



NA-MIC

National Alliance for Medical Image Computing

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Cardiac Agatston Scoring

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Learning Objective

This tutorial demonstrates a semi-automated method to segment and identify calcium plaques in coronary arteries. Then calculate the Agatston score.

Following this tutorial, the user will be able to load scans into Slicer4.3.1, segment calcium plaques, then calculate a calcium score and label statistics.





Pre-requisite

- Pre-requisite tutorial:
 - “Data loading and 3D visualization”
 - Author: Sonia Pujol, Ph.D.
 - <http://www.slicer.org/slicerWiki/index.php/Documentation/4.3/Training>



Material

This tutorial requires the installation of the Slicer4.3.1 release built after 06-05-2014 and the tutorial dataset. They are available at the following locations:

Slicer download page

<http://download.slicer.org/>

Tutorial dataset: [name of dataset]

<http://wiki.na-mic.org/Wiki/index.php/>

[File:CardiacAgatstonMeasures_TutorialContestSummer2014.zip](http://wiki.na-mic.org/Wiki/index.php/File:CardiacAgatstonMeasures_TutorialContestSummer2014.zip)

Note: A SimpleITK bug fix occurred on 06-04-2014 that is necessary for this module to function.

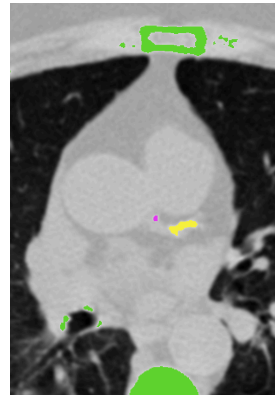
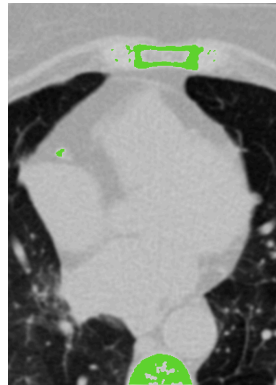
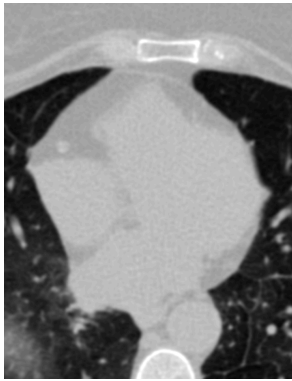






Platforms

Tutorial Name	Platform	Slicer Version	Test Date	Author	Test Results
Cardiac Agatston Measures	Mac OS	4.3.1-2014-06-05	2014-06-19	Jessica Forbes	All tests pass
Cardiac Agatston Measures	Windows 7 64 bit	4.3.1-2014-06-05	2014-06-23	Jessica Forbes	All tests pass
Cardiac Agatston Measures	Linux 64 bit	4.3.1-2014-06-05	2014-06-20	Jessica Forbes	All tests pass



Overview



	Index	Label Name	Agatston Score
	2	Left Main (LM)	4.5229
	3	Left Arterial Descending (LAD)	88.3706
	5	Right Coronary Artery (RCA)	24.2671
	6	Total	117.161



Part 1:
Load
module
and data

Part 2:
Threshold
scan

Part 3:
Identify
calcium
plaques

Part 4:
Calculate
scores
and label
statistics

Part 5:
Save
results



Background

- CVD is the leading global cause of death: 17.3 million deaths/year
- USA: 1 million die of SCD or MI
- 40-60% have no cardiac symptoms before the event*
- Important to identify asymptomatic patients at risk of coronary events

*Myerburg et al. *Am J Cardiol* 1997
Virmani et al. *Cardiovasc Pathol*. 2001



Test Procedure

- EKG-gated non-contrast cardiac CT
- No special preparation
- Scan completed within 5-10 min
- Breath-hold for 10-30 seconds during imaging
- Coronary Artery Calcium (CAC) Score – Agatston Score
 - Based on area and density of calcified plaque
 - Typical report includes:
 - Agatston score for each major coronary artery
 - Total Agatston score for the patient



Part 1: Loading Module

3D Slicer 4.3.1-2014-06-05

Modules: Welcome to Slicer

- All Modules
- Annotations
- Data
- DataStore
- DICOM
- Markups
- Models
- Scene Views
- Subject Hierarchy
- Transforms
- View Controllers
- Volume Rendering
- Volumes
- Welcome to Slicer
- Wizards
- Informatics
- Registration
- Segmentation
- Quantification
- Diffusion
- IGT
- Filtering
- Surface Models
- Converters
- Endoscopy
- Utilities
- Developer Tools
- Legacy
- Testing
- Examples
- MultiVolume Support

Cardiac Agatston Measures

Change the Module to Cardiac Agatston Measures.



Part 1: Loading Data

Open files using "DATA" or "DCM"

Choose File to Add

Select OK

3D Slicer 4.3.1-2014-06-05

Modules: Cardiac Agatston Measures

3DSlicer

Help & Acknowledgement

Advanced - Reload & Test

Reload

Reload and Test

Input Parameters

Input Volume: Select a Volume

80 KEV 120 KEV

Threshold Volume

Add Data into the scene

Choose Directory to Add Choose File(s) to Add Show Options

File	Description
<input checked="" type="checkbox"/> /scratch/cardiac_agatston_score_test_scan.nii.gz	Volume

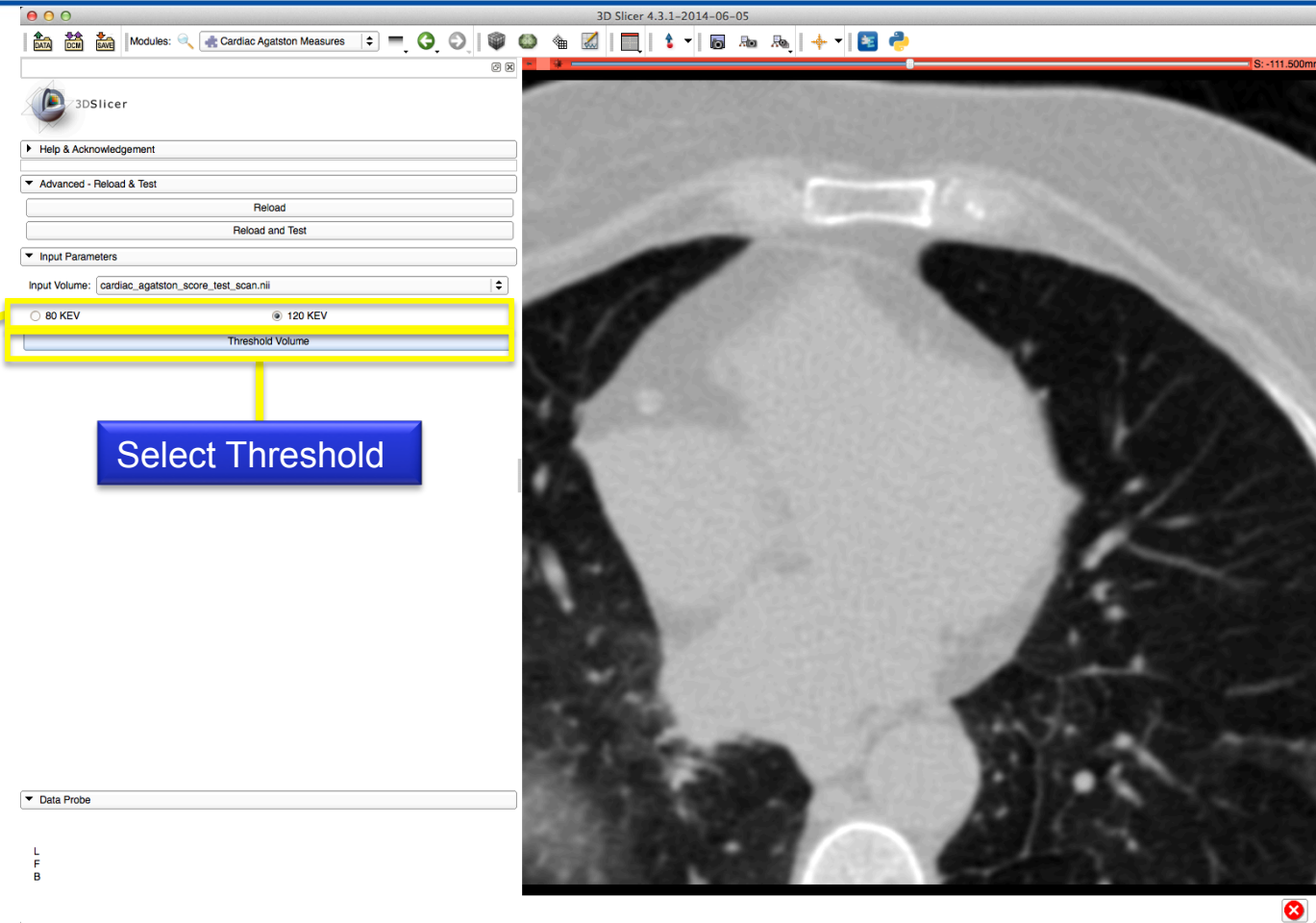
Reset OK Cancel

Data Probe

L
F
B



Part 2: Thresholding Scan



Choose if scan is 80 KEV or 120 KEV

Select Threshold



Part 3: Identifying plaques

3D Slicer 4.3.1-2014-06-05

Cardiac Agatston Measures

3DSlicer

Help & Acknowledgement

Advanced - Reload & Test

Reload

Reload and Test

Input Parameters

Input Volume: cardiac_agatston_score_test_scan.nii

80 KEV 120 KEV

Threshold Volume

Edit Selected Label Map

Default

LM

LAD

LCX

RCA

Undo/Redo/Default: [undo] [redo] [default] [apply]

Active Tool:

Label: default 1

Apply

Chart Agatston Score [dropdown] [checkbox] Ignore Zero

Save

Data Probe

S: -108.500mm

Click on one of the 5 label selection buttons

Click on an island of calcium plaque to identify as one of the 5 labels



Part 3: Identifying plaques

3D Slicer 4.3.1-2014-06-05

Cardiac Agatston Measures

3DSlicer

Help & Acknowledgement

Advanced - Reload & Test

Reload

Reload and Test

Input Parameters

Input Volume: cardiac_agatston_score_test_scan.nii

80 KEV

120 KEV

Threshold Volume

Edit Selected Label Map

Default

LM

LAD

LCX

RCA

Undo/Redo/Default: [undo] [redo] [default]

Active Tool: ChangelandEffect

Label: Right Coronary Artery (RCA) 5

Click on segmented region to change all segmentation directly connected to it to current label.

Apply

Chart Agatston Score [checkbox] Ignore Zero

Save

Data Probe

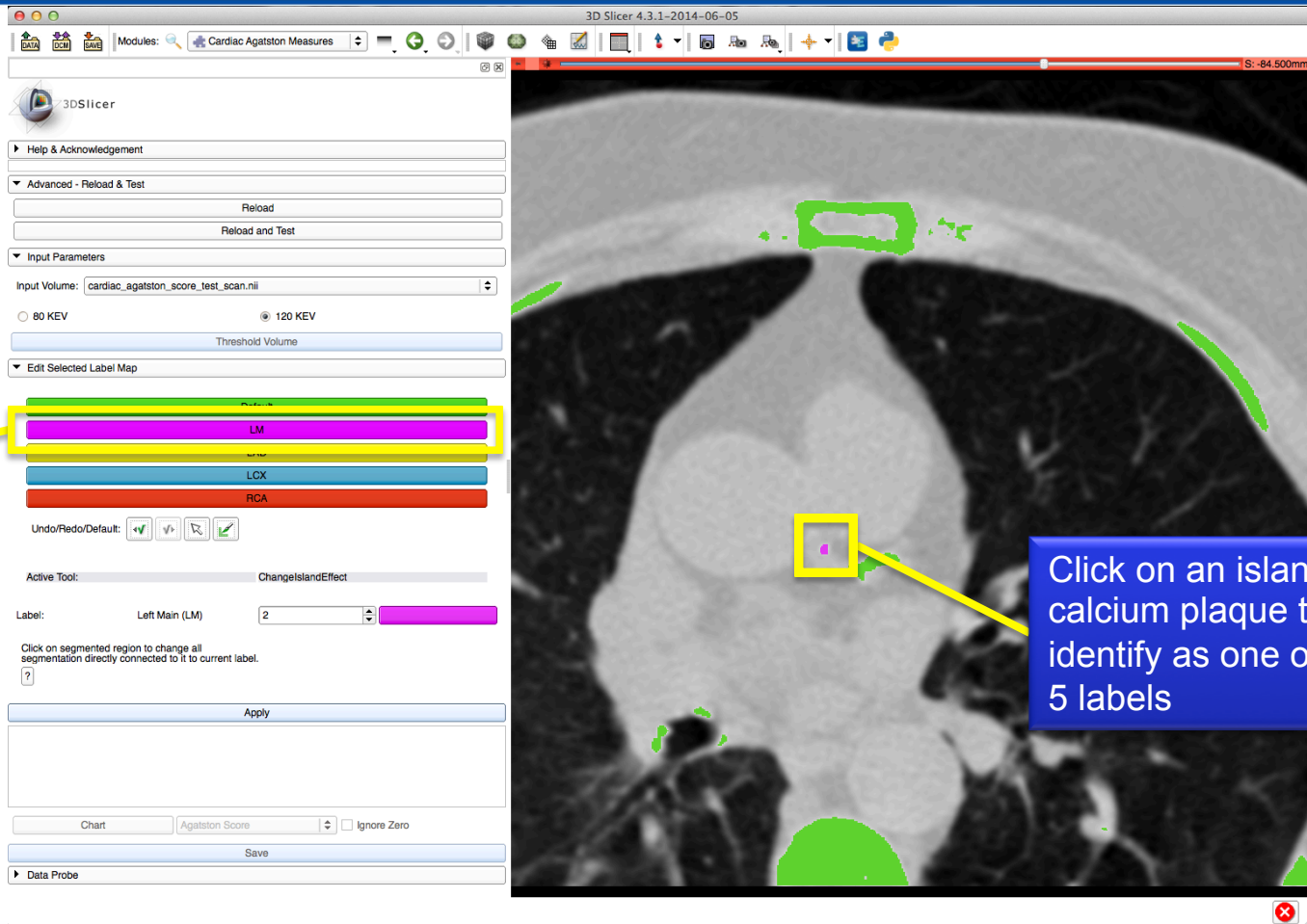
S: -108.500mm

Click on one of the 5 label selection buttons

Click on an island of calcium plaque to identify as one of the 5 labels



Part 3: Identifying plaques

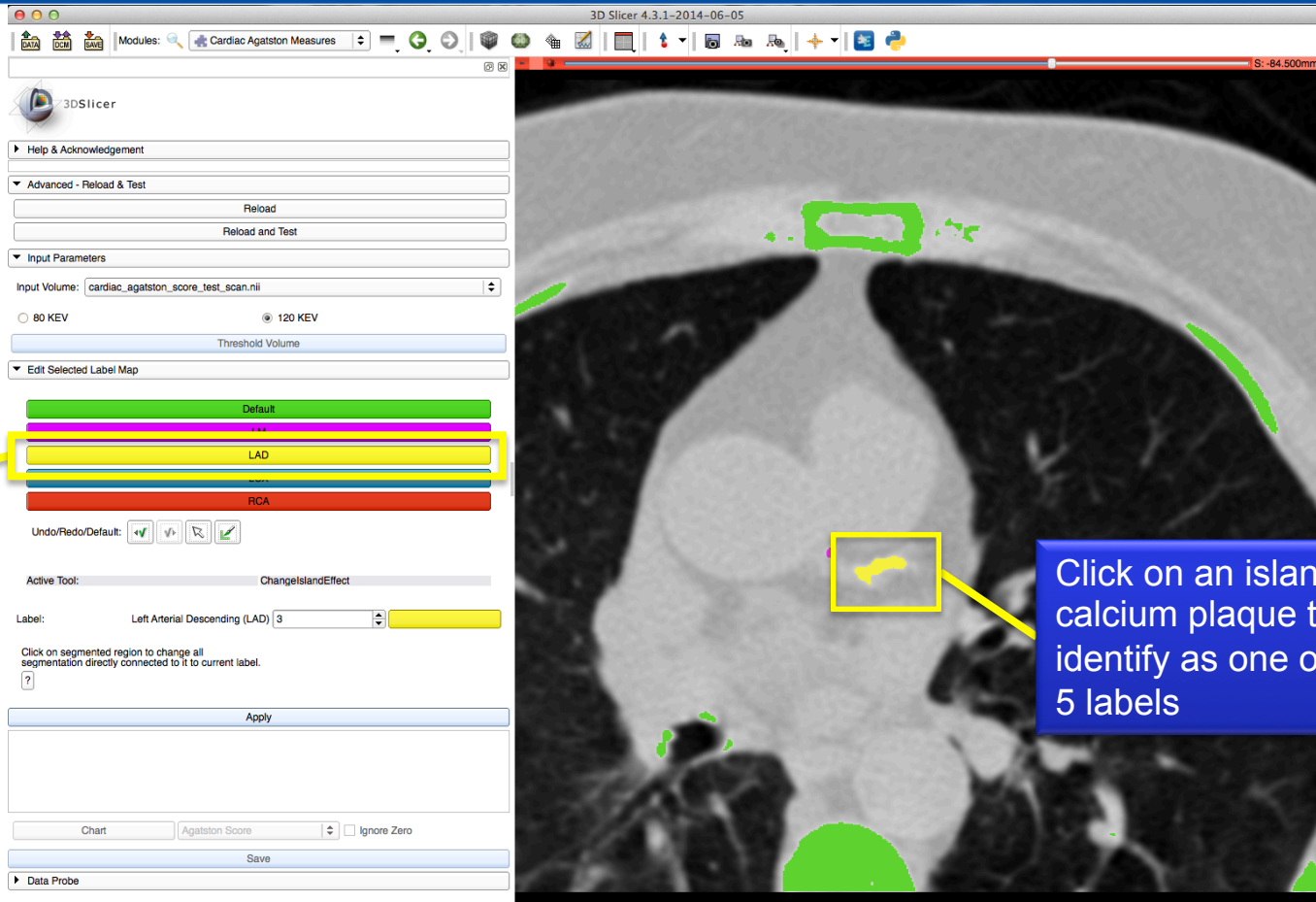


Click on one of the 5 label selection buttons

Click on an island of calcium plaque to identify as one of the 5 labels



Part 3: Identifying plaques



Click on one of the 5 label selection buttons

Click on an island of calcium plaque to identify as one of the 5 labels



Part 4: Calculating Scores

Select Apply to calculate the Agatston score for individual labels and total

Apply										
	Index	Label Name	Agatston Score	Count	Volume mm ³	Volume cc	Min	Max	Mean	StdDev
	2	Left Main (LM)	4.5229	26	6.78436	0.00678436	137	276	201.538	44.7251
	3	Left Arterial Descending (LAD)	88.3706	254	66.2779	0.0662779	131	654	290.76	121.42
	5	Right Coronary Artery (RCA)	24.2671	104	27.1374	0.0271374	130	384	208.077	61.6902
	6	Total	117.161	384	100.2	0.1002	130	654	262.326	111.709

Chart	Agatston Score	<input type="checkbox"/> Ignore Zero
	Count	
	Volume mm ³	
	Volume cc	
	Min	
	Max	
	Mean	
	StdDev	

Select Chart and Column to compare the values for each label



Part 4: Calculating Scores

3D Slicer 4.3.1-2014-06-05

Modules: Cardiac Agatston Measures

3DSlicer

Help & Acknowledgement

Advanced - Reload & Test

Reload

Reload and Test

Input Parameters

Input Volume: cardiac_agatston_score_test_scan.nii

80 KEV 120 KEV

Threshold Volume

Edit Selected Label Map

Default

LM

LAD

LCX

RCA

Undo/Redo/Default:

Active Tool: DefaultTool

Label: Left Arterial Descending (LAD) 3

Apply

Index	Label Name	Agatston Score
2	Left Main (LM)	4.5229
3	Left Arterial Descending (LAD)	88.3706
5	Right Coronary Artery (RCA)	24.2671

Chart: Agatston Score Ignore Zero

Save

Data Probe

Label Statistics

Agatston Score

Left Main (LM) Left Arterial Descending (LAD) Right Coronary Artery (RCA) Total

S: -84.500mm R: -7.399mm A: 146.836mm



Part 5: Saving Results

Select Save.
This saves the MRML scene and a CSV file containing the calculated scores and statistics.

Then select the New Folder icon.
Rename the folder.

Choose the newly created folder.

Index	Label Name	Agatston Score	Color
2	Left Main (LM)	4.5229	26
3	Left Arterial Descending (LAD)	88.3706	254
5	Right Coronary Artery (RCA)	24.2671	

Label Statistics

Agatston Score

Left Main (LM) Left Arterial Descending (LAD) Right Coronary Artery (RCA) Total

Label

Apply

Save



Conclusion

- All tests passed with:
 - Linux 64-bit
 - MacOS
 - Windows 7 64-bit



Acknowledgments



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SINAPSE Lab