

QUICKSEE:

Virtual-Endoscopic System for Interactive Navigation and Detailed Quantitation

William E. Higgins,^{1,2} Krishnan Ramaswamy,¹
Geoffrey McLennan,² Eric A. Hoffman,² Roderick Swift¹

¹Penn State University, University Park, PA 16802

²University of Iowa, Iowa City, IA 52246

RSNA '96 -- infoRAD, Chicago, IL, 1 December 1996



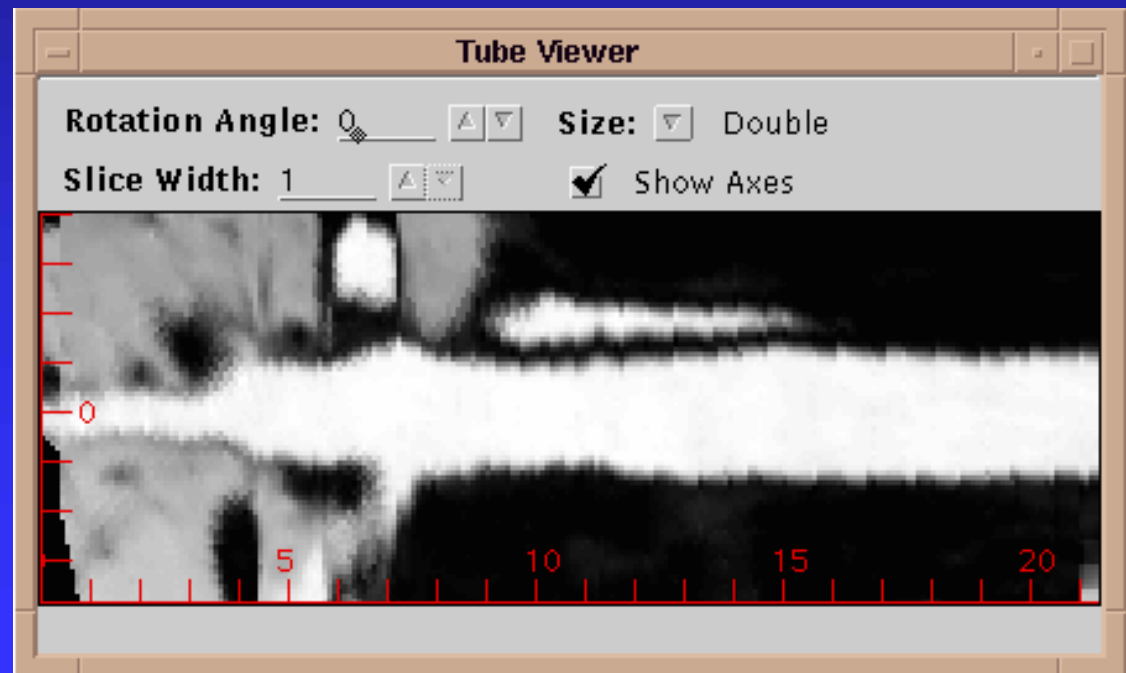
Acknowledgments:

Research supported by grants from:

- Whitaker Foundation --- Biomedical Engineering Grant
- National Cancer Institute of the NIH, grant CA53607.
- NSF --- Biological Instrument Devel., grant BIR9317816

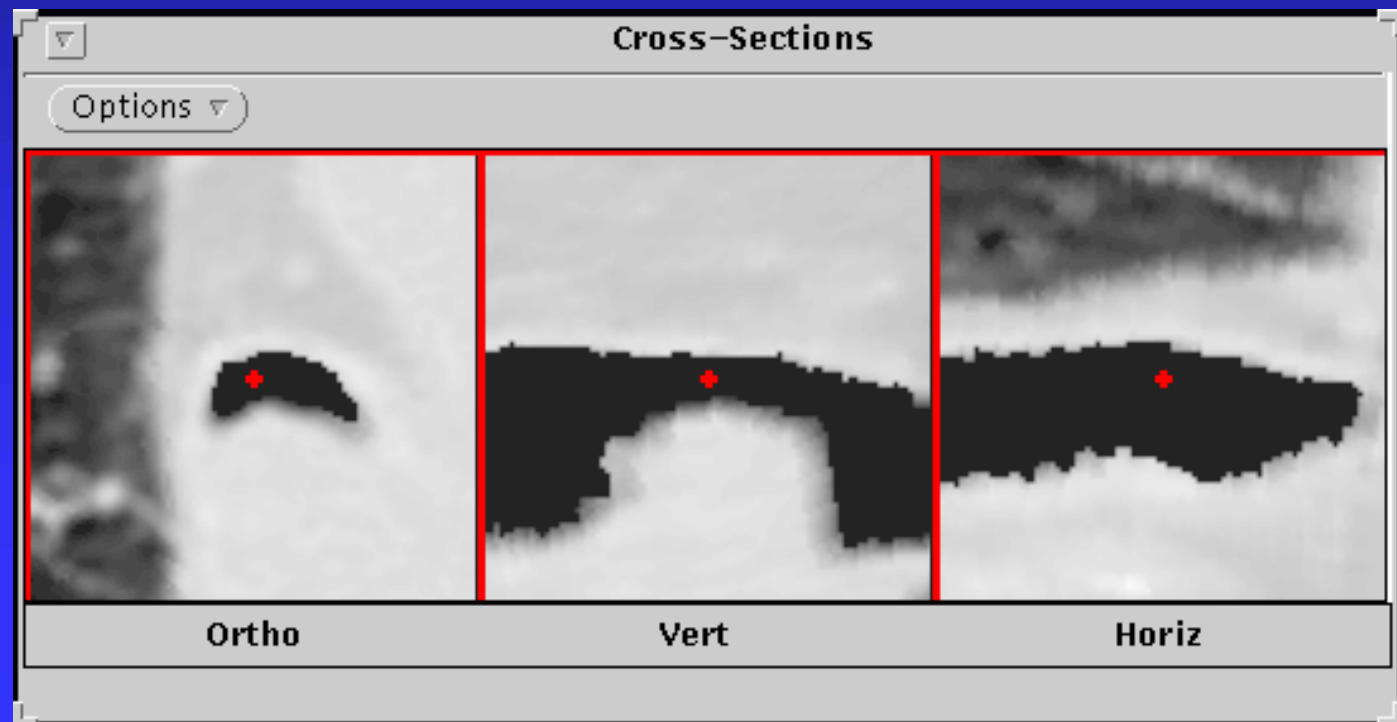
infoRAD Exhibit Goals:

1. Appreciate virtual endoscopy's *potential* for 3D thoracic image assessment



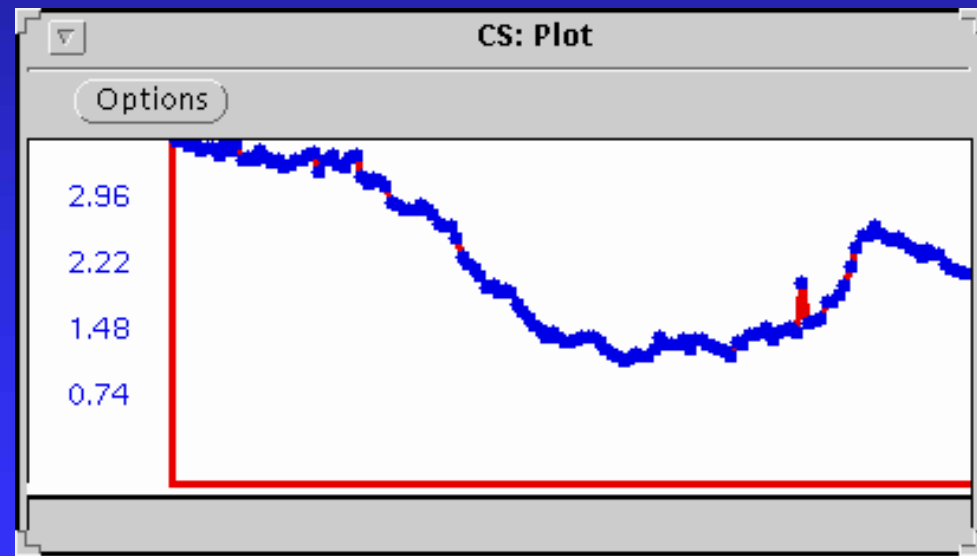
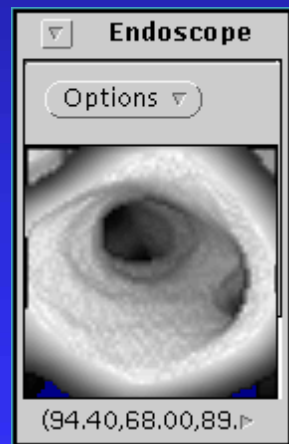
infoRAD Exhibit Goals:

2. Understand the “enhanced awareness” afforded by *virtual* endoscopy over *traditional* endoscopy



infoRAD Exhibit Goals:

3. Realize need for *automatic image analysis* to make virtual endoscopy truly useful



QUICKSEE: virtual-endoscopic software system

1. 3D thoracic analysis

QUICKSEE: virtual-endoscopic software system

- 2 . Provides many *pictorial* and *quantitative* tools:
 - a. Visualize airways
 - b. Get measurements (cross-sectional area)

QUICKSEE: virtual-endoscopic software system

3. Automatic or manual navigation
 - a. use automatically computed paths
 - b. create one yourself

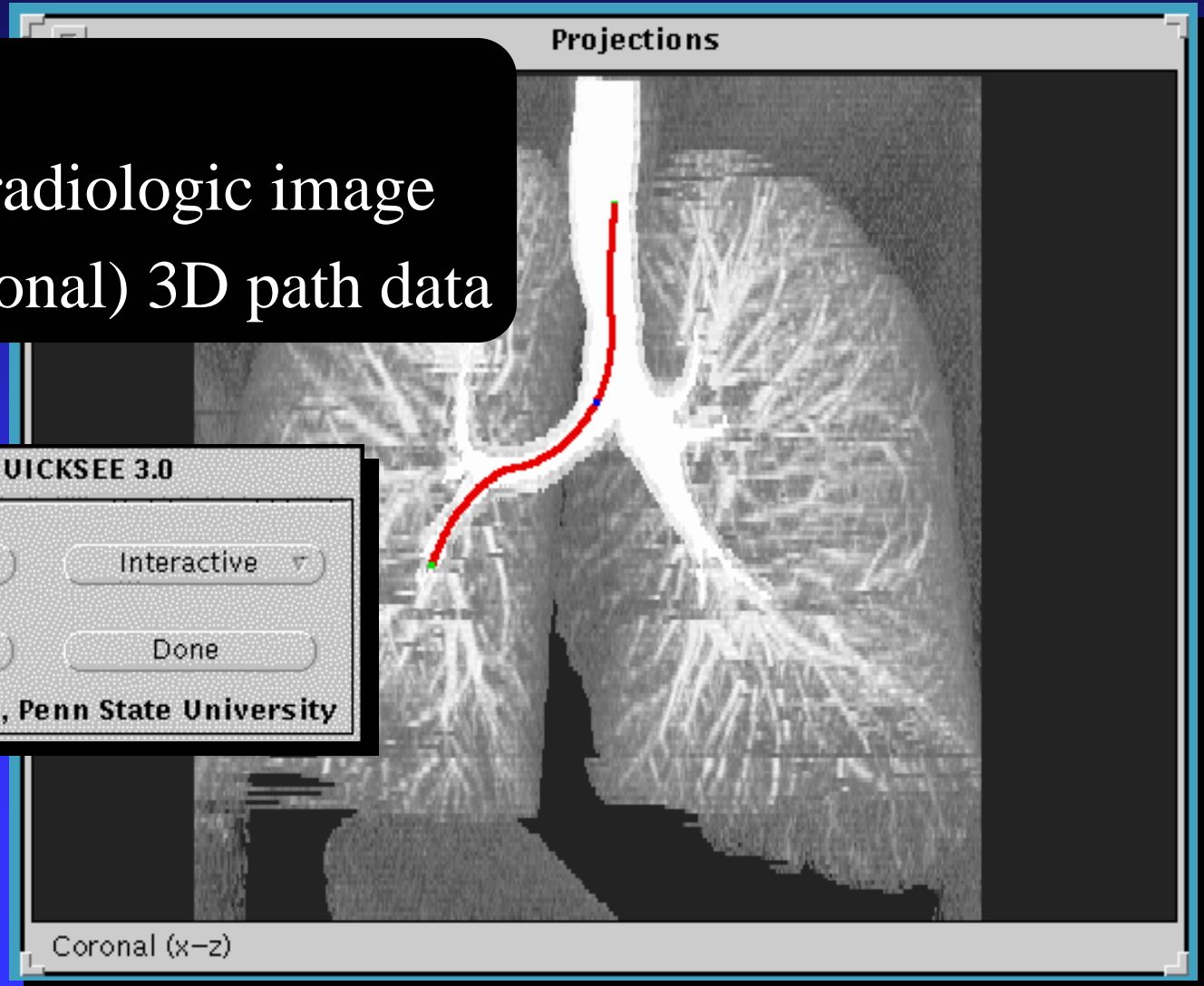
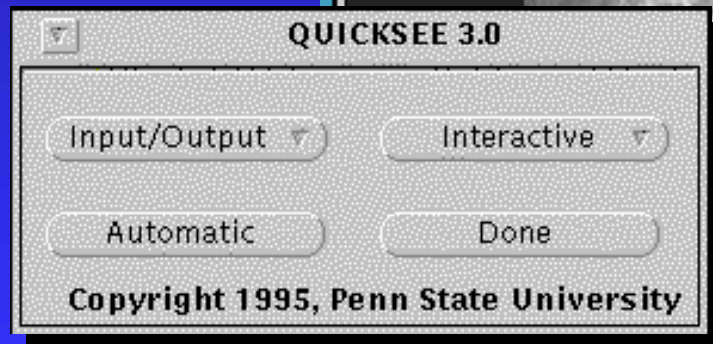
Virtual Endoscopy --- Idea

- Input a high-resolution 3D radiologic image
 - ➔ virtual copy of anatomy
- Use computer to explore virtual anatomy
 - ➔ permits unlimited navigation exploration

QUICKSEE --- basic operation

1. Load:

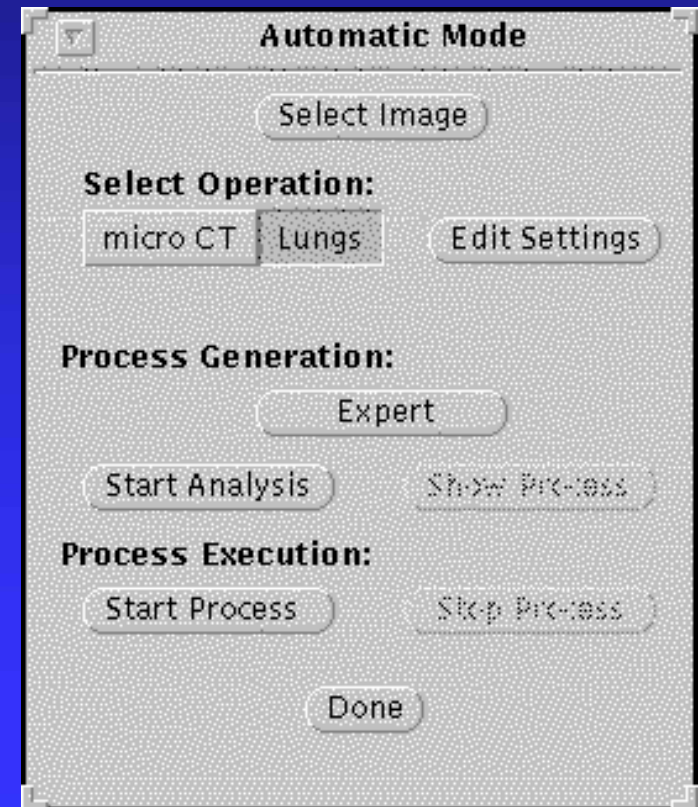
- ◆ 3D radiologic image
- ◆ (optional) 3D path data



QUICKSEE --- basic operation

2. Automatic Mode:

- ◆ Automatically compute:
 - ◆ paths (axes)
 - ◆ extracted regions (airways)



QUICKSEE --- basic operation

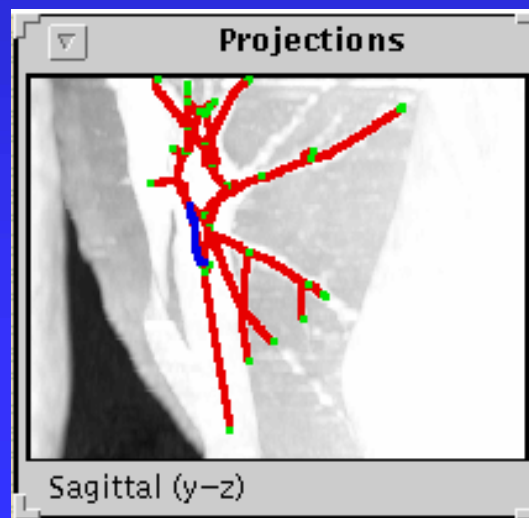
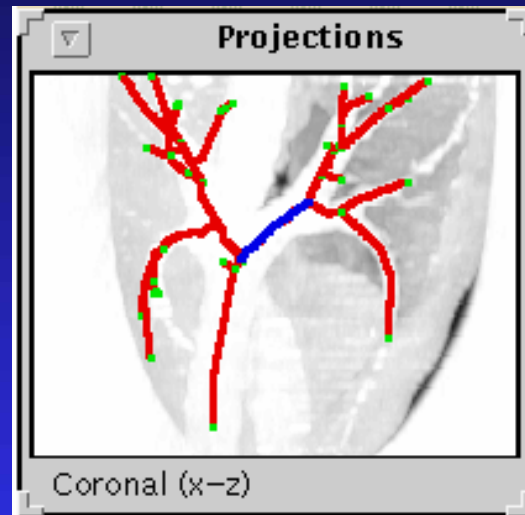
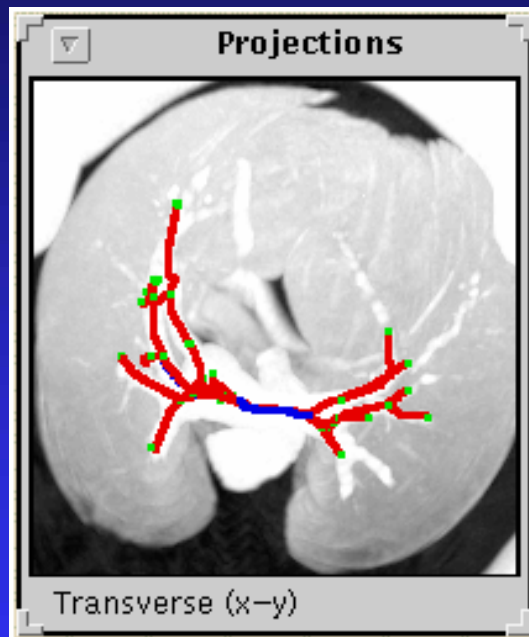
3. Interactive Mode:

- ◆ View, Edit, Create paths
- ◆ View structures; get quantitative data

Case 1:

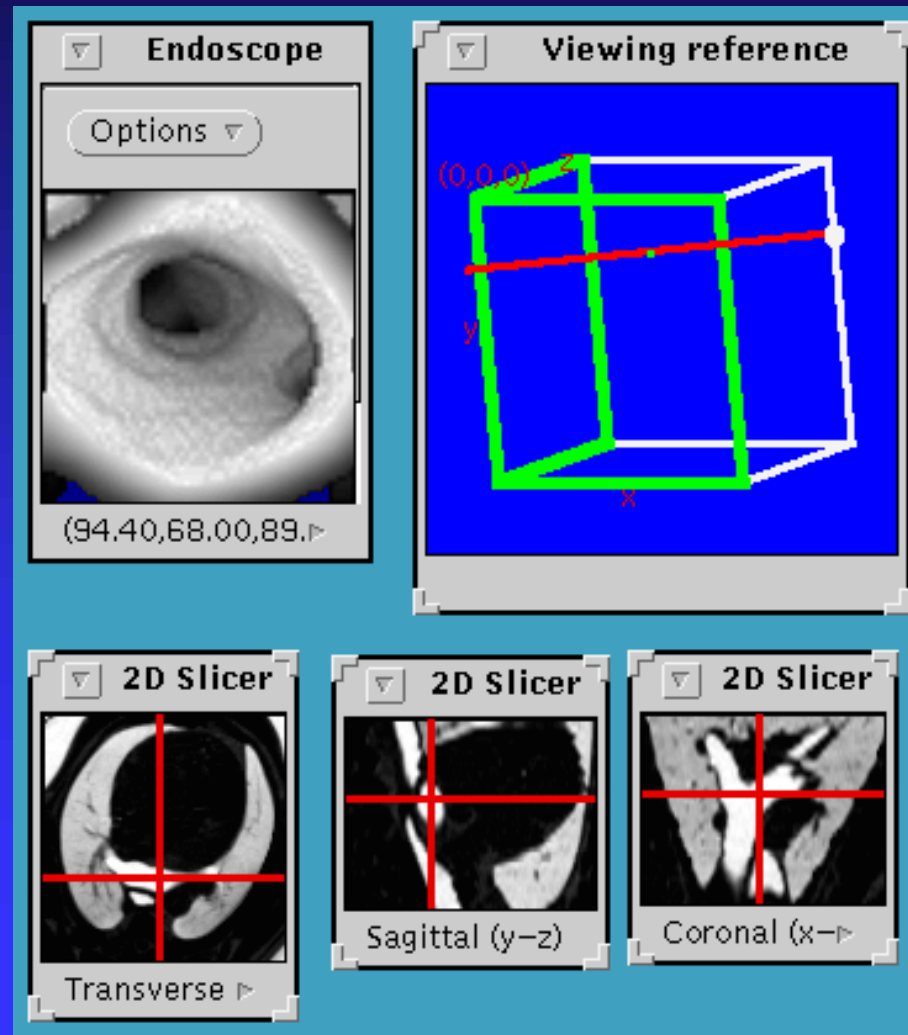
Dog Lung

1. View automatically computed airway axes on reference projections.



Case 1:
Dog Bronchial Tree

2. See Virtual Endoscopic View and 2D Slices.



Case 1:
Dog Bronchial Tree

3. See quantitative data and local 2D cross-sections.

CS: Measurements

Current site: (94.40,68.00,89.40)

Shape characteristics:

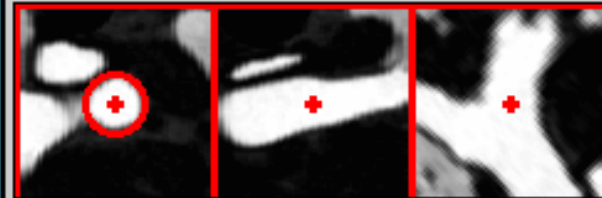
Total normalized volume of object: 489
MBC origin (x,y): (-40,-40)
Normalized Max. width: 80;
Normalized Max. height: 80
Centroid: x = -0.58, y = -33.38
Normalized Central Moments
mu00: 1.00 mu01: 0.00 mu02: 2.39 mu10: 0.00
mu11: -0.22 mu12: -1.71 mu20: 8.74 mu21: 0.29

Gray-level characteristics:

Minimum: 0
Maximum: 255
Mean: 182.66
StDev: 87.89
10% value: 26.30
90% value: 254.08
Normalized BAP value: 89319

Cross-Sections

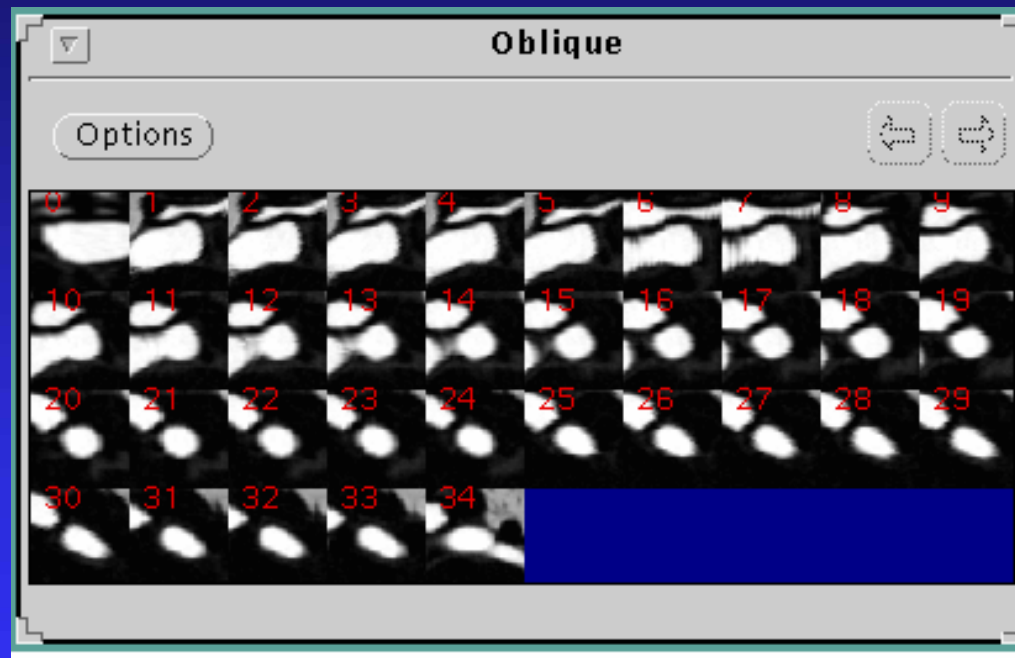
Options ▾



Ortho Vert Horiz

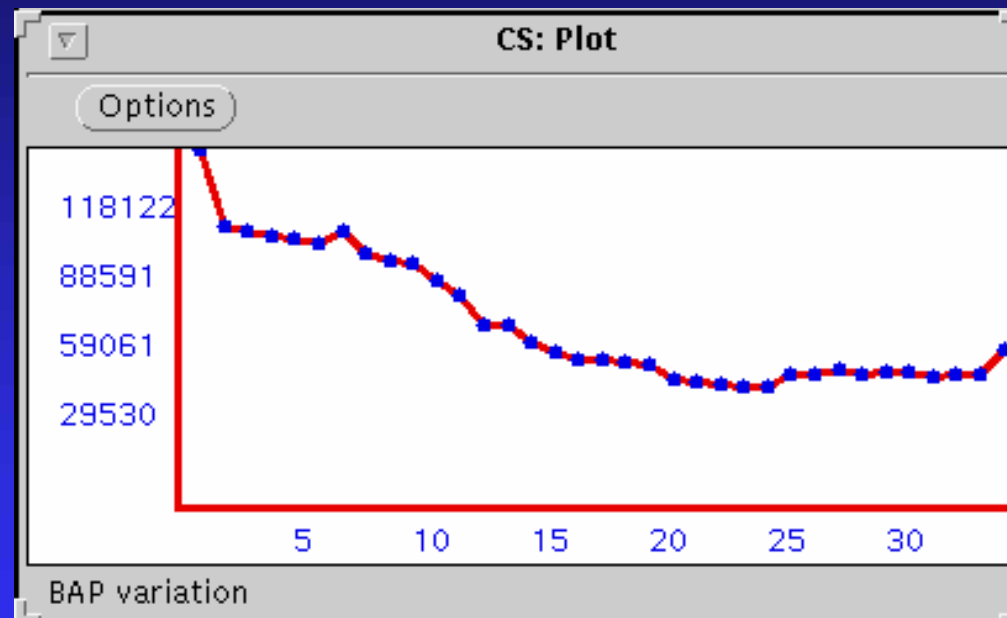
Case 1:
Dog Bronchial Tree

4. See Oblique slices along airway.



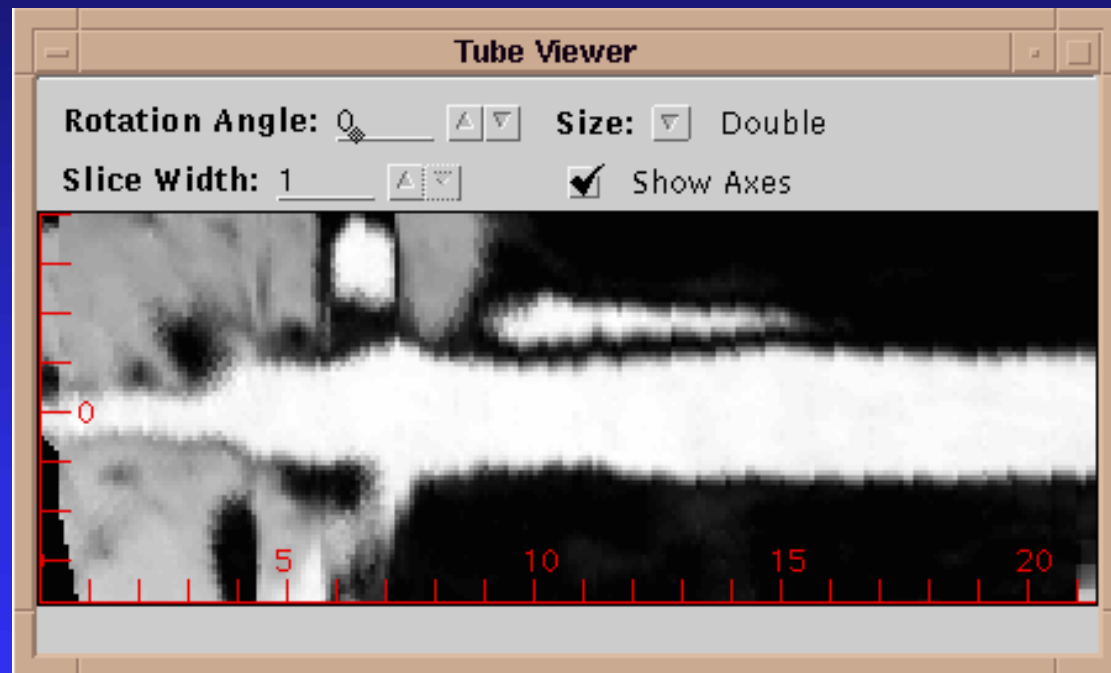
Case 1:
Dog Bronchial Tree

5. See plot of lumen diameter along airway extent.



Case 1:
Dog Bronchial Tree

6. See a straightened “Tube View” along airway.



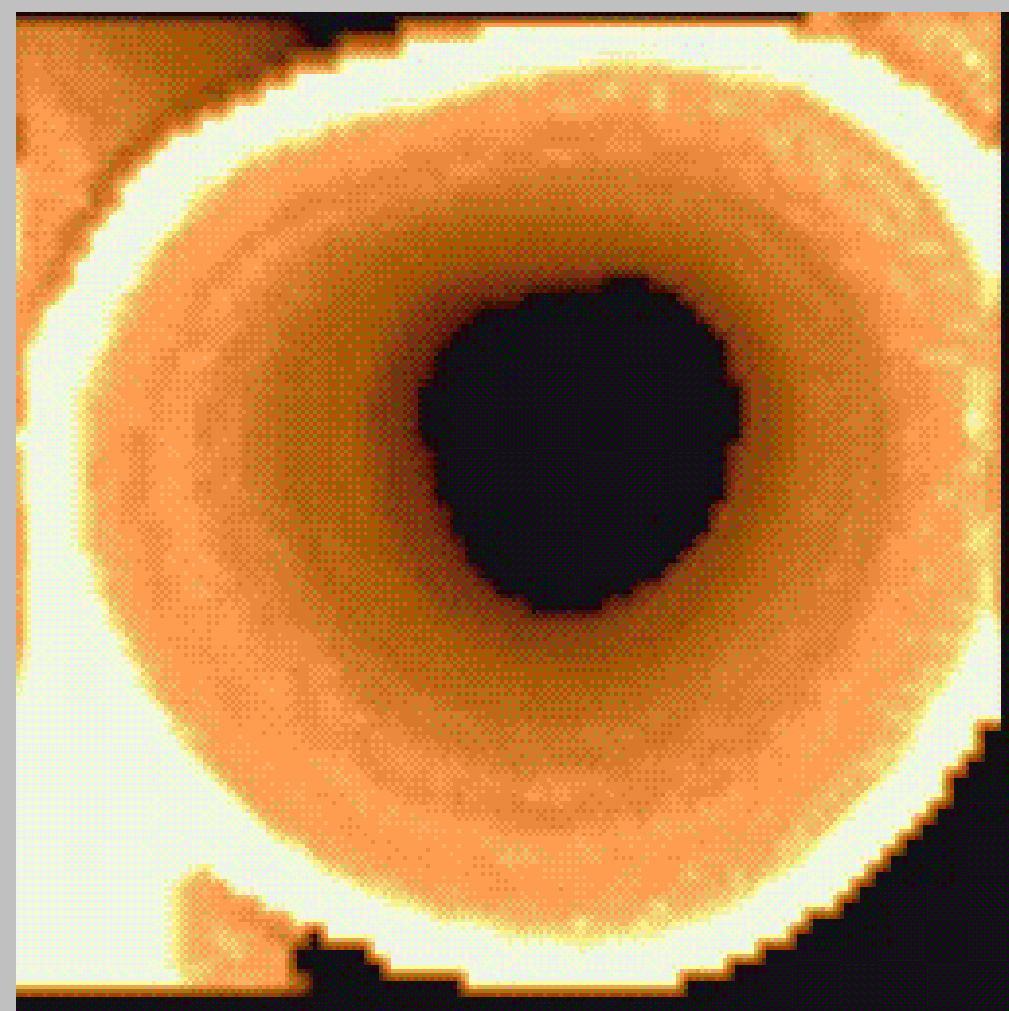
Case 1:
Dog Bronchial Tree

7. See Virtual Endoscopic movie along airway.



Case 1:
Dog Bronchial Tree

8. MPEG recording of Virtual Endoscopic movie along airway.



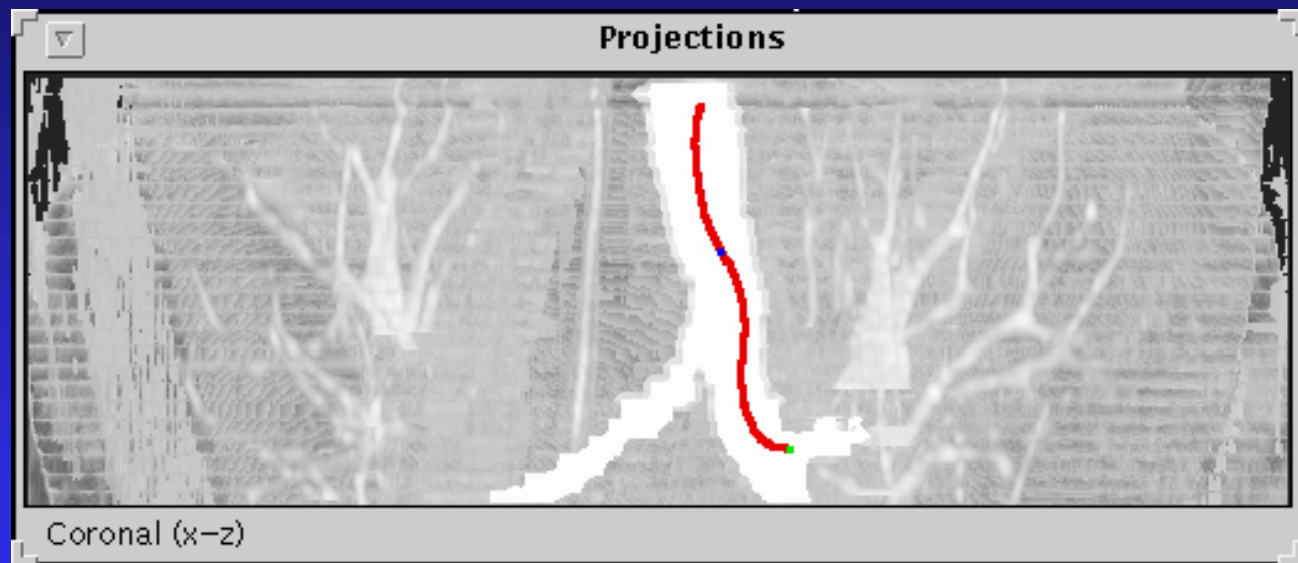
lung_f.mpg

Case 1:
Dog Bronchial Tree



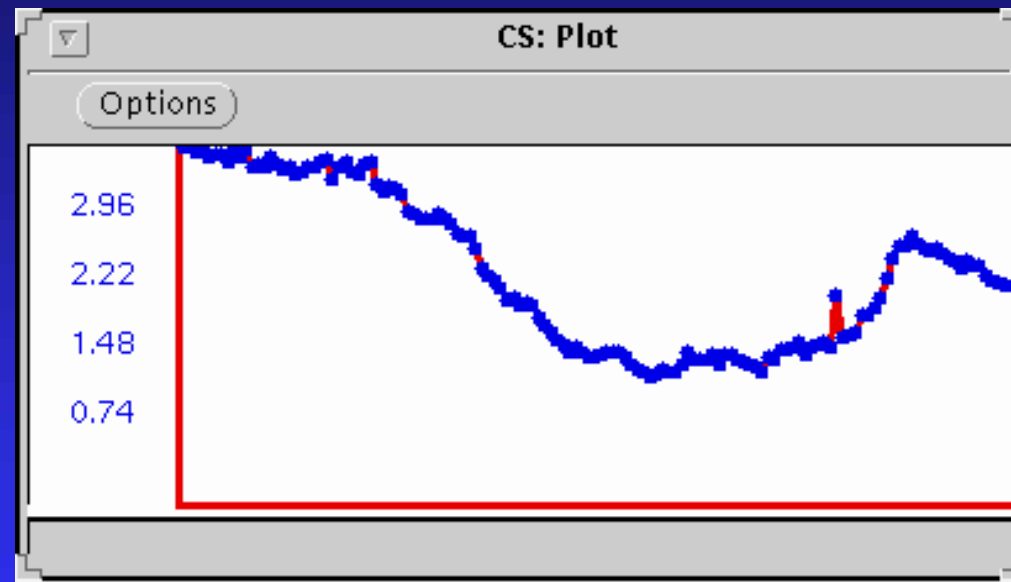
Example 2:
Lung Cancer Patient

1. Get automatically computed paths.



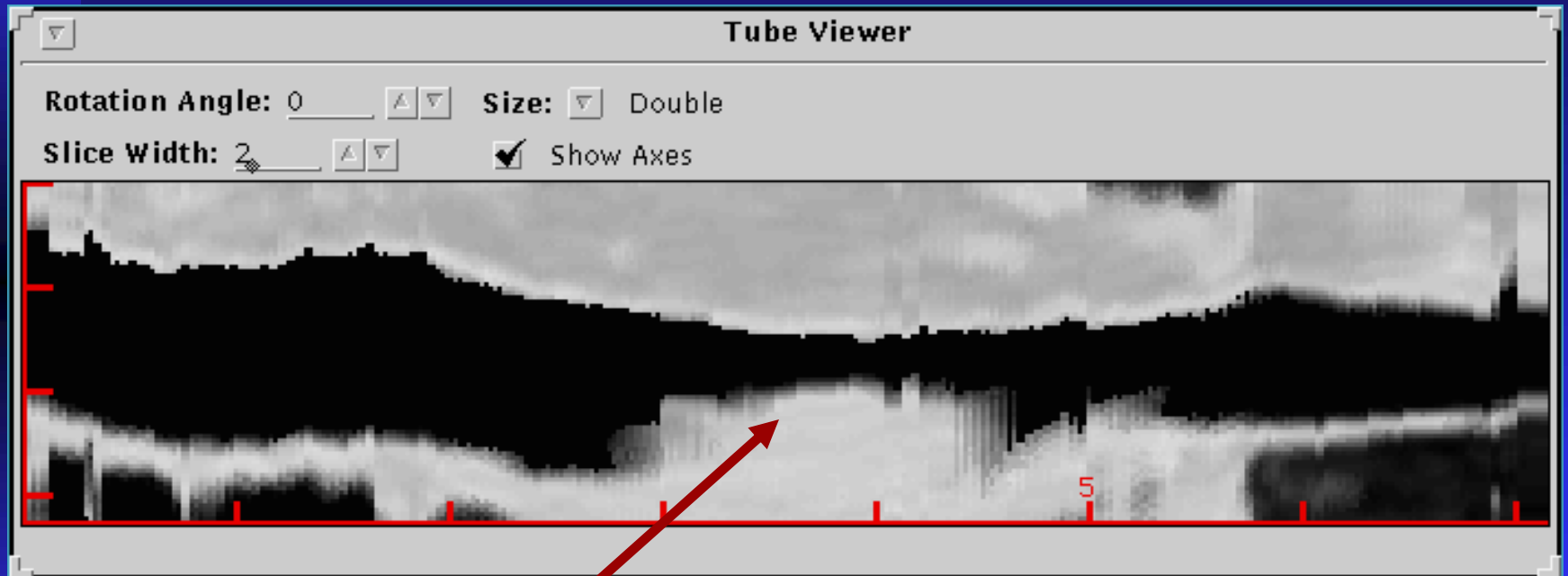
Case 2:
Lung Cancer Patient

2. See lumen diameter along airway path.



Case 2:
Lung Cancer Patient

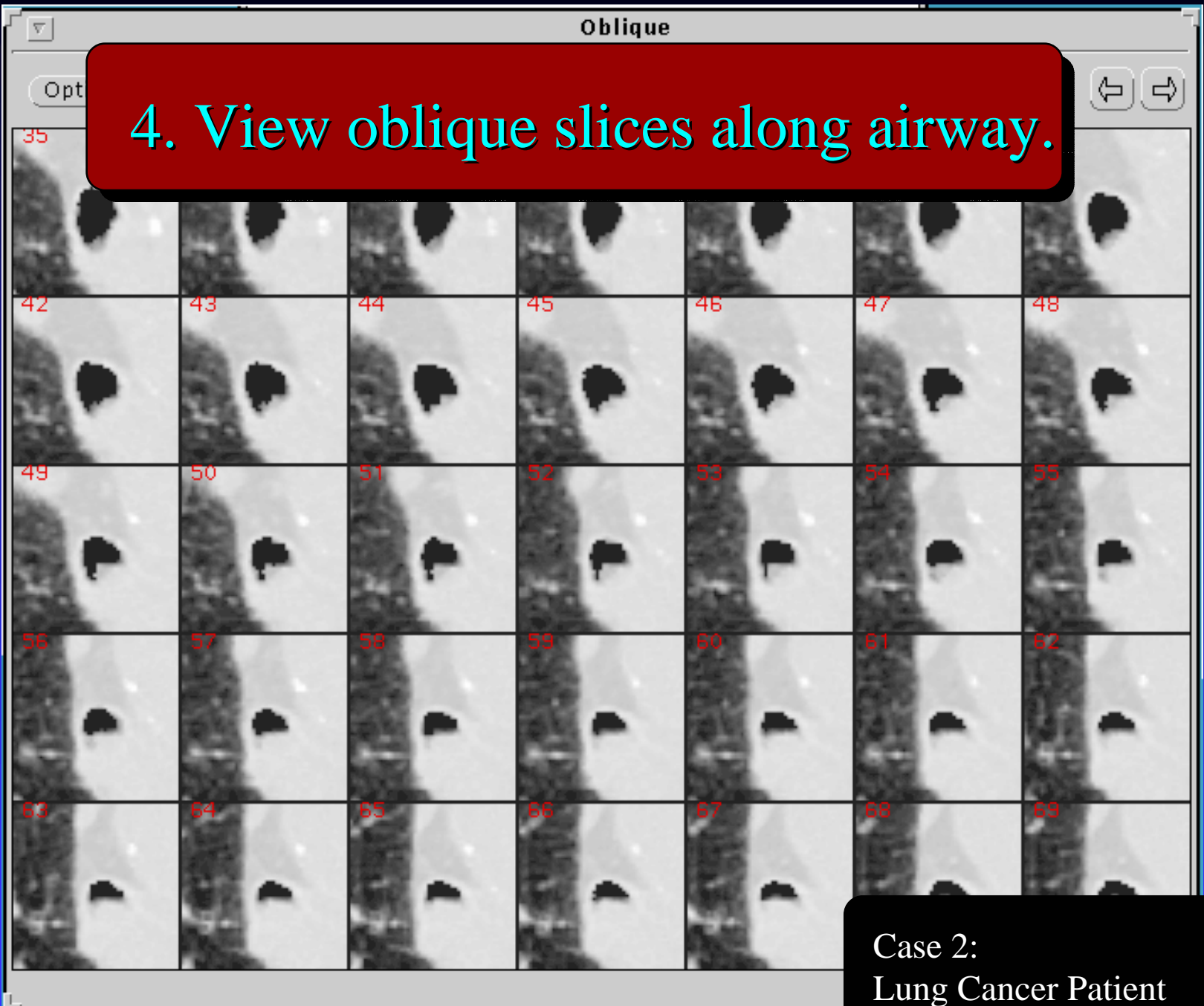
3. View straightened “Tube View” along airway.



Note severe narrowing
due to cancer.

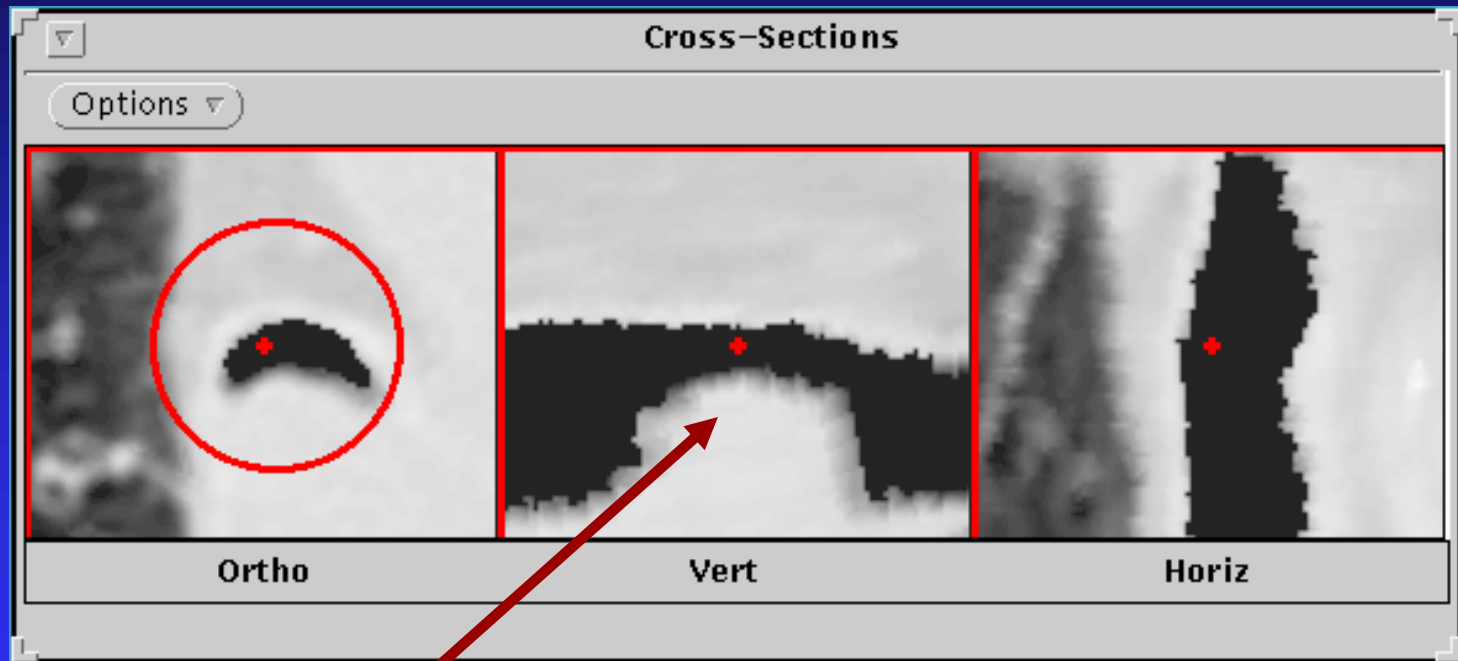
Case 2:
Lung Cancer Patient

4. View oblique slices along airway.



Case 2:
Lung Cancer Patient

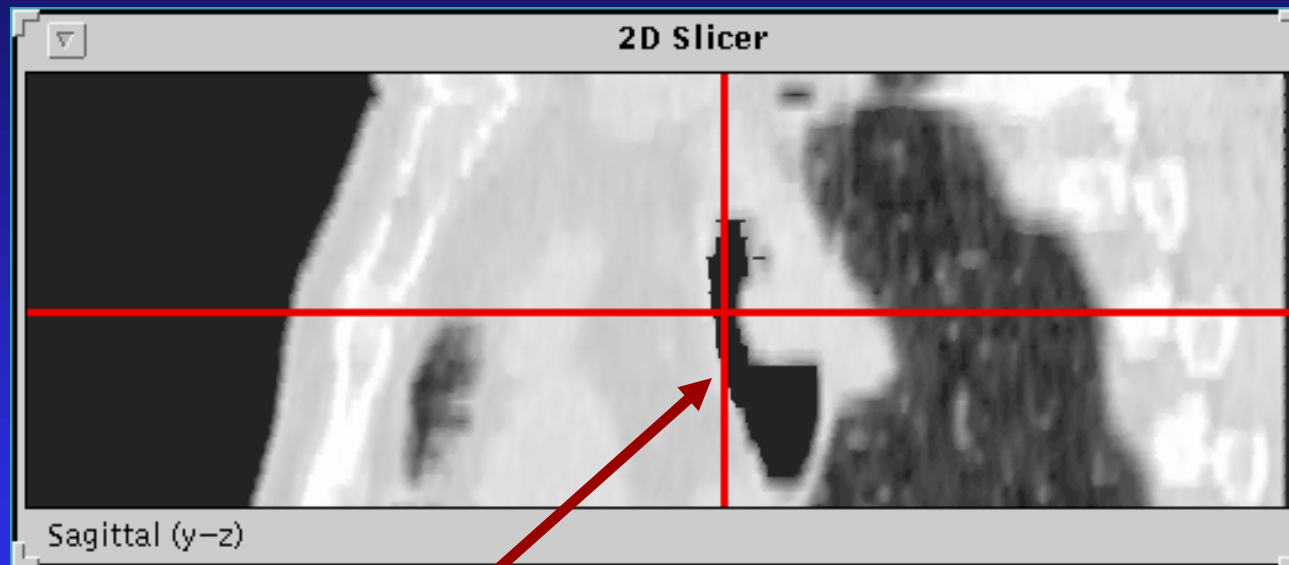
5. See local cross-sections at cancer site.



Note severe narrowing
due to cancer.

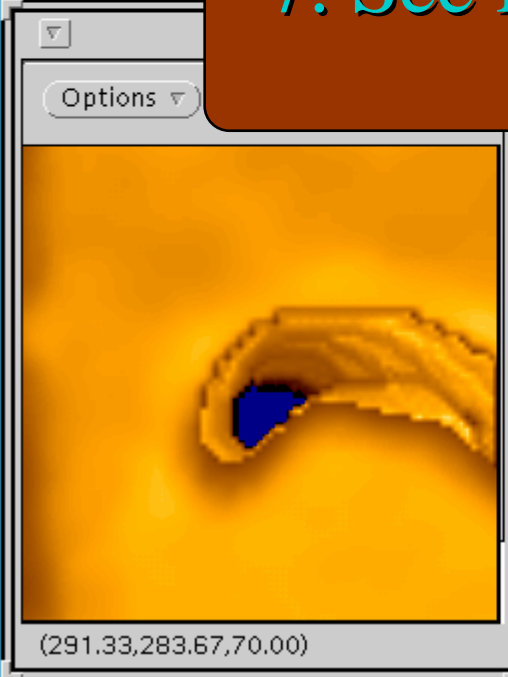
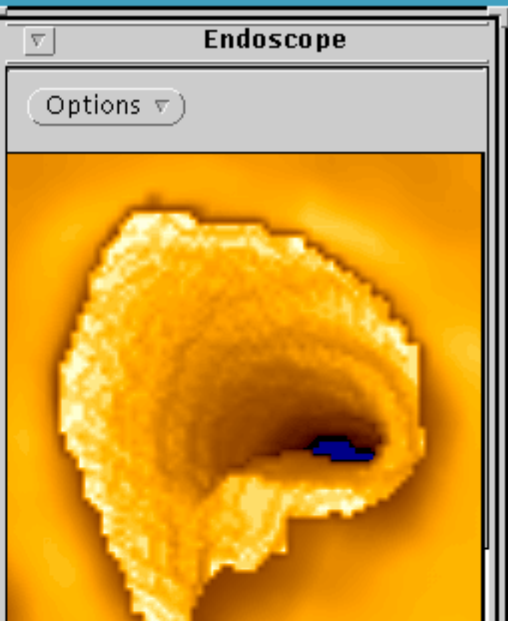
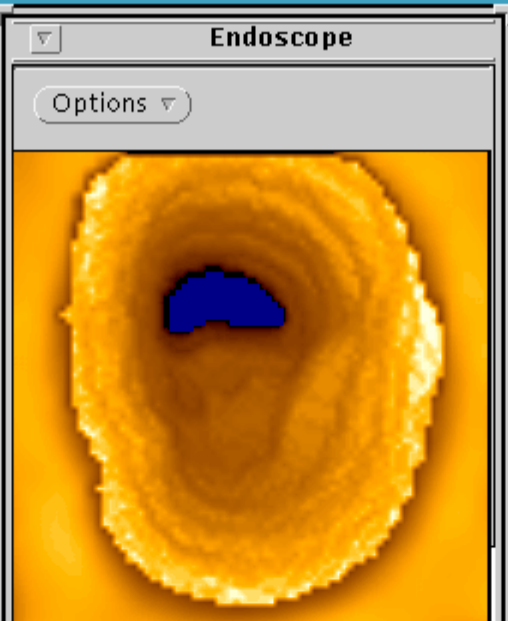
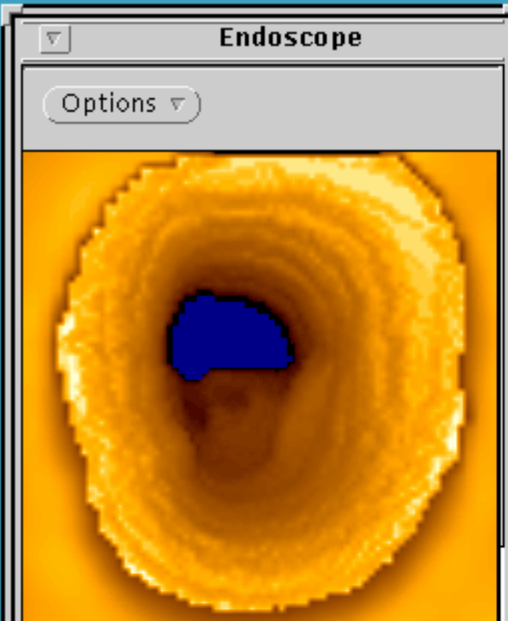
Case 2:
Lung Cancer Patient

6. See global 2D slice at cancer site.



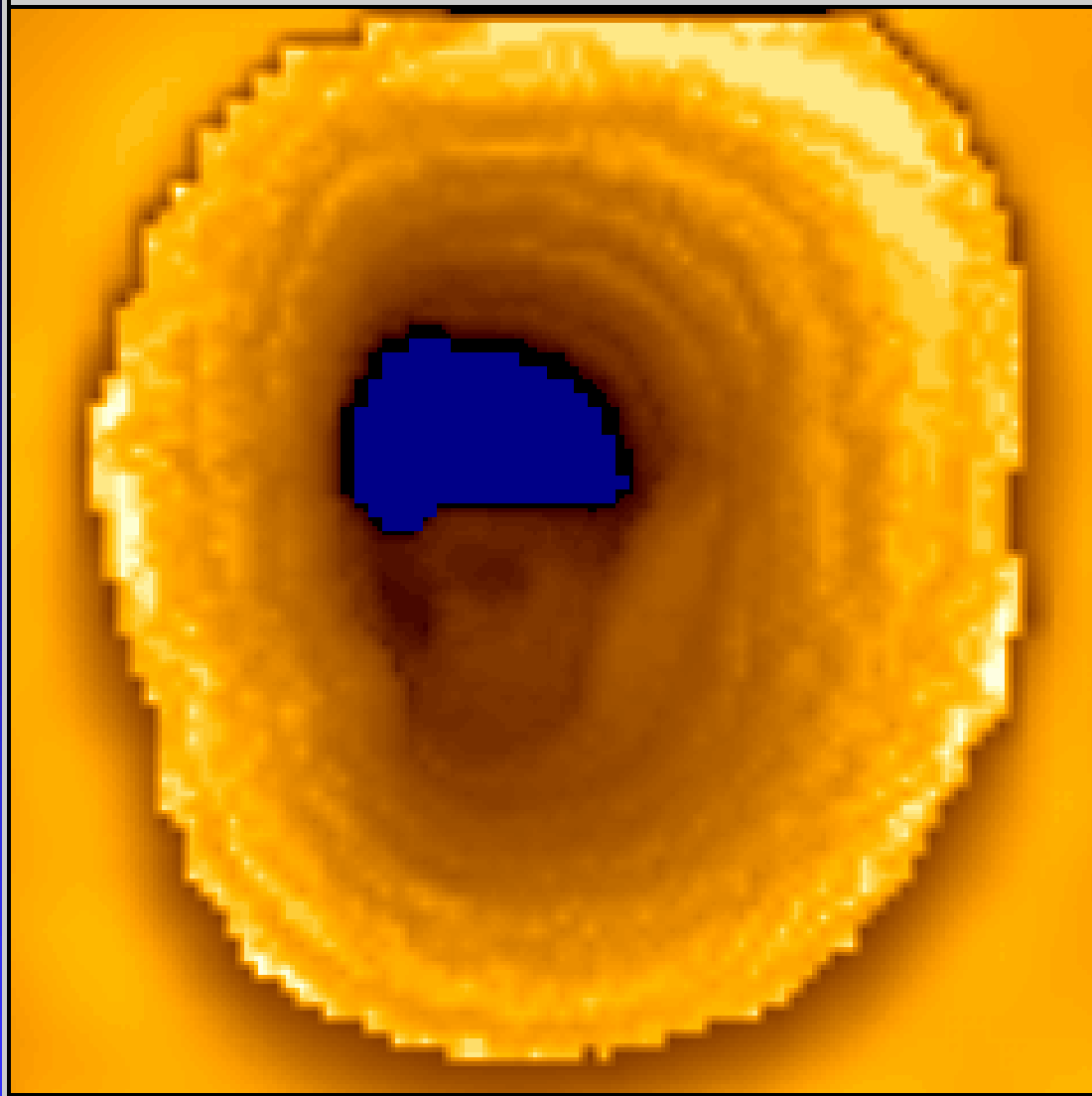
Note severe narrowing
due to cancer.

Case 2:
Lung Cancer Patient



7. See Endoscopic Movie along diseased airway.

Case 2:
Lung Cancer Patient



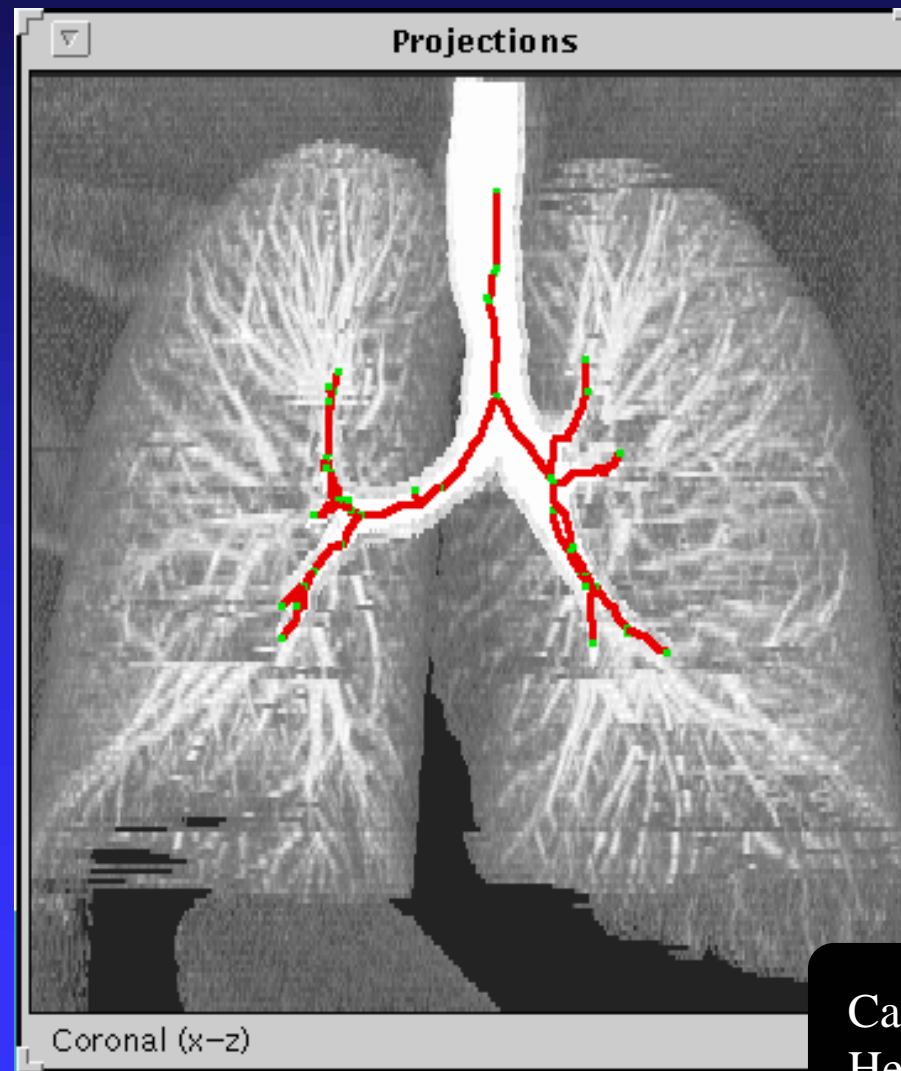
J_44_2.mpg

Case 2:
Lung Cancer Patient

Case 3:

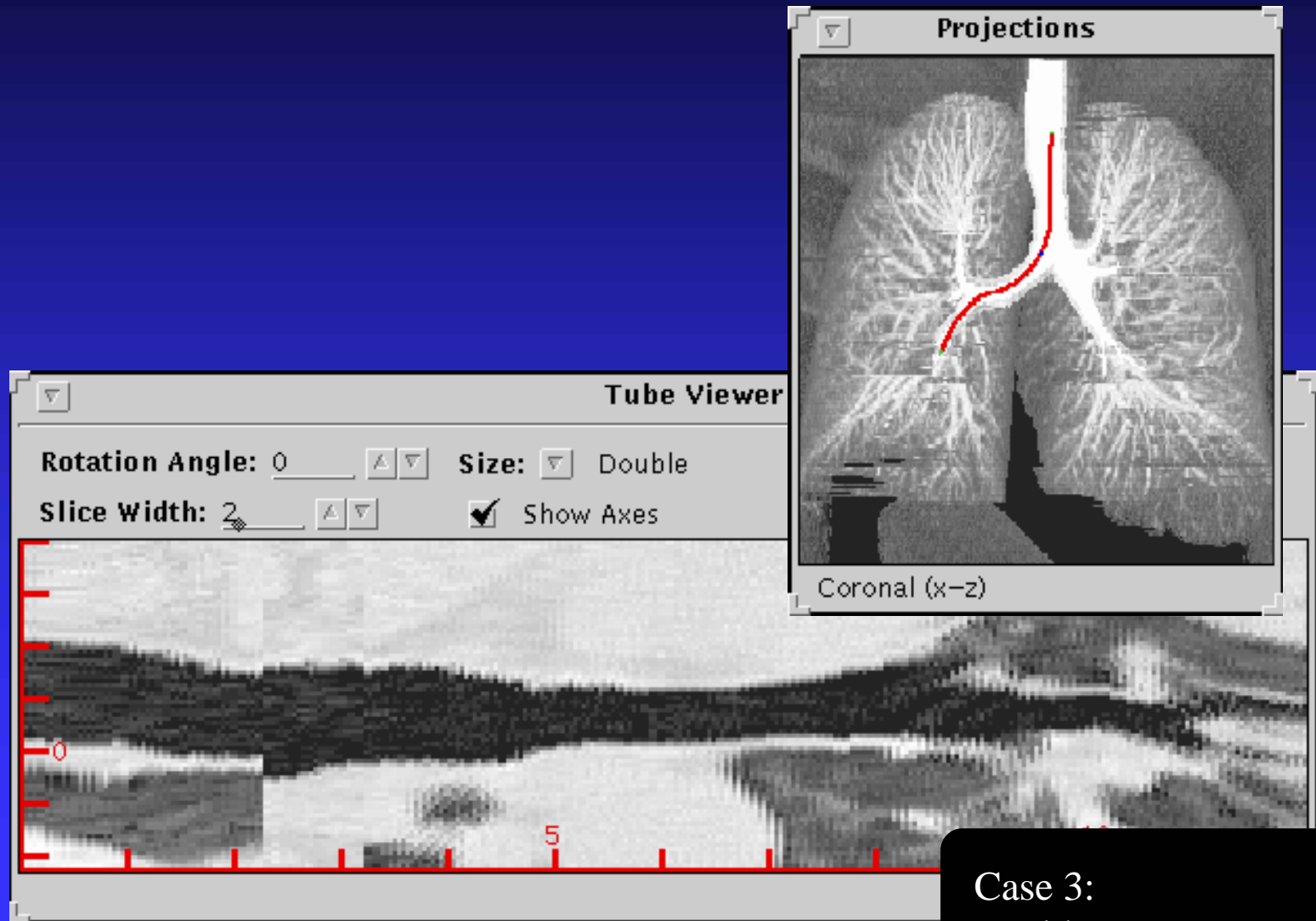
Healthy Human
Complete Lung Scan

1. Get automatically computed paths.



Case 3:
Healthy Human

2. See Tube View along airway.



Case 3:
Healthy Human

3a. View 2D Global Slices at a site

Sagittal...



Case 3:
Healthy Human

3b. View 2D Global Slices at a site

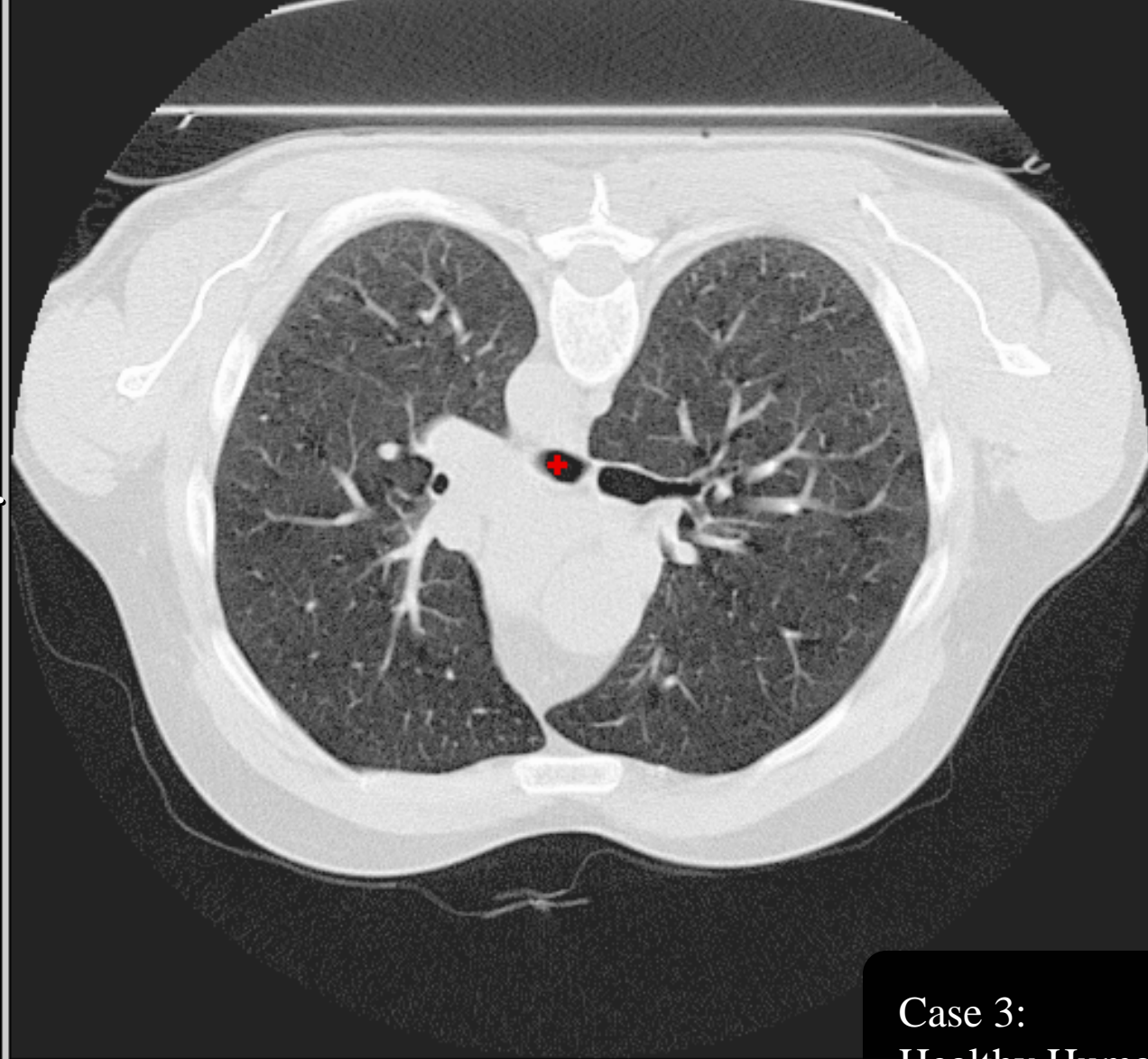
Coronal...



Case 3:
Healthy Human

2D Slicer

3c. View 2D Global Slices at a site



Transverse...

Transverse (x-y)

Case 3:
Healthy Human

4. If desired, navigate through lungs yourself!

