

Exercise 48 : Tree Analysis In Depth Examination of Coronary Arteries

The Tree Analysis module allows users to take an in-depth look at tree-like structures in medical images, such as coronary arteries. Branching angles, segment lengths, and cross sectional areas can all be measured with the module. This exercise will demonstrate how to use Tree Analysis to create, review, and sample a coronary tree.

Tree Generation



1. Load the **Coronary_CT.avw** data set from the **\$(\BIR\images\TutorialData** directory.
2. Open the **Tree Analysis** module (**Measure > Tree Analysis**).
3. Open the **Slice** window (**Generate > Slice**) and set Slice to 64.
4. Open the **Generate Tree** window (**Generate > Generate Tree**).
5. Set the **Threshold Minimum** to **130** and **Maximum** to **255**.
6. Since the thinning algorithm used in the tree generation process is sensitive to holes within structures it is advised that the **Fill Holes** option always be left checked.
7. Leave the **Shortest Skeleton Branch** and the **Maximum/Minimum Tree Length** fields as their defaults.
8. Set the **Approximate Root Location** values to **X: 56, Y: 69, Z: 125**. Note that you can also set the Approximate Root Location by clicking in the main module window.
9. Click **Generate Tree**. The Tree Plot window will automatically be returned when the extraction is complete. The Tree Plot window can be used to view the trees generated and provides a number of tools for in-depth analysis of the structures.

Tree Display Options

10. To view the trees generated in the extraction process, use the Tree drop-down menu [A] in the Tree Plot window. Select **Tree 2**.
11. Select all four of the **Views** buttons [B] to display the left, top, right and bottom views of the tree.
12. Check **Render** [C] from the Display options at the bottom of each window. A MIP rendering will be displayed behind each view of the trees. Experiment with the different Label and Display options.

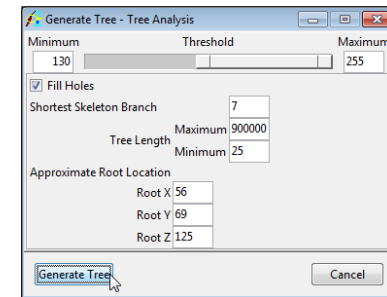


Figure 1

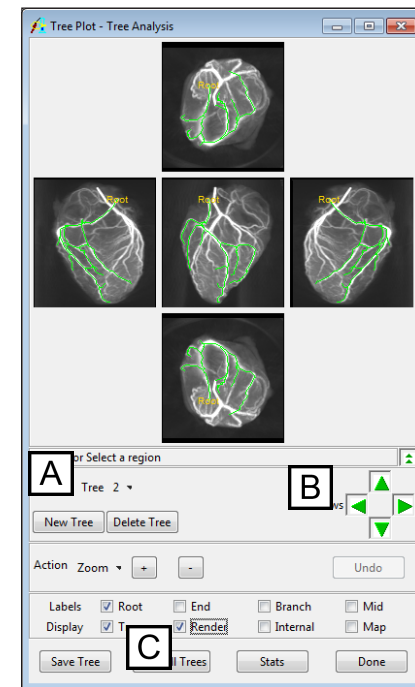


Figure 2

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13. Several of the Action options can also be used to manipulate the tree display. With **Action** set to **Zoom**, click the **+** and **-** buttons to increase or decrease the tree display size. To magnify a specific area in a tree, click and drag a rectangle over the area in any of the displayed views.
14. Now, set **Action** to **Rotate**. Click in any of the views and drag the tree to a new rotation angle.
15. To return all views to their default display, right-click on any of the views and select **Reset**.

Tree Manipulation

16. A new tree can be added by clicking the **New Tree** button. With **Action** set to **Add Point**, construct the new tree by drawing branches over the rendering in any of the views. The Add Point action can also be used to add branches to an existing tree.
17. An entire tree can also be deleted by selecting the **Delete Tree** button. Click **Undo** to recover deleted trees.
18. To only delete branches from a tree, set **Action** to **Delete Branch**. Click on a branch in any one of the views to delete it, all branches below it will also be removed from the tree.
19. Set **Action** to **Distance to Root** and check the **Log** option. Click on a point in the tree; the distance to the tree root from that point will be returned to a **Tree Distance Log** (figure 3).
20. Select **Stats** at the bottom of the Tree Plot window.
21. The Stats Option window returned allows specification of parameters used to calculate the various tree statistics (figure 4). The location where the resulting stats files are saved can also be set in this window. To calculate stats, press the Calculate Stats button.
22. The Tree Stats window (figure 5) displays the 'Summary' statistics for each branch of the tree. Select the 'Detailed' option from the bottom of the window to view statistics on each of the points in the branches.

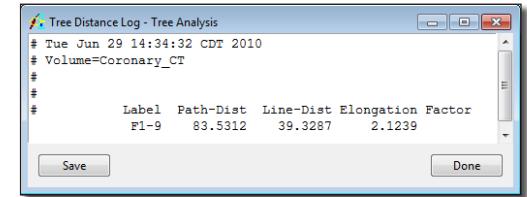


Figure 3

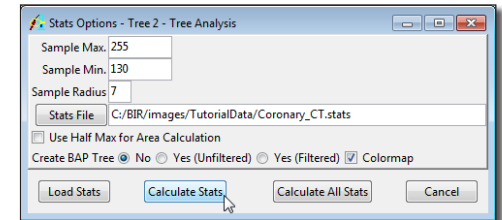


Figure 4

Name	Product	Area	BAP	St Dev	Average Area	St Dev	Length	Children (Name, Angle)
A1	501.47	187.69	13.09	8.17	43	(B1, 133.7) (B2, 97.4)		
B1	266.16	440.54	9.18	11.23	45			
B2	1064.14	355.59	31.95	5.76	22	(C1, 156.8) (C2, 133.2)		
C1	171.02	351.83	6.93	9.52	57			
C2	1116.62	427.01	26.15	9.55	13	(D1, 99.6) (D2, 133.0)		
D1	168.61	349.91	7.11	9.77	18			
D2	1343.00	188.93	23.65	5.48	23	(E1, 109.7) (E2, 141.5)		
E1	597.92	412.42	16.56	8.27	25	(F1, 140.5) (F2, 60.0)		
F1	332.45	205.07	11.36	6.24	92			
F2	182.25	300.01	7.89	9.28	44			
E2	556.67	103.90	12.97	4.13	36	(F3, 131.8) (F4, 157.6)		
F3	206.80	364.00	6.65	8.93	20			
F4	499.86	116.91	13.43	4.43	28	(G1, 90.0) (G2, 132.2)		
G1	144.80	201.59	11.30	8.10	10			
G2	188.86	157.27	7.82	5.10	22			

Figure 5

tip When a point is selected in the 'Detailed' view, a BAP Plot will be returned and the point's branch will be highlighted in the Tree Plot window.

Additional Task

1. Generating a Fly-Through Movie

1. Check **Internal** from the Display options in the Tree Plot window (figure 1).
2. Set **Action** to **Select** and click on the point in the tree from which you wish to begin your fly-through movie. The Renderings window will be returned.
3. By default, the Renderings window will display both fly-through sequence views: Away from Root on the left and Toward Root on the right (figure 2). Preview the sequence using the slider bar.
4. To generate the fly-through movie, right-click in the Renderings window and from the **Sequence** sub-menu, specify the direction of movement and the viewpoint for the movie. The movie will then automatically be saved to the main Analyze workspace and can be viewed with the Movie module (**Display > Movie**) (figure 3).
5. Close the Tree Analysis and Movie modules before proceeding to the next exercise.

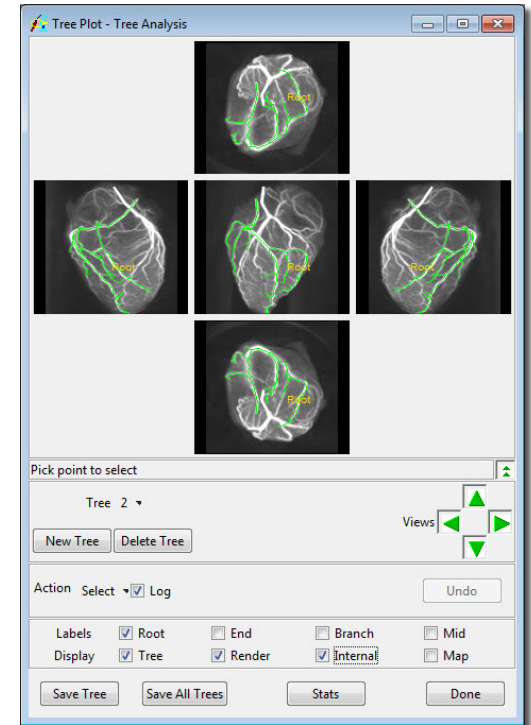


Figure 1

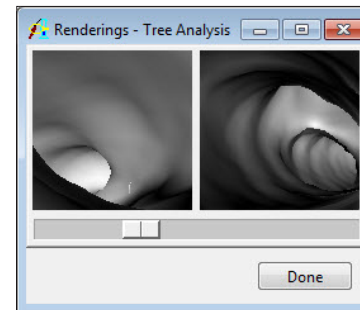


Figure 2

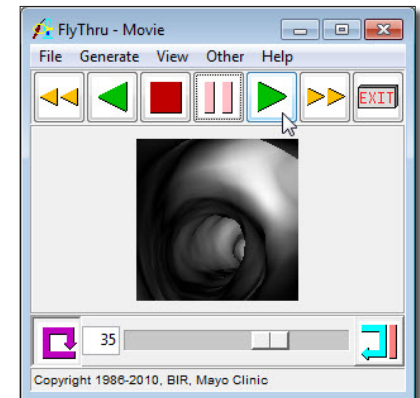


Figure 3