# A Quick User Guide for  2D Vessel Measurement

A vessel analysis usually starts from vessel segmentation and centerline extraction. We have built a coronary CTA segmentation wizard for such purpose; for more information about that we will refer you to http://www.osirix-viewer.com/CTA_Plugin/index.htm. We are also trying to provide a non-click coronary segmentation and centerline tracking solution. Although it is still a work in progress, more tests and improvement are needed, please feel free to try the "autoseeding" function from the plug-in menu.

In this instruction, instead of using the wizard we start with manually creating vessel centerlines, just to show what alternative methods you have to perform vessel analysis in OsiriX.

## Creating Centerline Manually

Open "2D View" and switch to "CPR mode" by choosing the tab view in the left upper area.  Click "create a centerline" button. Your mouse will work as an "Open Polygon" tool in the left bottom MPR view,o click along the vessel while scrolling and rotating the view with the sliders around the view. Remember to click "Finish Centerline Editing" when it is done.

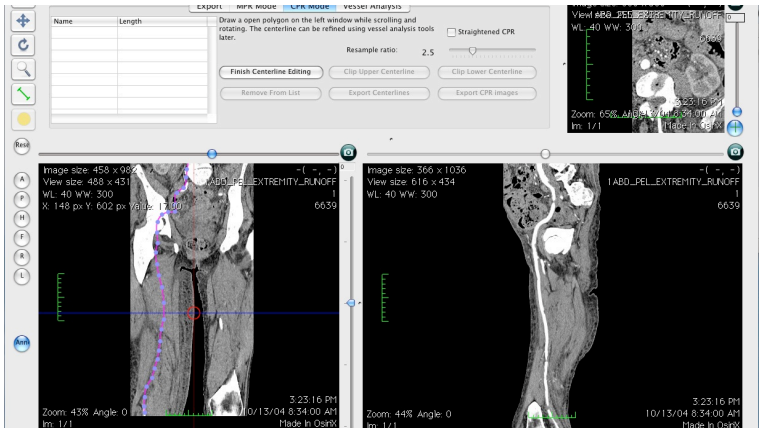


Figure 1. To create a centerline manually, you need to draw an open polygon in the left bottom view.

Tips: hotkeys "M" "Z" and "O"(for move, zoom and opened polygon tool) are very useful during the manually centerline tracking.

## Interface of 2D vessel analysis

Switch to "vessel analysis" mode by changing the tab view again.

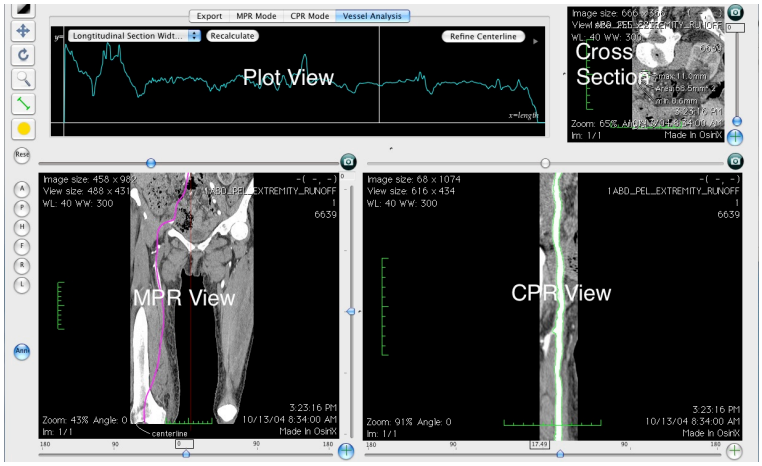


Figure 2 user interface of the vessel analysis tool, the size of each view can be changed by dragging the split bar between them

The four sub-views are “plot view” which shows the quantitative measurement along a vessel, “cross section view”, “straightened CPR vies” and “MPR view”. The cross hair in MPR view and reference line in the CPR view will be automatically updated when you scroll the cross section view.

## Using Plot View

The *x* coordinate of the plot is the distance from the starting point of the centerline. The *y* coordinate can be changed by selecting different label from the pop up list in the left top corner. “Longitudinal Section Width” means the horizontal distance between the two edges along the vessel’s longitudinal section (showing in the straightened CPR View). This value can be treated as one direction diameter of the vessel if the centerline is perfectly centered. The “Cross Section Shortest Diameter” and the “Cross Section Area” measured from the right “cross section view” of the vessel are more reliable than “Longitudinal Section Width”, but might still be questionable where sharp distortions appear on the automatically/manually created “centerlines”, which is often the case at bifurcations or segments with heavy calcifications.

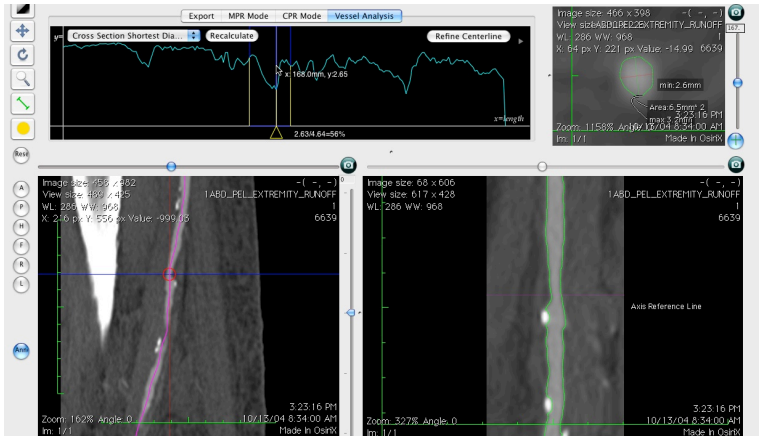

Figure 3 Using Plot View. *y* is set to shortest diameter of the cross section; 2.63/4.64=56%, 2.63 is the *y* value at the yellow line pointed by the triangle; 4.64 is the mean value of the yellow lines on left and right hand.

Clicking inside the plot view will bring the corresponding cross section image at current *x* coordinate to the "cross section view" on the right. Dragging mouse inside the plot view will show the ratio of the *y* values at the start and end location, which may suggest the percentage of stenosis at the end location compared to the start location. Furthermore, dragging the yellow triangle below *x*-axis will change the comparison with one reference to a comparison with two references, which gives the percentage of stenosis compared to the mean value of two reference locations (start and end lines of the rectangle above *x*-axis, see example in Figure 3).

**Important: Interpret the numbers at your own risk. The plug-in only gives the measurement of the 2D contour you see in the longitudinal/cross section view.**

### Segmentation method and parameters

The algorithm used here for 2D section contour segmentation is threshold level set from ITK (http://www.itk.org). It might be likened to a region growing method but using a curvature factor to constrain the evolving surface to be smooth and therefore preventing "leaking". For more information please read "ITK User Guide" chapter 9.3.

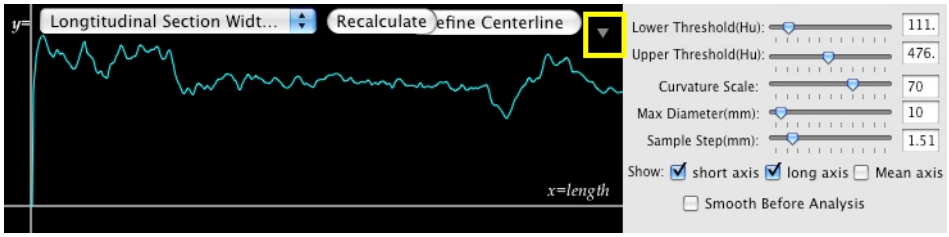


Figure 4 Clicking on the small triangle button will show/hide the parameter for the segmentation algorithm.

Clicking on the small triangle in the right top corner of the plot view, you will see all the parameters you can change. Besides the first 3 parameters for the level-set method, "Max Diameter" is like FOV of the cross section segmentation procedure – reducing it will speed up the cross section analysis. "Sample step" controls how often the segmentation is performed along the centerline.

Recalculate Button: After parameters have been changed, the cross section view will be updated in real-time. But neither the longitudinal section view nor the plot view will be updated. Use this button to force the program to recreate those data.

## Using Repulsor


Figure 5 Using “repulsor” to correct the vessel contour manually

In addition to tuning those parameters, we have taken the advantage of the lovely “repulsor” tool of OsiriX to provide users the ability to correct the segmentation results manually. A limit of the current version is that the changes in the “cross section view” will NOT be shown in the plot view. But the plot of “Longitudinal Section Width” and the diameters shown in the “cross section view” will be updated when you release the mouse button.

## Refine Centerline

Manually/automatically created centerlines sometime are not perfectly centered, as showing in Figure 2, which may affect the accuracy of the 2D measurements. The “refine centerline” function is designed to correct those errors. If, in the plot view, *y* is set to “Longitudinal Section Width”, the new centerline will be created by calculating the centerline of the 2D auto-segmented or repulsor-corrected contour. If *y* is set to anything else, the new centerline will be created by connecting the mass centers of all cross section contours along the vessel, which will take longer time.

## Export Results

Use the “camera” button in the right top corner of each sub-view to capture shown images. All images listed in the “Export” tab will be automatically saved into one series when the window is closed.

If you want to export all cross-section images, switch the tab view directly to “Export” tab, and choose “batch export” button. “Polygon Measurement” tool in the plugin menu is designed to perform analyses on these exported cross section images.

## Auto-saving

All centerlines created in the plugin will be automatically saved to “./OsiriX Data/ CMIVCTACache” folder when the window is closed. It will be deleted if it has not been used for 10 days. To change the auto-cleaning period, go to the “Auto-seeding” menu and choose “Advanced settings”