Spine Segmentation & Osteoporosis Screening in CT
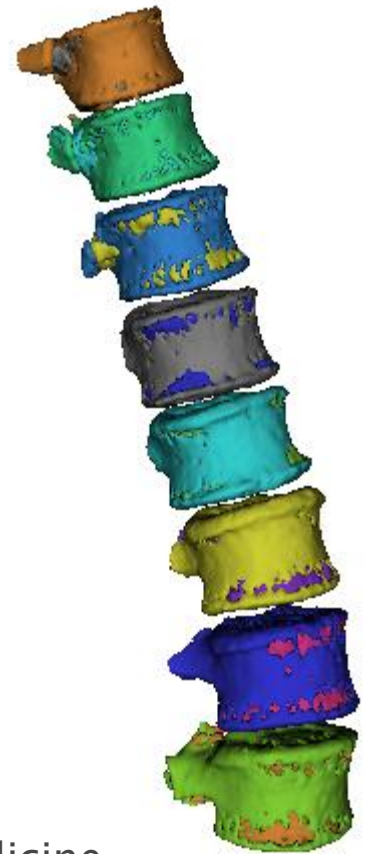
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Screening for Osteoporosis in CT Scans

- *Osteoporosis* – *A condition of decreased bone mass leading to fractures*

- *Common*
  - 1.5 million vertebral fractures per year (US)
  - 180 thousand patients placed in nursing homes per year (US)

- *Devastating & Costly*
  - immobility, pain, mortality
  - 18 billion dollar per year (US)

- *Preventable & Treatable*
  - diet, exercise
  - quit smoking & access drinking
  - medication, fall prevention, etc…

- *Under Diagnosed*
  - DXA screening has low compliance rate
 - Frequently missed in CT

Our Solution

Automated screening for findings of osteoporosis in CT scans performed for other clinical reasons

Detect: Vertebral fractures, Low bone density Etc.

Milestone 1 – Spine Segmentation

- NA–MIC Spine Segmentation Challenge + full automation
- Slicer integration
  - Basic integration complete: Spine Segmentation Module + Tutorial
  - Atlas integration in the works

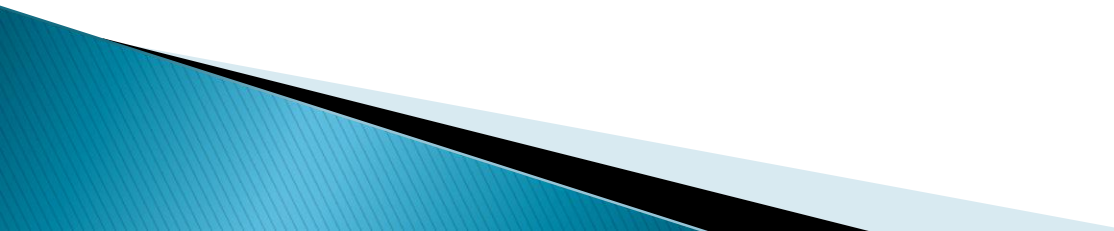The different colors highlight holes in the cortex
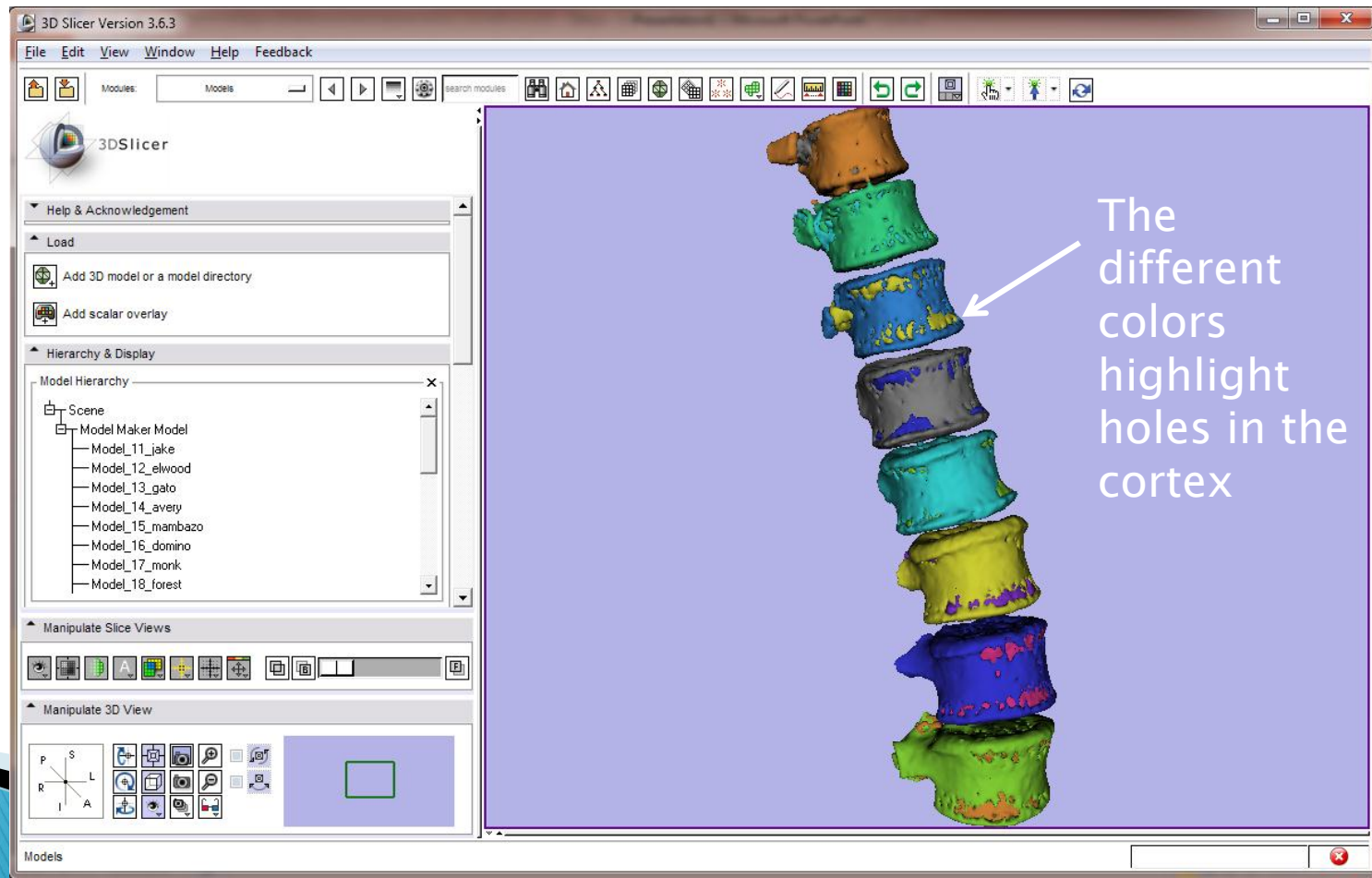
Not a Silver Bullet (yet)

- Abdomen CT only. Chest CT in next milestone.
- Tested on Windows 7 64 bit, 3DSlicer 3.6.3
- Mapping to formal vertebrae labels – TBD
- Known issues to be resolved in
  next milestone:
  - Calcifications
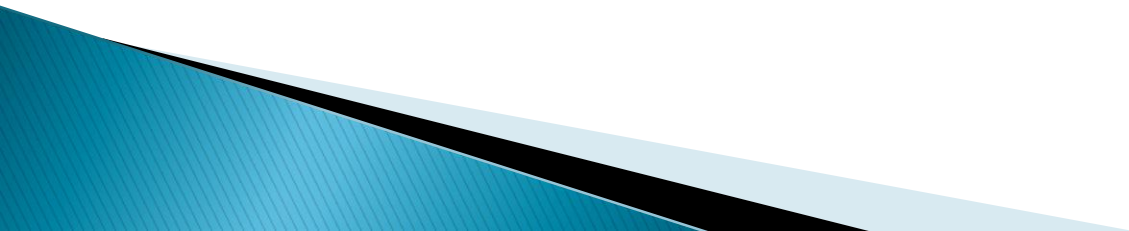 - Contrast

Need to Remove calcification in the aorta
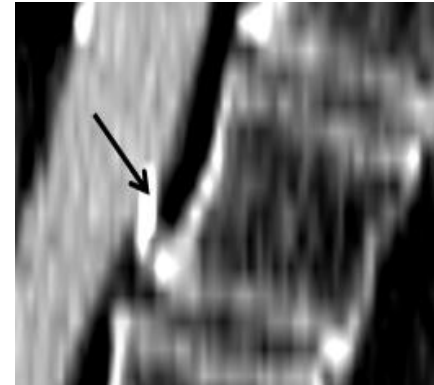
But keep osteophytes

- Availability
  - Segmentation module expected to be available for NA-MIC research community, pending legal review.

- More details
  - Anthony.Blumfield@Radnostics.com
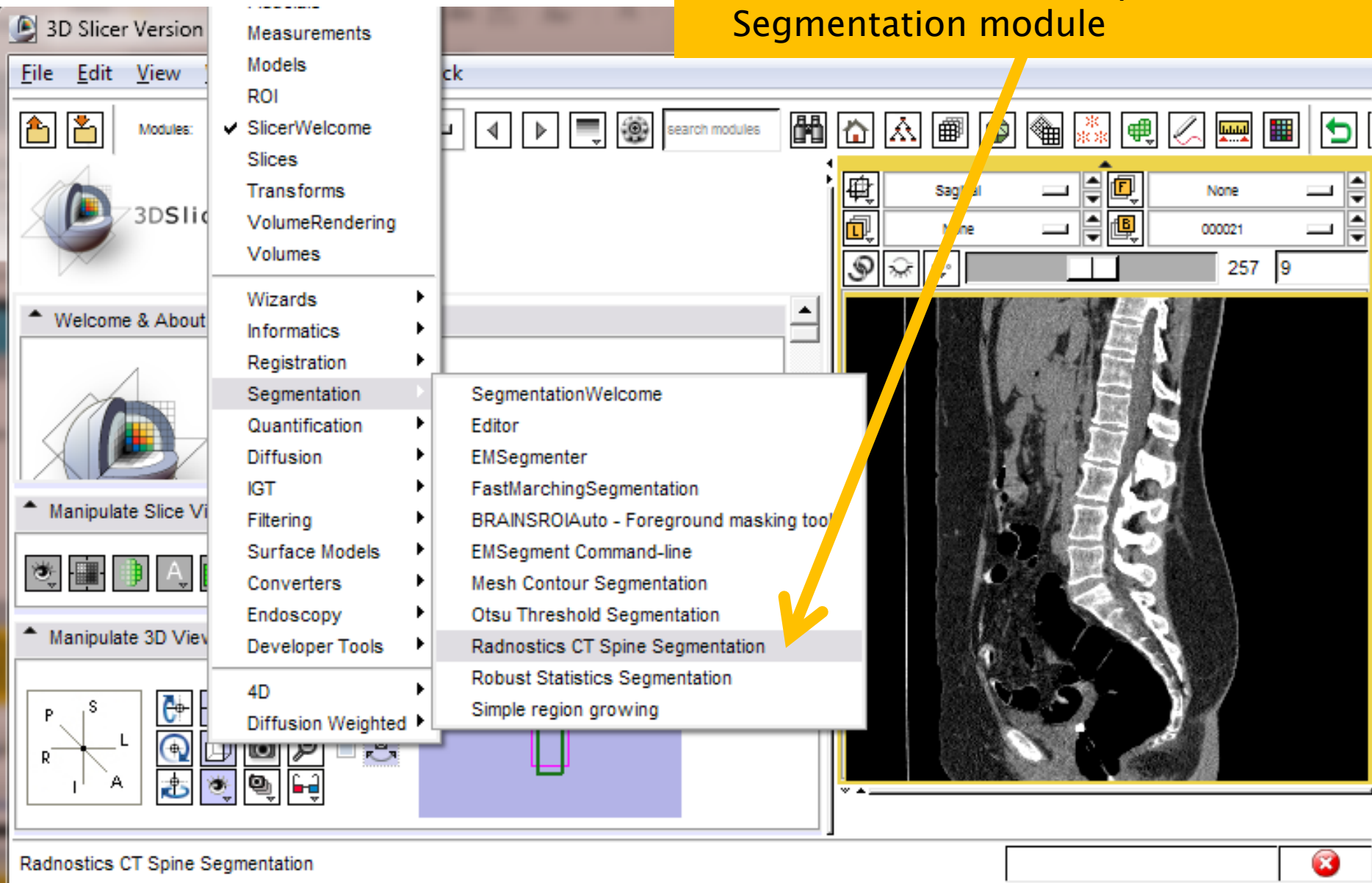
- Thank you
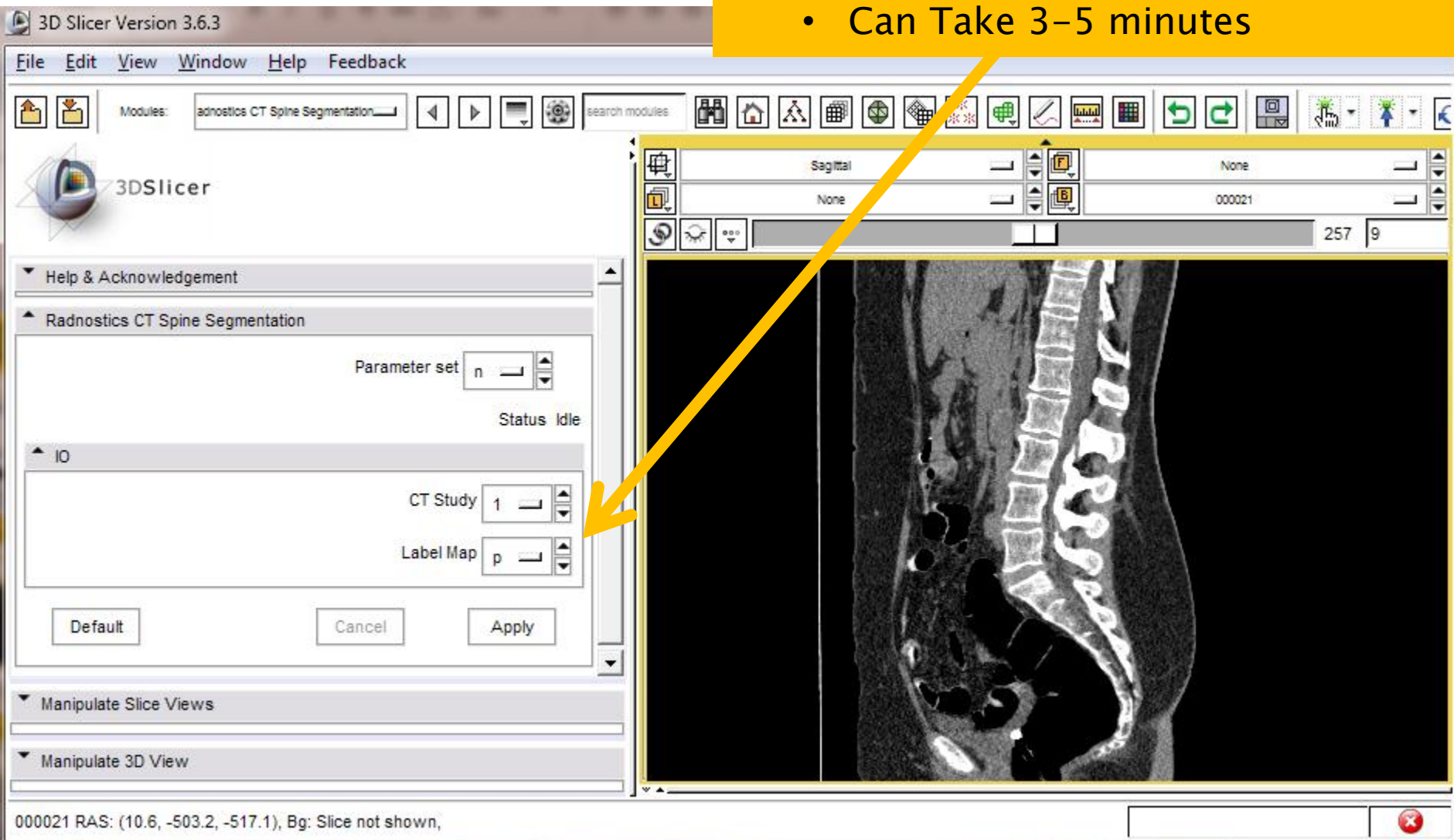
Appendix

Execution – 1

- Load an abdomen CT study into 3D Slicer
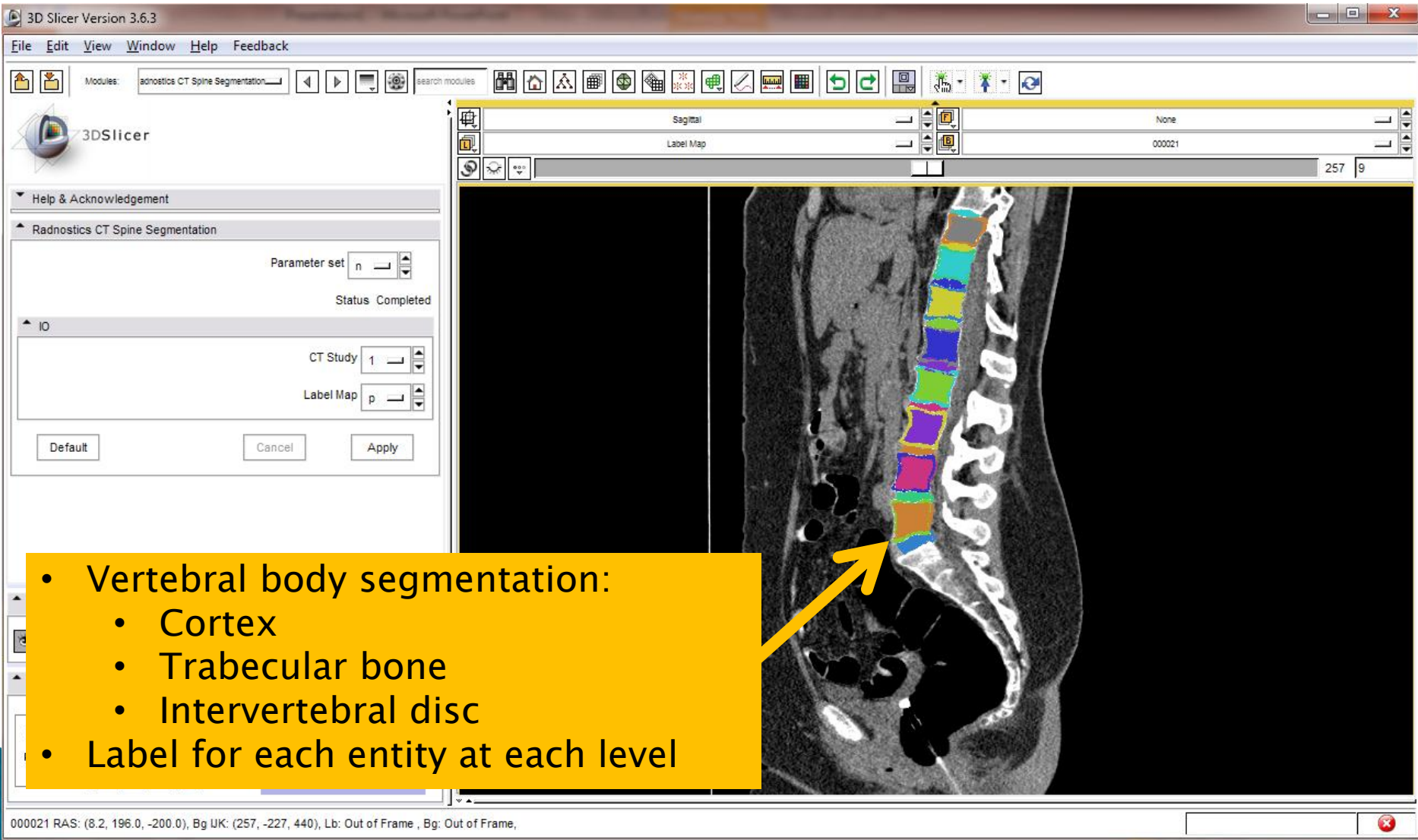- Select Radnostics CT Spine Segmentation module

Execution - 2

- Select loaded volume as CT Study
- Select "Create New Volume" as label map
- Press Apply
- Wait Patiently
 - Can Take 3-5 minutes

Results in Sagittal View

- Vertebral body segmentation:
  - Cortex
  - Trabecular bone
  - Intervertebral disc
- Label for each entity at each level

Results as Surface Model

1. Use Model Maker to create a surface model
- Use labelmap as input volume and Create New for models
- Select Joint Smoothing, press apply.

The different colors highlight holes in the cortex
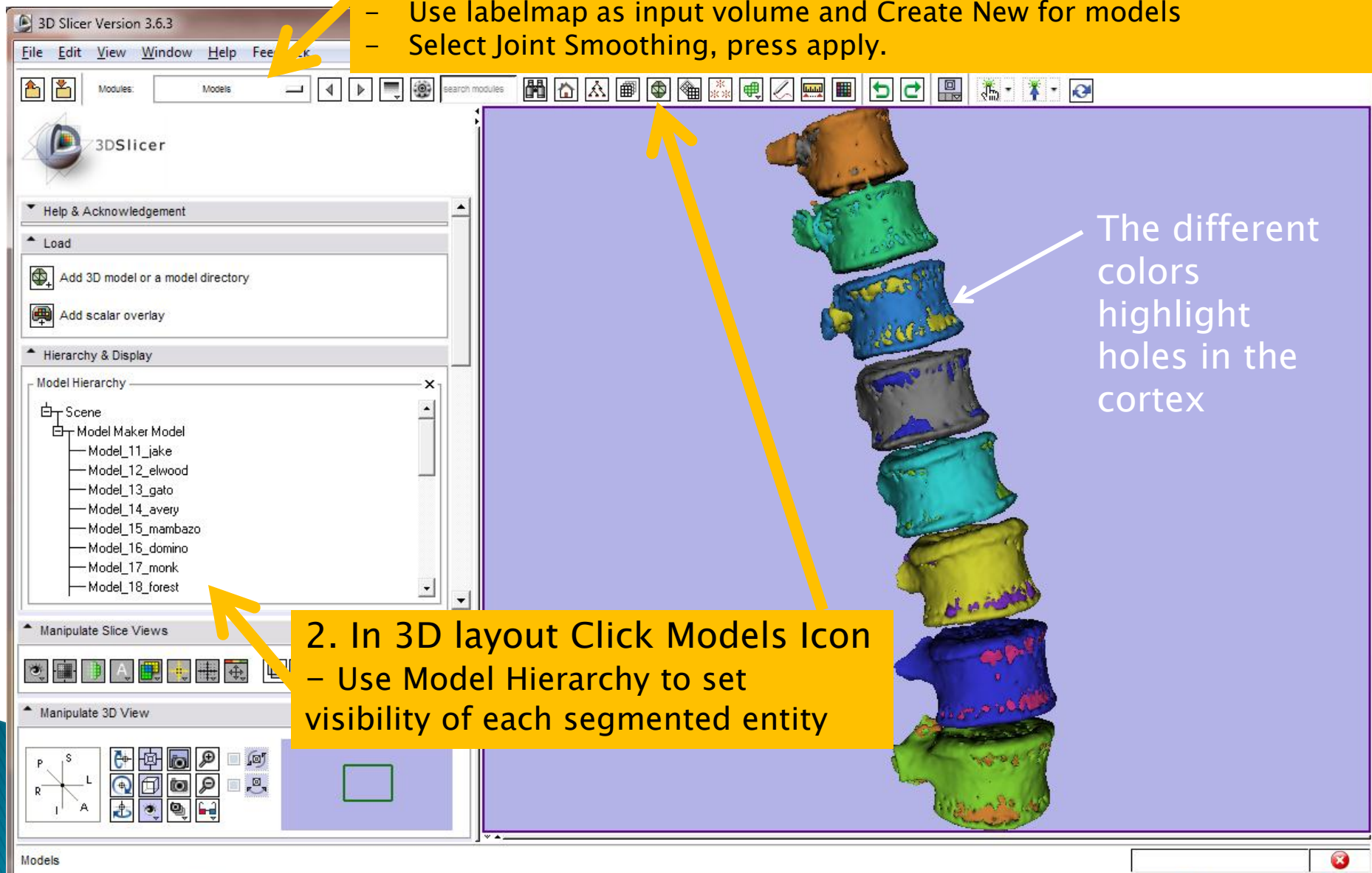
2. In 3D layout Click Models Icon
– Use Model Hierarchy to set visibility of each segmented entity

Command Line Execution

RadnosticsCTSpineSegmentation.exe [--testdir <TestDirectory>] [--logfile <Logfile>] [--cache] <InputFilePath> [<OuputFilePath>]

- InputFilePath: path of CT study
  ◦ MHA, NRRD etc.
  ◦ If DICOM, will search for complete series in same directory
- OutputFilePath: path of output file
  ◦ Deafult: <InputFilePath>.Labelmap.mha
- --testDir <TestDirectory>: Name of test directory.
  ◦ default: %temp%
- --logfile <Logfile>: Name of logfile.
  ◦ default: logfile.xml
- --cache: use cached input from proceeding execution of same volume
  ◦ Useful to avoid rereading 100s of DICOM files during debug sessions.

  ◦ Basic Example:
  ◦ RadnosticsCTSpineSegmentation.exe C:\Images\Study1\000001.dcm Study1Labelmap.mha