name and specify if you are a clinician or not.

### **3.2 Selection of the annotation**

Immediately below by using a pop-up menu you have to indicate which is going to be your annotation path:

- (a) annotate a new set of images
- (b) annotate new points in already annotated set
- (c) annotate existing points in already annotated set

### 3.3 (a) Annotate new set of images



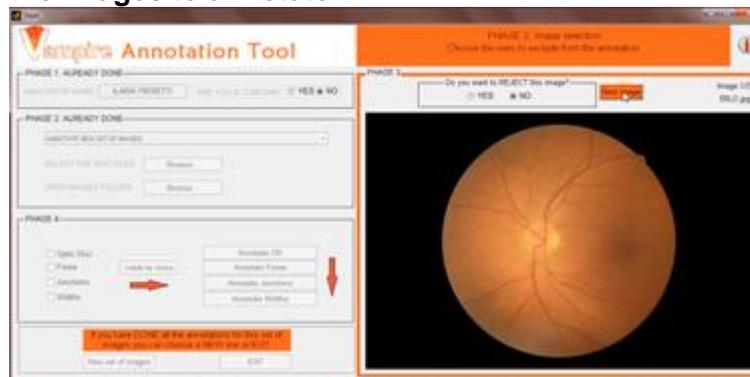
If you want to do a completely new annotation choose the first option of the menu.

### 3.4 (a) Choice of the set of images



On the main screen on the right side open the folder that contains the images to annotate pressing "Browse..".

### 3.5 (a) Selection of the images to annotate



Now choose which images of this set you want to exclude from the annotation (their quality is too low, they are not centered, etc.) ticking YES or NO. To go to the next image press "Next image".

### 3.6 (a) What do you want to annotate?



When you have completed the selection on the images of this set, you have to choose what to annotate of these images ticking the checkboxes on bottom left side of the screen. The annotation of OD and fovea for choice (a) is compulsory so their checkboxes are already ticked. Once the choice has been made press "I made my choice".

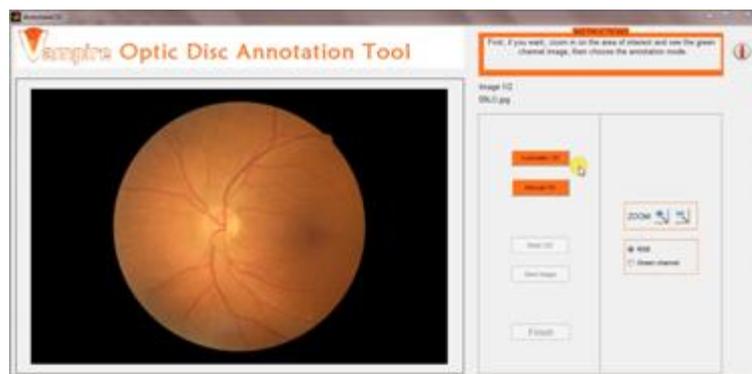
### 3.7 (a) Go to the sections of annotation



This will activate a menu just to the right, from which the user will be led to the screens of the annotations of OD, Fovea, Junctions and Widths.

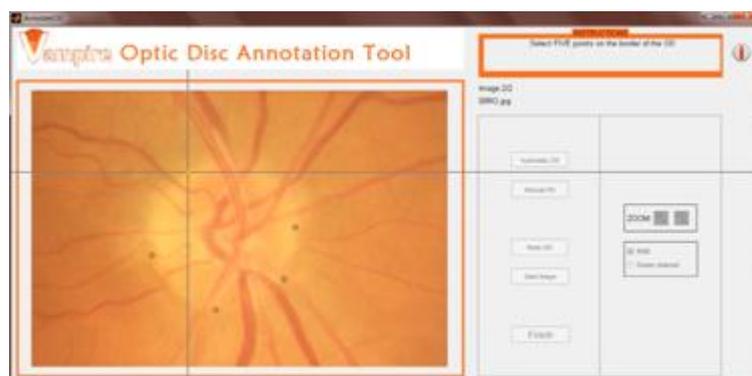
### 3.8 (a) Optic Disc Annotation Tool

#### 3.8.1 (a)



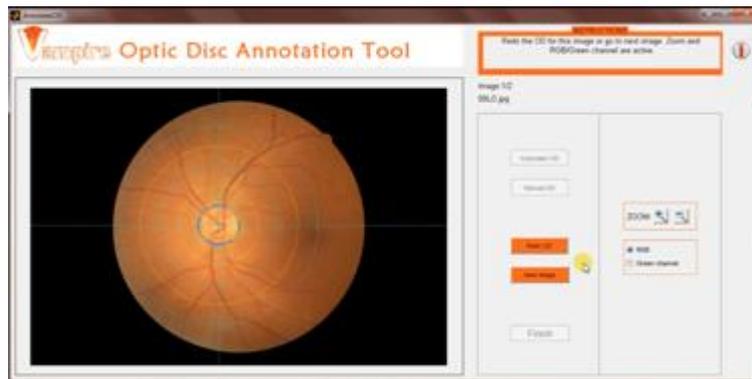
In this section you have to annotate the optic disc. You can choose to do it automatically. For the automatic mode press "Automatic OD" and wait until the calculated OD appears.

#### 3.8.2 (a)



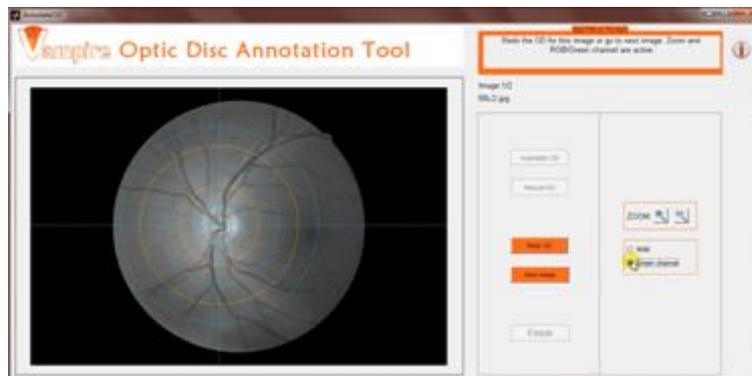
For the manual mode press "Manual OD" and then select five points on the edge of the OD.

### 3.8.3 (a)



When the ellipse appears, if you do not like it you can redo it (press "Redo OD"), otherwise you can go to the next image pressing "Next image".

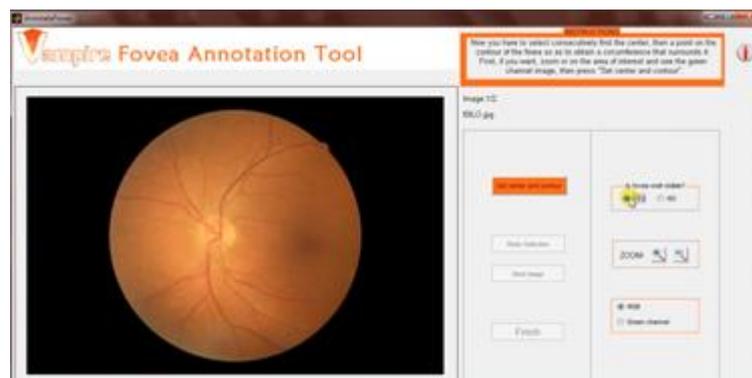
### 3.8.4 (a)



In this section (and also in the fovea, junctions and widths ones) at any time you can see the green channel image using the appropriate panel.

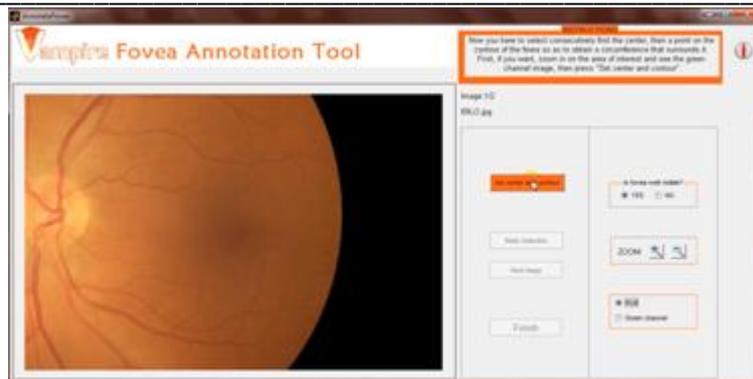
## 3.9 (a) Fovea Annotation Tool

### 3.9.1 (a)



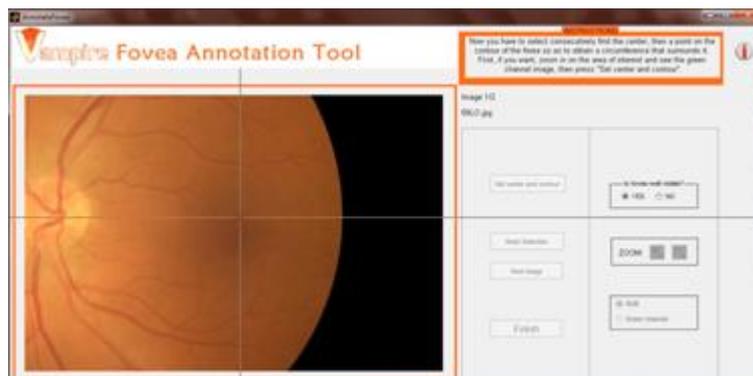
In this section you have to annotate the center and the contour of the fovea. First of all, you are asked if the fovea in this image is well visible or not. In this way you save the accuracy of the annotation you are going to do.

### 3.9.2 (a)



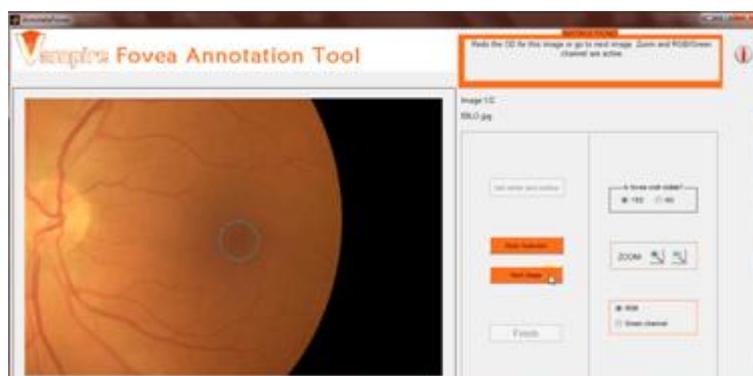
Before the selection of center and contour you have the possibility to zoom on the area of the image where the fovea is and/or see the green channel image.  
To select the center and the contour of the fovea press "Set center and contour" ...

### 3.9.3 (a)



... and then click on the image first on the center then on the contour.

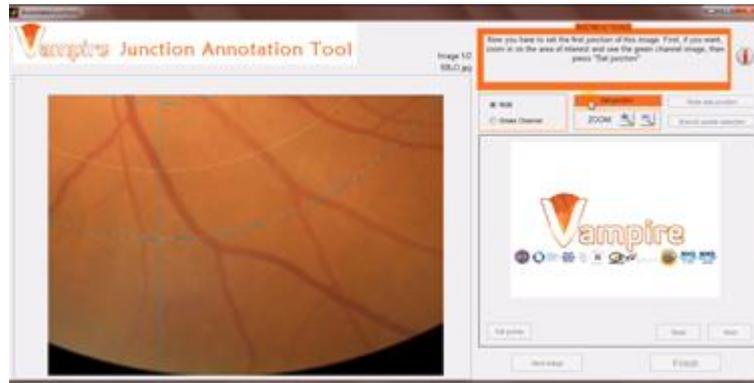
### 3.9.4 (a)



When the circle appears, if you do not like it can redo it (press "Redo Selection"), otherwise you can go to the next image pressing "Next image".

### 3.10 (a) Junctions Annotation Tool

#### 3.10.1 (a)



The first step is to select all the junctions of interest of this image. Before the selection of each point you have the possibility to zoom on the area of the image where the junction is and/or see the green channel image. To select each junction press "Set junction".

#### 3.10.2 (a)



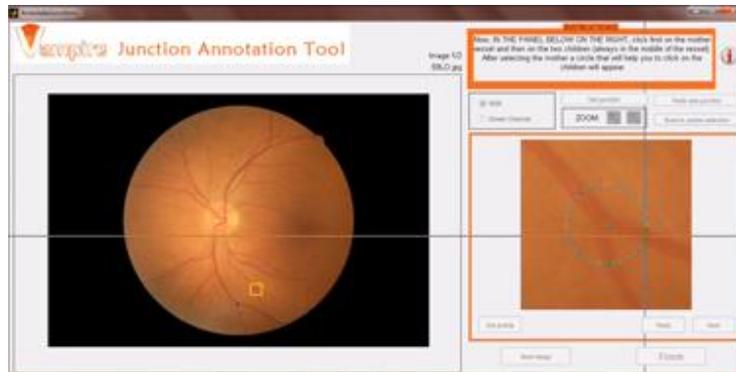
Then click on the image in the point you have chosen (to indicate a point belonging to a vein press simultaneously shift key while clicking and the point will appear blue, to indicate an artery do a simple click and the point will appear red).

#### 3.10.3 (a)



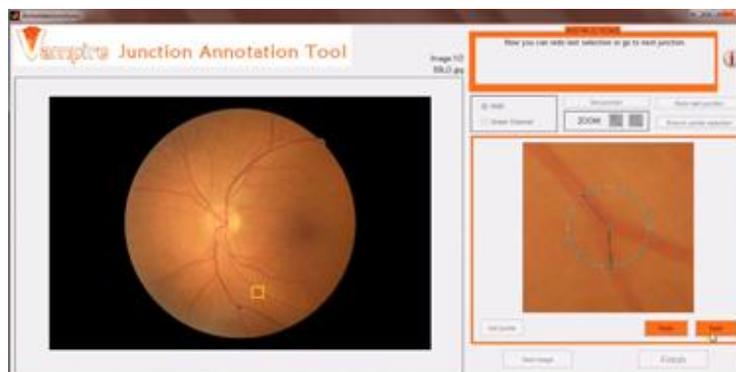
If you want to redo the last junction/s press "Redo last junction", otherwise set another junction on this image (press "Set junction") or, if you have selected all the junctions for this picture start the calculation of the angles (press "Branch points selection").

### 3.10.4 (a)



To calculate the bifurcation's angles you have to select (within the little screen just appeared on the right side) the three points belonging to the vessels involved in the bifurcation (first click on the mother vessel, then on the two children). At the same time a yellow square will appear in the big screen on the left to show you the junction you are working on.

### 3.10.5 (a)



If you do not like how you selected the three points you can redo them (press "Redo"), otherwise go to the next junction of this image (press "Next").

### 3.11 (a) Widths Annotation Tool

### 3.11.1 (a)



The first step is to select all the points where you want to measure widths in this image. Before the selection of each point you have the possibility to zoom on the area of the image where the vessel is and/or see the green channel image. To select each point press "Set point in the vessel".

### 3.11.2 (a)



Then click on the image in the point you have chosen (to indicate a point belonging to a vein press simultaneously shift key while clicking and the point will appear blue, to indicate an artery do a simple click and the point will appear red).

### 3.11.3 (a)



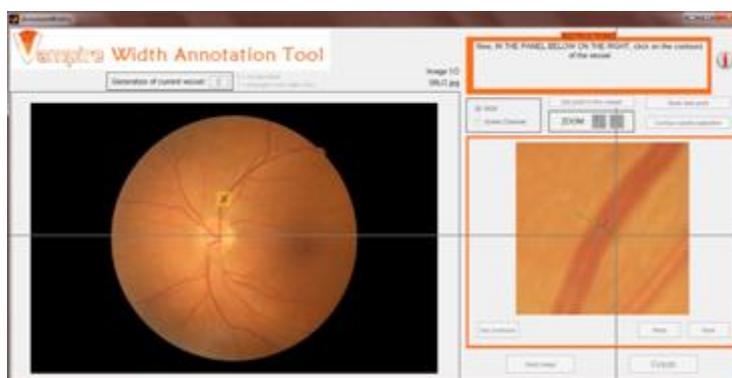
After selecting the point on the image, you can specify the generation of the vessel (where the point is) in the box above the picture.

### 3.11.4 (a)



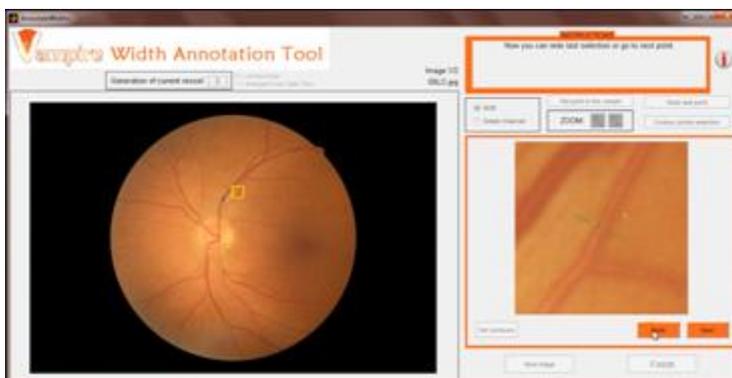
If you want to redo last point/s press "Redo last point", otherwise set another point on this image (press "Set point in the vessel ") or, if you have selected all the points for this picture start the measurement of the widths (press "Contour points selection").

### 3.11.5 (a)



To annotate the width you have to select (within the little screen just appeared on the right side) two points on the edges of the vessel near the point previously selected. A green line will appear through the selected points. It should match with the cross section of the vessel passing through the point within it; if not, it is advisable to reselect the points on the contour to have a better measure of width. At the same time a yellow square will appear in the big screen on the left to show you the point you are working on.

### 3.11.6 (a)



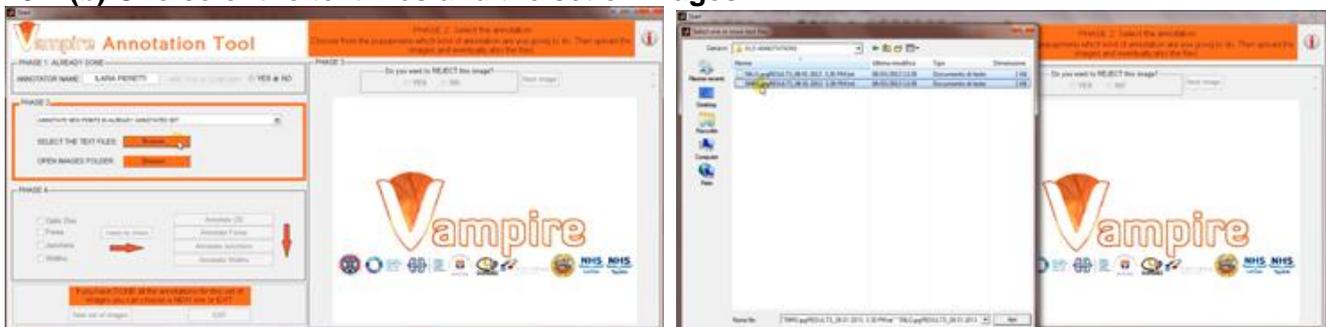
If you do not like how you selected the two points you can redo them (press "Redo"), otherwise go to the next point of this image (press "Next").

### 3.3 (b) Annotate new points in already annotated set



If you want to continue an annotation previously done adding new junctions/widths, choose the second option of the menu.

### 3.4 (b) Choice of the text files and the set of images



On the main screen on the right side upload the text files containing the old annotations pressing "Browse.." and selecting the files in their folder.

Look at the 3.4 (a) to see the part concerning the set of images.

### 3.5 (b) Selection of the images to annotate

The same as for the choice (a) so look at the 3.5 (a).

### 3.6 (b) What do you want to annotate?

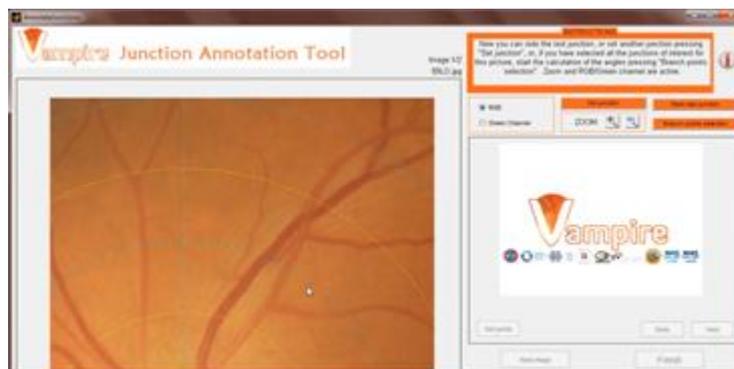
The same as for the choice (a) so look at the 3.6 (a). The only difference is that in this case the annotation of OD and fovea should NOT be taken so their checkboxes are NOT ticked.

### 3.7 (b) Go to the sections of annotation

The same as for the choice (a) so look at the 3.7 (a).

### 3.8 (b) Junctions Annotation Tool

#### 3.8.1 (b) - 3.8.3 (b)



The same as for the choice (a) so look at the 3.10.1 (a) - 3.10.3 (a). The only difference is that on the big screen the junctions annotated in the old annotation will appear shown as small crosses (instead the new ones always as dots).

### 3.8.4 (b) - 3.8.5 (b)

The same as for the choice (a) so look at the 3.10.4 (a) - 3.10.5 (a).

Note: only the new junctions are uploaded into the small screen on the right to measure the branching angles.

### 3.9 (b) Widths Annotation Tool

#### 3.9.1 (b) - 3.9.4 (b)



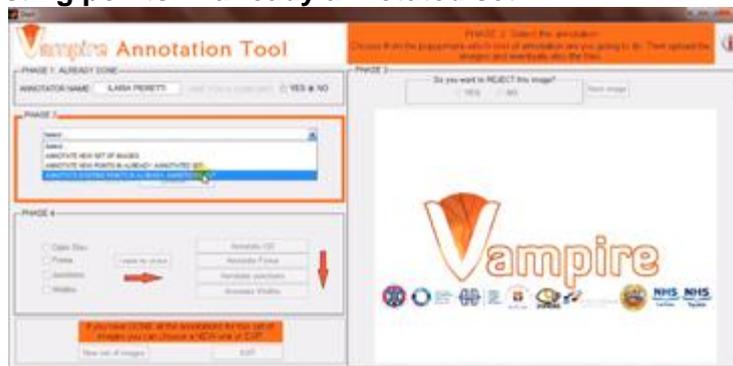
The same as for the choice (a) so look at the 3.11.1 (a) - 3.11.4 (a). The only difference is that on the big screen the points annotated in the old annotation will appear shown as small crosses (instead the new ones always as dots).

### 3.8.5 (b) - 3.8.6 (b)

The same as for the choice (a) so look at the 3.11.5 (a) - 3.11.6 (a).

Note: only the new points are uploaded into the small screen on the right to measure the width.

### 3.3 (c) Annotate existing points in already annotated set



If you want to redo an annotation previously done measuring again angles and widths in the old points, choose the third option of the menu.

### 3.4 (c) Choice of the text files and the set of images

The same as for the choice (b) so look at the 3.4 (b).

### 3.5 (c) Selection of the images to annotate

The same as for the choice (a) so look at the 3.5 (a).

### 3.6 (c) What do you want to annotate?

The same as for the choice (a) so look at the 3.6 (a). The only difference is that in this case the annotation of OD and fovea should NOT be taken so their checkboxes are NOT ticked.

### 3.7 (c) Go to the sections of annotation

The same as for the choice (a) so look at the 3.7 (a).

### 3.8 (c) Junctions Annotation Tool

Here the junctions on the big images are automatically uploaded (and plotted) from an old annotation so the tool skips directly to the part of the selection of the branching points on the little screen on the right.

#### 3.8.1 (c) - 3.8.2 (c)

The same as for the choice (a) so look at the 3.10.4 (a) - 3.10.5 (a).

### 3.9 (c) Widths Annotation Tool

Here the points on the big images are automatically uploaded (and plotted) from an old annotation so the tool skips directly to the part of the selection of the points on the vessels' contour on the little screen on the right.

#### 3.9.1 (c) - 3.9.2 (c)

The same as for the choice (a) so look at the 3.11.5 (a) - 3.11.6 (a).

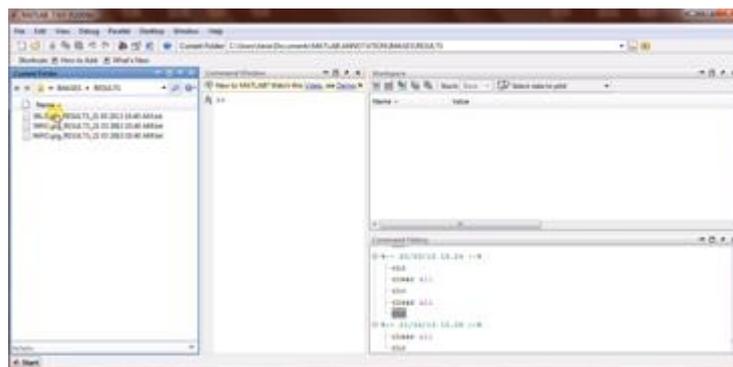
### 3.12 Chose another set of images or EXIT the Tool



After the whole annotation of the first set of images, you can select another set of images (press "New set of images") or you can exit the tool (press "EXIT").

## 4.0 The output text file:

The program returns in output one text file for each image of the set. This files are automatically saved in a folder called "RESULTS" created automatically in the folder of the images.



The name of the file is always like: *ImageName\_RESULTS\_DateAndTime.txt*

The file contains information about the user, the image and the annotations taken.

In the first line it is always shown if the image has been processed ('PROCESSED') or if it has been rejected ('NOT PROCESSED') by the user.

In the second line you can always find the name of the image, information about the user (name and belonging to the clinicians), date and time of the annotation, information about the annotation of OD and fovea (annotator and date and time that can coincide with the first -choice (a)- or not -choice (b) and (c)).

If the image has been processed by the user, from third line onwards you can find:

-third line: always information about the OD. Cartesian coordinates of its center, the two radii and the coefficient theta of the ellipse that fits the OD.

-fourth line: always information about the fovea. Cartesian and polar coordinates of its center, the radius.

From fifth line onwards you can find information about junctions and widths (depending on the case the number of

junctions and widths could range from zero to many):

- junctions: Cartesian and polar coordinates of the point in the center of the junction, the type of the vessel (vein or artery) where the junction is, Cartesian coordinates of the three points belonging to the three vessels involved in the junction, the three bifurcation angles.

-widths: Cartesian and polar coordinates of the point within the vessel where you measured the width, the type of the vessel (vein or artery) where the point is, the width and the generation of this vessel.

```

Editor - C:\Users\ilaria\Documents\MATLAB\ANNOTATION\IMAGES\RESULTS\84RO.jpg_RESULTS_21_03_2013_10.40 AM.txt
File Edit Text Go Tools Debug Desktop Window Help
Stack: Base - fx
1 NOT PROCESSED
2 Image:84RO.jpg, annotator name:ILARIA PIERETTI, Not a clinician, date and time:21 03 2013 10.40 AM, OD and fovea annotator:ILARIA PIERETTI, date and time OD and fovea annotation:21 03 2013 10.40 AM
3

```

```

Editor - C:\Users\ilaria\Documents\MATLAB\ANNOTATION\IMAGES\RESULTS\59RO.jpg_RESULTS_21_03_2013_10.40 AM.txt
File Edit Text Go Tools Debug Desktop Window Help
Stack: Base - fx
1 PROCESSED
2 Image:59RO.jpg, annotator name:ILARIA PIERETTI, Not a clinician, date and time:21 03 2013 10.40 AM, OD and fovea annotator:ILARIA PIERETTI, date and time OD and fovea annotation:21 03 2013 10.40 AM
3 OD: Xc:1901.9, Yc:1199.4, radius1:152.0, radius2:158.3, theta:0.6, annotationType:Manual
4 FOVEA: Xc:1154.9, Yc:1259.9, thetaOD:97.2, thetaODfov:90.0, rhoOD:793.4, thetaIC:99.9, rhoIC:622.8, radius:72.8, visible:YES
5 JUNCTION: Xj:2211.2, Yj:698.8, thetaOD:324.3, thetaODfov:319.0, rhoOD:187.8, thetaIC:313.4, rhoIC:664.8, vesselType:A, Xc:2192.3, Yc:728.9, Xc1:2199.1, Yc1:658.6, Xc2:2247.1, Yc2:684.3, phi1:136.8, phi2:91.0, phi3:132.2
6 JUNCTION: Xj:2199.0, Yj:861.2, thetaOD:915.7, thetaODfov:308.4, rhoOD:417.0, thetaIC:302.0, rhoIC:548.4, vesselType:V, Xc:2160.5, Yc:893.9, Xc1:2201.1, Yc1:815.6, Xc2:2239.6, Yc2:873.0, phi1:120.5, phi2:94.2, phi3:145.4
7 WIDTH: Xw:2173.2, Yw:1429.2, thetaOD:225.2, thetaODfov:219.0, rhoOD:382.9, thetaIC:239.1, rhoIC:524.5, vesselType:A, width:10.9
8 WIDTH: Xw:2107.7, Yw:1466.8, thetaOD:213.9, thetaODfov:204.6, rhoOD:370.1, thetaIC:230.3, rhoIC:493.2, vesselType:V, width:16.8, generation:1
9

```