

# Volume Animation

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# Agenda

— [ Volume Rendering

— [ Galactic Animation

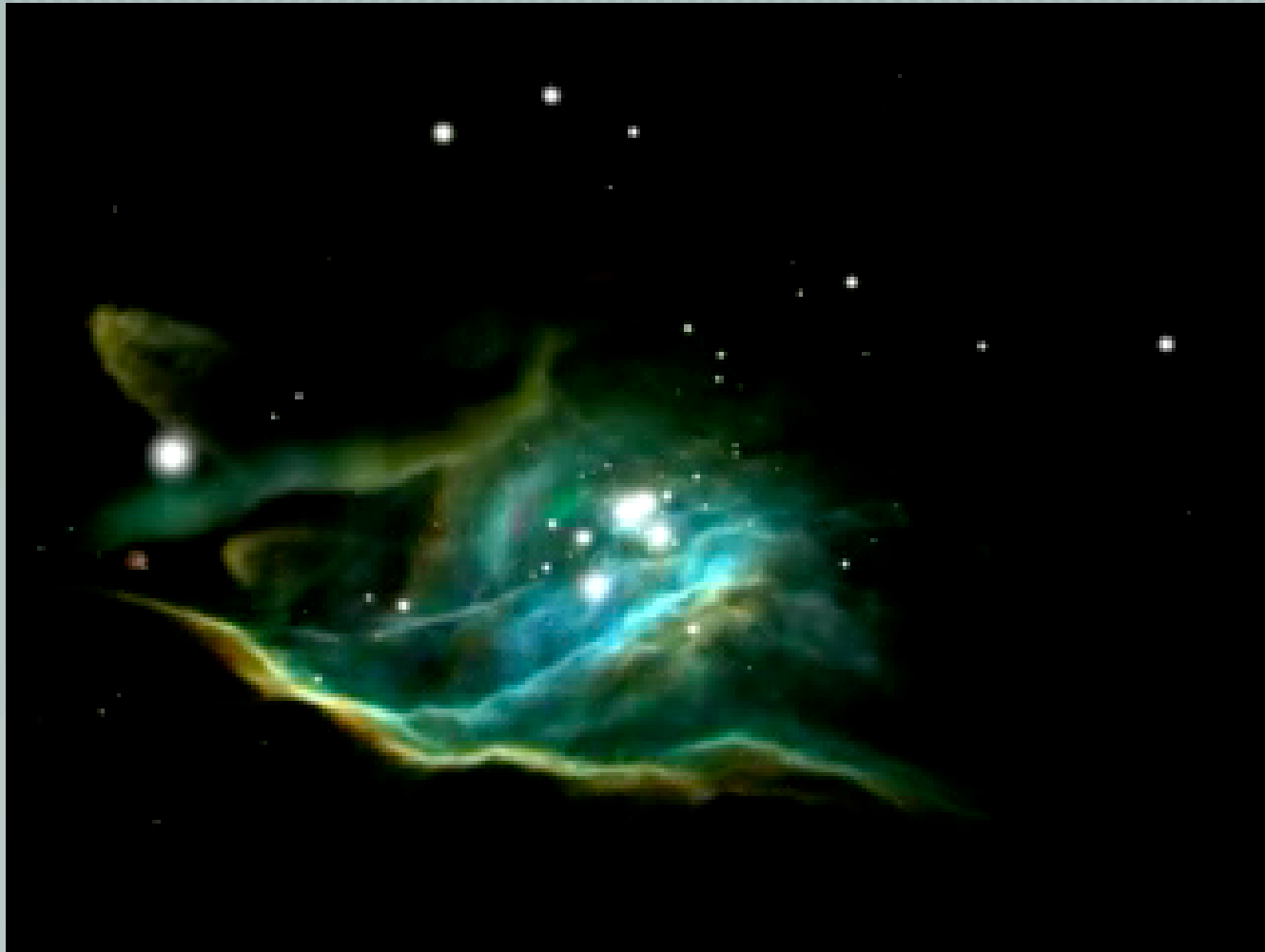
— [ Skeleton Extraction

— [ Spatial Transfer Functions

— [ Volume Keyframing

— [ Conclusion

# Galactic Animation (Motivation)



Source: <http://vis.sdsc.edu/research/orion.html>

# Volumes

— [ Often result from scientific simulations and observations

— [ Three-dimensional field containing scalar or vector values

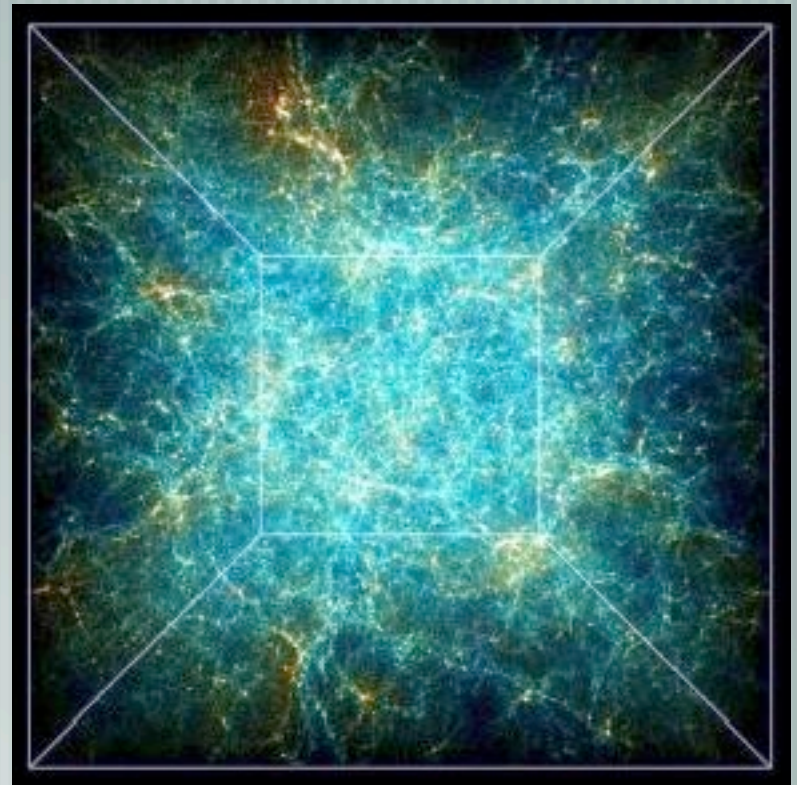
— [ Need to be able to see inside the volume

# Galactic Animation

— [ Our volumes are “structures of varying depth that attenuate traversing light”

— [ That’s kind of what a galaxy is too!

— [ Soon to be a thesis topic



# Volume Rendering

- [ Indirect Volume Rendering (IVR)

- Extract an isosurface, polygonize, render

- [ Direct Volume Rendering (DVR)

- Ray casting

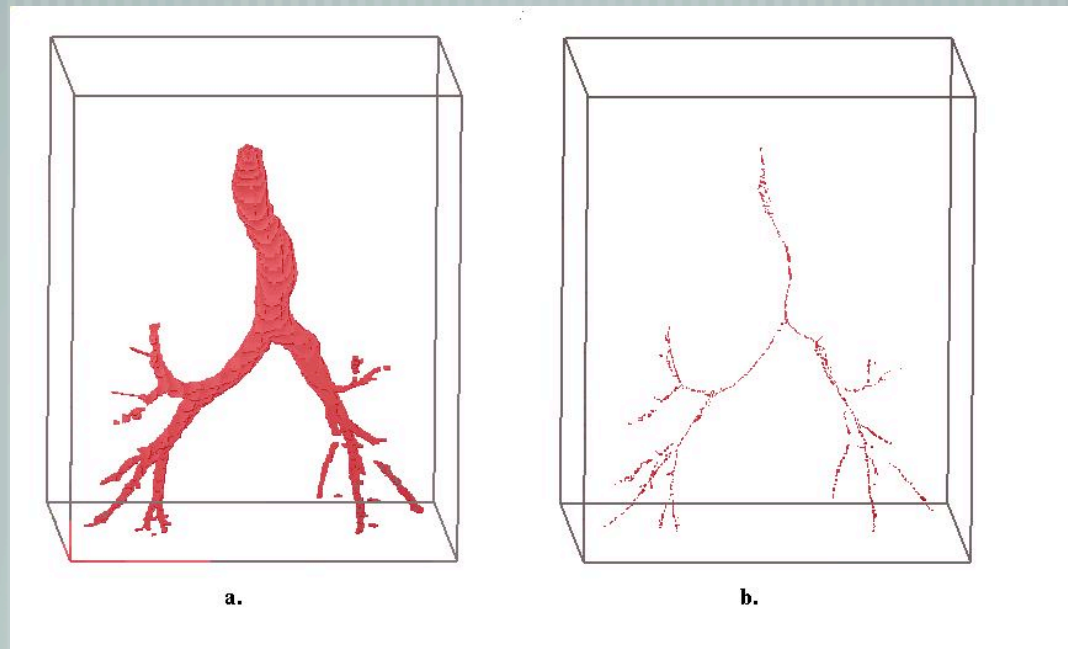
- Splatting

- Sample voxel and map to opacity/color

# Skeletons

— [ Skeleton = Medial surface

— [ Centerline = curve-like representation of medial surface



Source: <http://www.caip.rutgers.edu/~gagvani/skel/>

# Skeleton Extraction

— [ Compute distance from voxel to boundary

— [ Discard voxels below a weighted threshold

— [ Yields skeleton that is not necessarily connected

— [ Connect voxels using a minimum spanning tree

# Skeleton Uses

- [ Import skeleton into animation package (e.g. Maya)

- [ Need to recreate volume from deformed skeleton

  - Can grow skeletal voxels into spheres

    - This loses the texture

  - Place bounding boxes around limbs

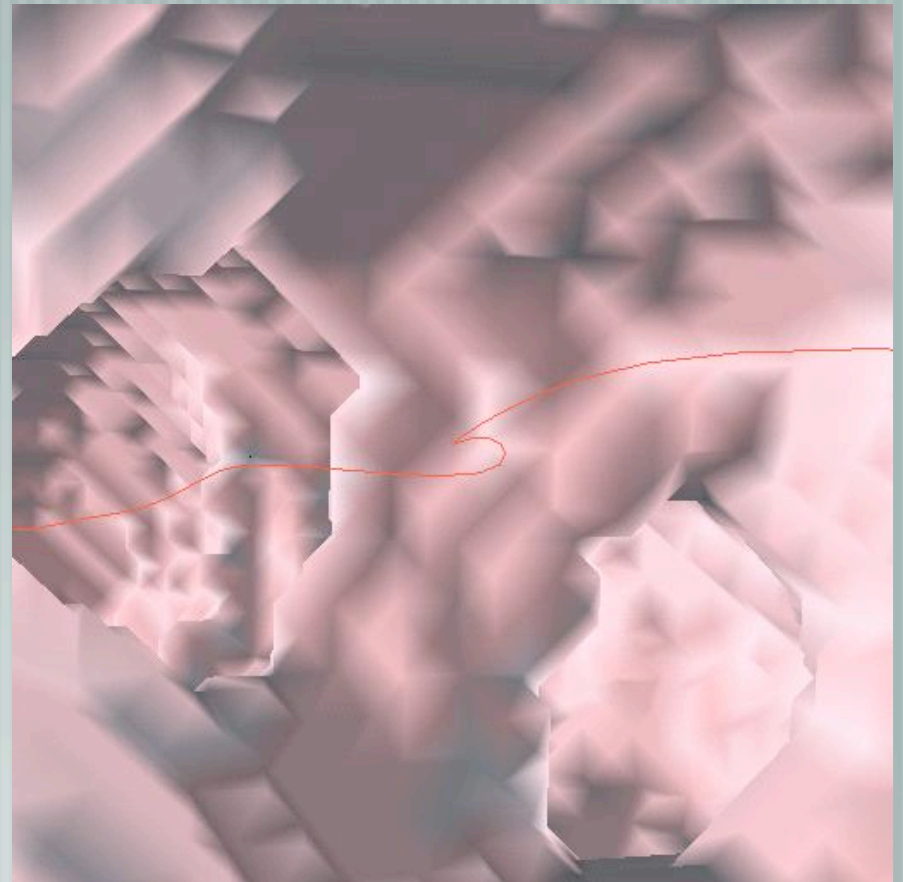
    - Use bounding box to map back to original texture

# Centerline Uses

- [ Automatic path following

- Virtual colonoscopy!

- Follow the arms of a spiral galaxy?



Source: <http://www.caip.rutgers.edu/~gagvani/skel/>

# Spatial Transfer Functions

— [ Volume Rendering maps sampled voxel to opacity/color

— [ ST functions map voxel position to another voxel position

— Changes the voxel being sampled in volume rendering

— [ Add time parameter to animate

# Blowing up the Visible Human



Source: [http://www.caip.rutgers.edu/vizlab\\_group\\_files/CURRENT/index.html](http://www.caip.rutgers.edu/vizlab_group_files/CURRENT/index.html)

# Galactic Spatial Transfer Functions

— [ Slice galaxy to see both halves

— [ Split galaxy along spiral arms

— [ Spiral arms spin off into space

— Maybe not so scientifically useful

# Volume Keyframing

— [ Can be done with skeletons

— [ If building volume from scratch then record features

— [ Each sculpting operation creates a feature

— [ Features combine to make skeleton

# Conclusion

- [ Skeletons are really useful

- Extract from existing volume using thinning

- Record when modeling volume using features

- [ Spatial transfer functions map voxels to other voxels

- [ Galaxies are best modeled and animated as volumes

# Questions?

References available at [www.scompt.com](http://www.scompt.com)



Source: [http://www.caip.rutgers.edu/vizlab\\_group\\_files/CURRENT/index.html](http://www.caip.rutgers.edu/vizlab_group_files/CURRENT/index.html)