



Cardio Images

From Images to Measurements

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Version 1.4

For GIMIAS-1.4

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The aim of this exercise is to explore the different types of measurements we can do using GIMIAS, on a 3D + t image. The exercise will allow to perform all the steps from loading the DICOM image (acquired using MRI modality) measure distances, select points and save their coordinates in order to analyze their displacement in time, manually draw regions of interest (ROIs), compute mean, standard deviation, minimum and maximum intensity values of the image in the ROI, and plot these values over time.

Download the data

Download and decompress this file:

<ftp://193.145.50.28/projects/Tutorials/CardioImagesTutorialData.zip>

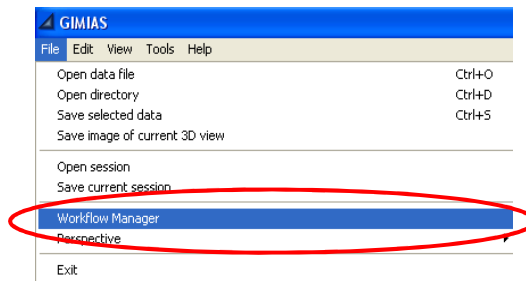
You need **these files** for this tutorial:

1. The folder: Cardiology/HeartModel/MRI/
2. The folder: Cardiology/HeartModel/MRI_fitting_LV/

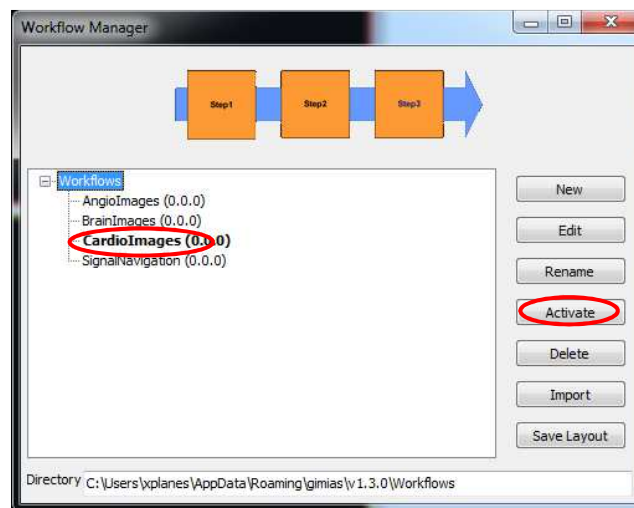
Activate the Cardio Images workflow

Before starting the workflow execution you need to update and activate the *CardioImages* workflow in GIMIAS.

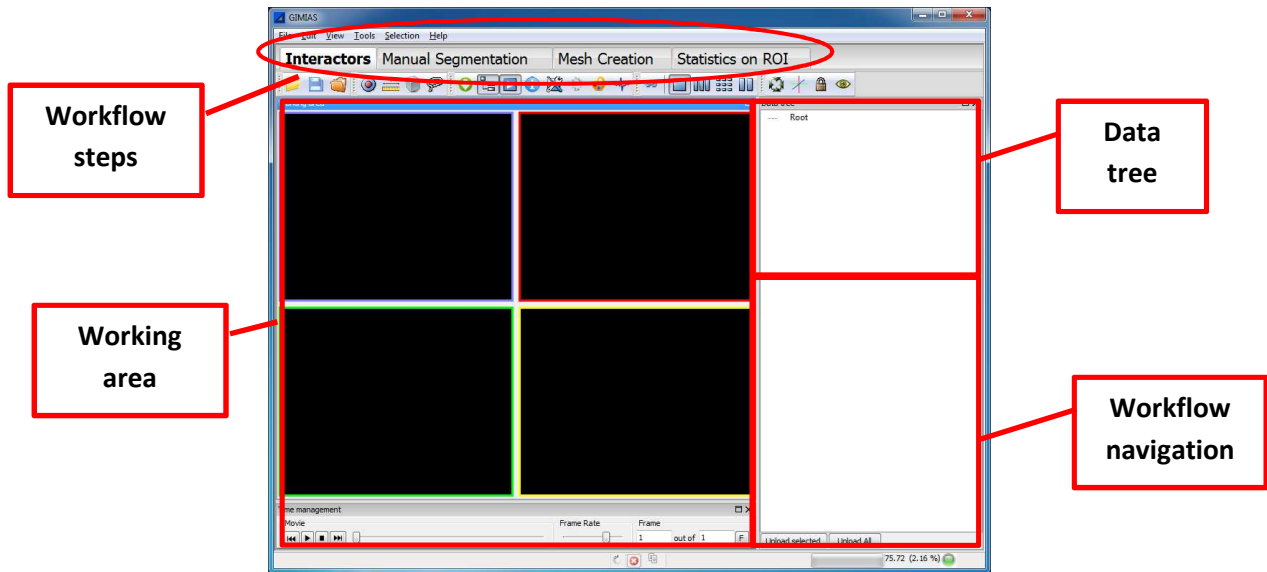
1. Open GIMIAS and from the top menu select File->**Workflow Manager**.



2. **Activate the workflow:** Select *CardioImages* workflow and press Activate button



3. GIMIAS will close and open again with the configuration shown in the figure below.

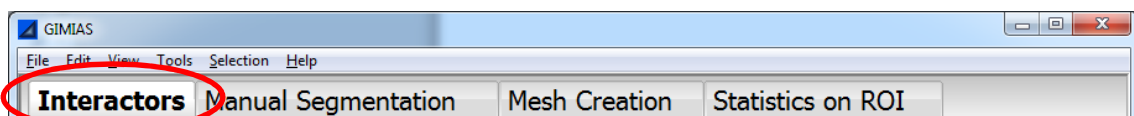


Each tab at the top of the working area corresponds to a workflow step. At the right bottom of the GUI are the processing steps defined for each workflow step.

- **Workflow steps:** these are the main steps of the workflow. For each step, there's a specific working area.
- **Working area:** The main visualization view. The data will be displayed here.
- **Data tree:** All data loaded into memory
- **Workflow navigation:** Allow to navigate through all the workflow steps using the arrows.

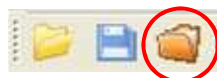
Step1: Interactors (Point Set and Measurement)

In the **Interactors** tab perform the following steps.



1. Load the image:

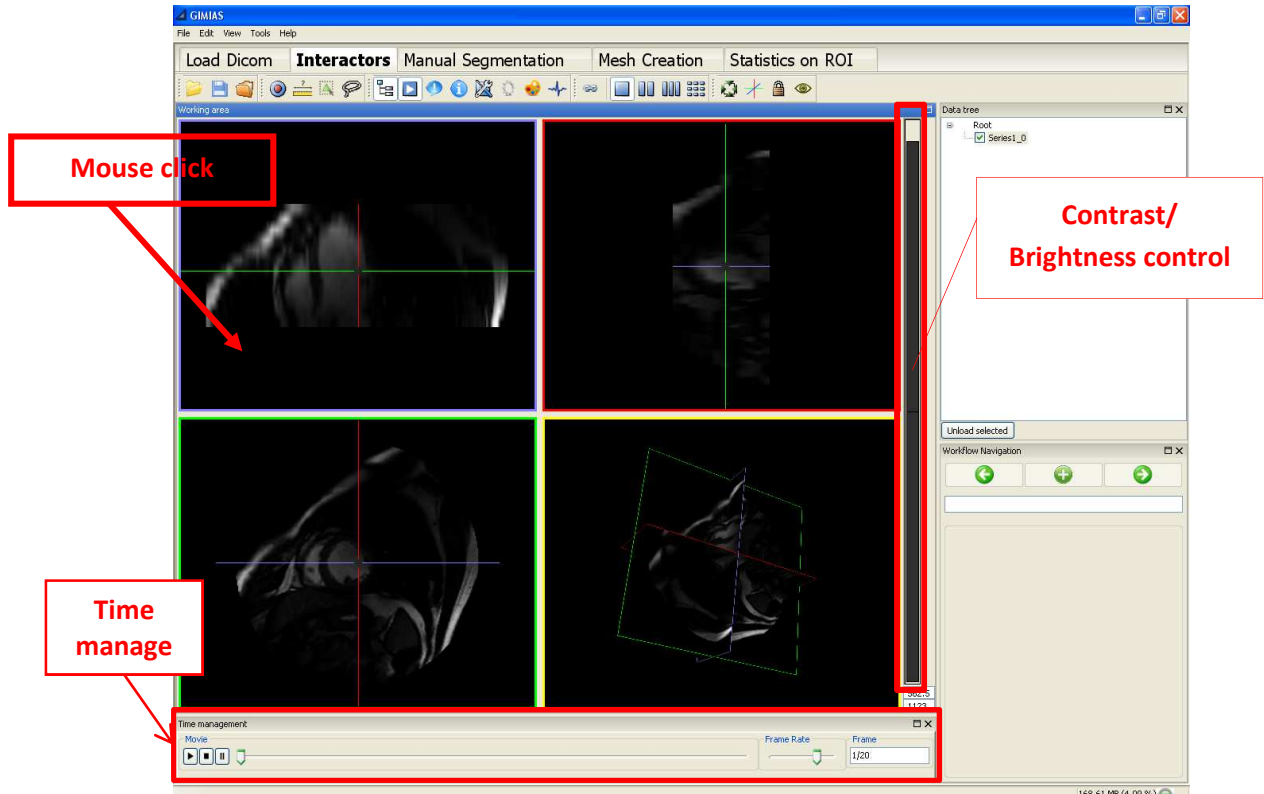
- In the IO Toolbar click on the Open Folder button and select the folder MRI you downloaded: **MRI**



2. Inspect the image:

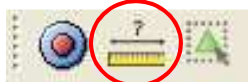
- You can navigate and inspect the image in the 2D views and in the 3D view. Use the mouse wheel button to navigate through different slices, the central button + drag to pan and the right button + drag to zoom/unzoom.

- c. Navigate to the image timepoints using the time management bar at the bottom of the GUI. When processing the image, you should always stop the time management bar.
- d. Adjust the contrast bar to improve image visualization. Click with the left mouse button on the visualization window and while the mouse button is pressed, drag the mouse in the direction up-down to change contrast, left-right to change brightness.

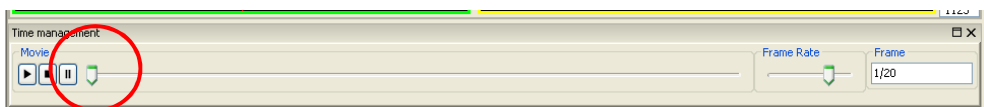


3. Measurements on the image:

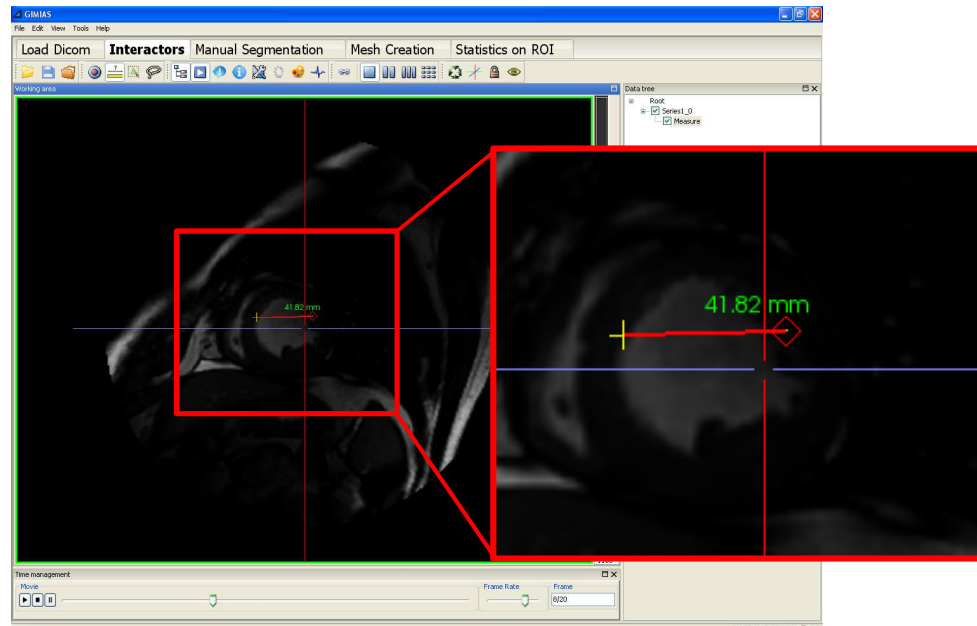
- a. In the Selection toolbar click on the Measurement button



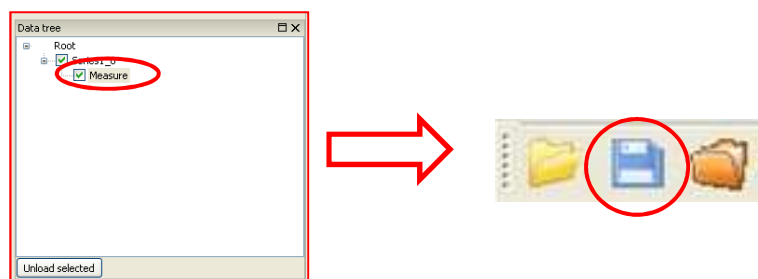
- b. Choose on which 2D view you want to perform the measurement. For instance double click on the Y plane (bottom left of the working area) to enlarge it.
- c. Choose the first timepoint, for instance the End of Systole (timepoint 17) using the slider



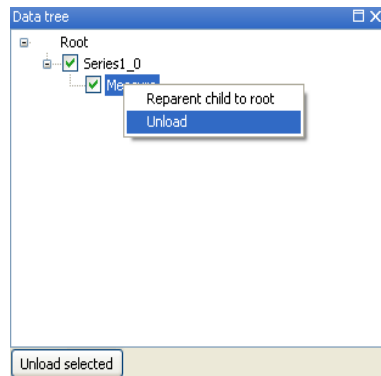
- d. Do the first measurement: SHIFT+LEFT CLICK to place the first landmark and SHIFT+LEFT CLICK to place the second landmark. Measure the diameter of the left ventricle as you can see in the image bellow.



- e. Choose the second timepoint, for instance the End of Diastole (timepoint 33), click on the Measurement button in the Selection toolbar and do another measurement as described before.
- f. Save the measurements done: select Measure in the Data Tree and click on the Save button in the IO Toolbar.



- g. Remove the Measure from the Data Tree: right click on Measure and select Unload.

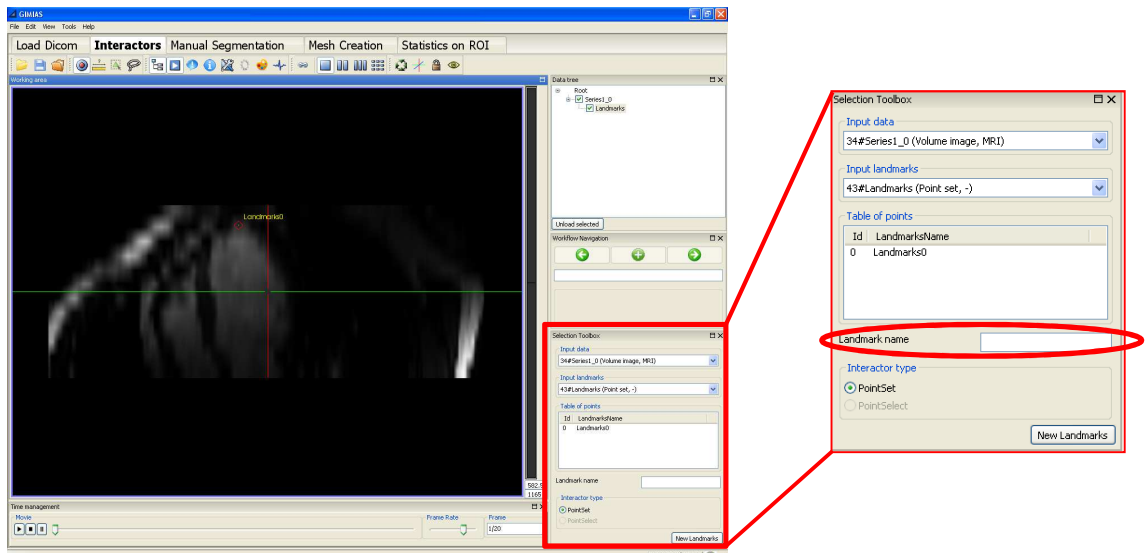


4. Place landmarks on the image

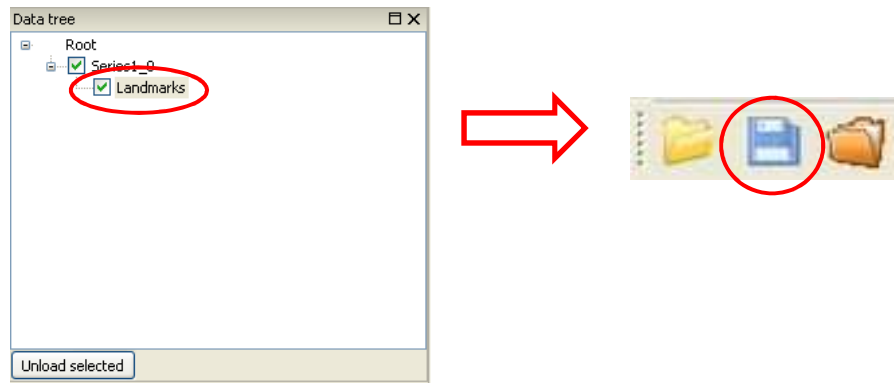
- a. In the Selection toolbar click on the Landmarks selector button



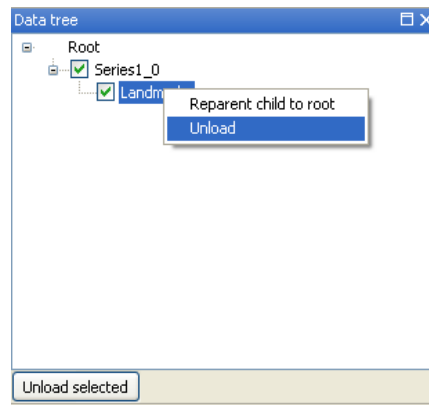
- b. Choose a point on the image that you want to follow in time and place a landmark (SHIFT + LEFT CLICK)
- c. Change timepoint using the time management bar and place another landmark.
- d. Do the same operation on all timepoints.
- e. Press play on the time management bar to see the landmark displacement over time
- f. In the Selection Toolbox change the name of the landmark by typing it in the Landmark name field.



- g. Save the Landmarks: select Landmark in the Data Tree and click on the Save button in the IO Toolbar.



- h. Remove the Landmarks from the Data Tree: right click on Landmarks and select Unload.

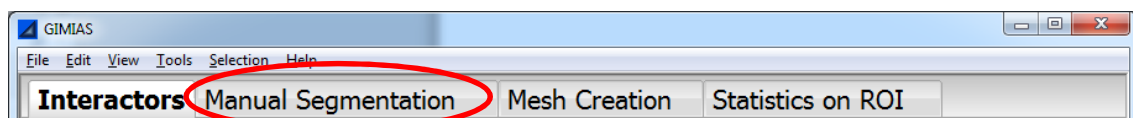


5. Save session

- a. Go to File->Save session and set the name "Session1" for the session. This will save all data you have generated until here and will allow to recover it later.

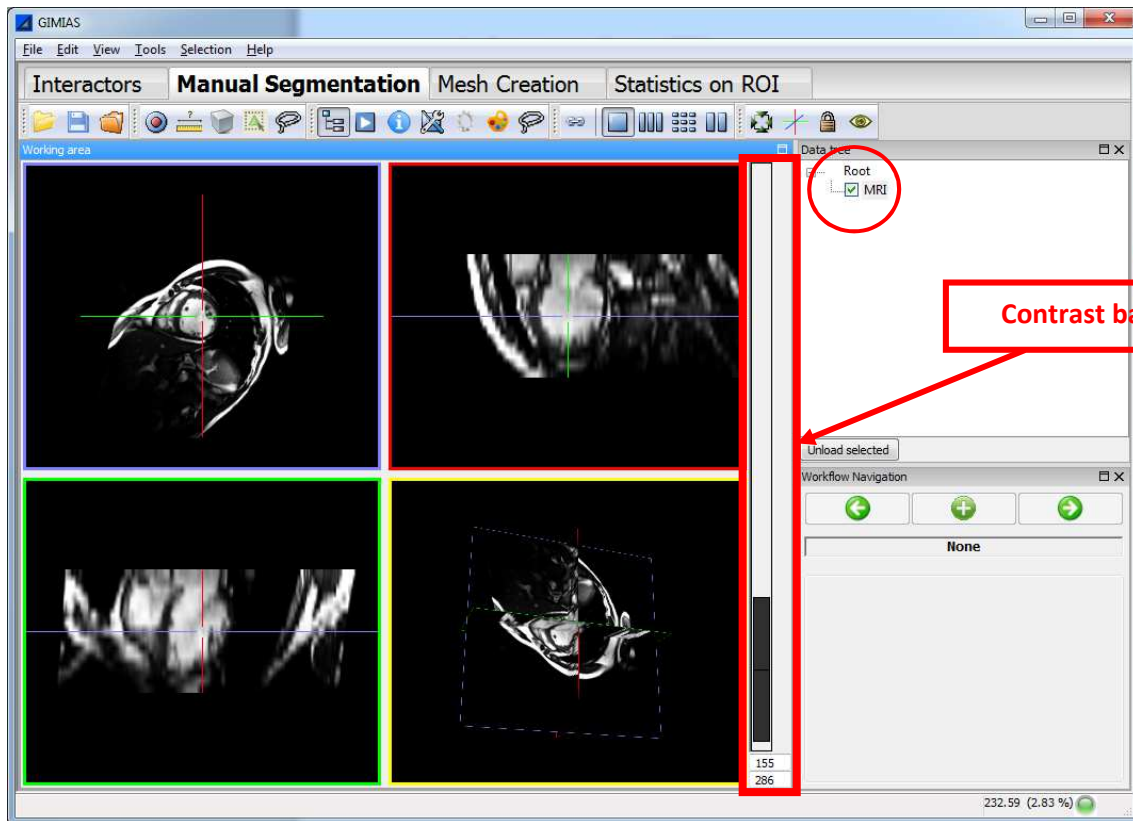
Step3: Manual Segmentation

Open the **Manual Segmentation** tab and perform the following steps.

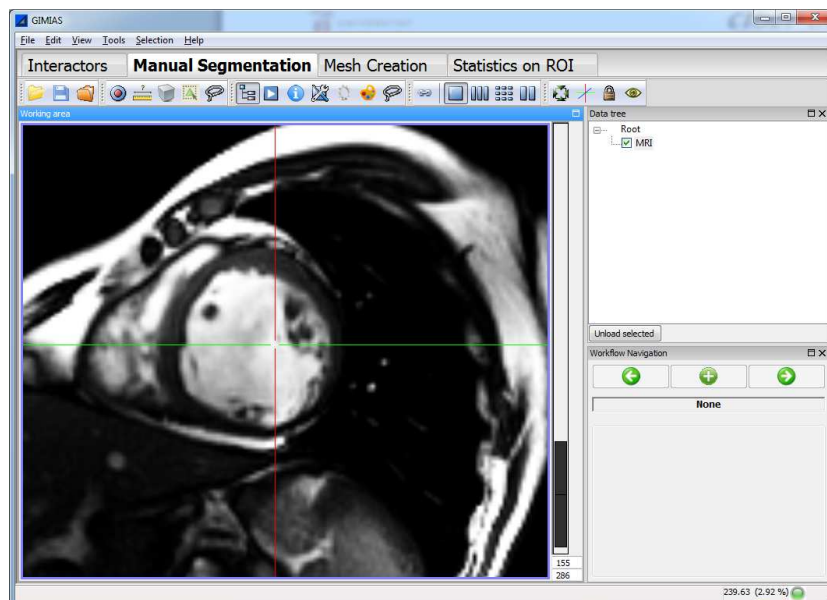


1. Draw a region of interest (ROI)

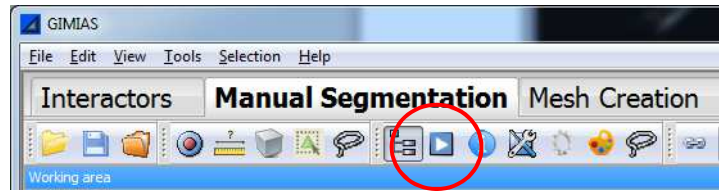
- a. Show the image pressing the check box and adjust the contrast bar to improve visualization



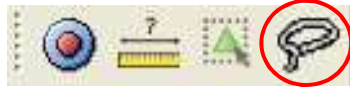
- b. Double click on the first view to maximize it and use right mouse button to zoom into the heart



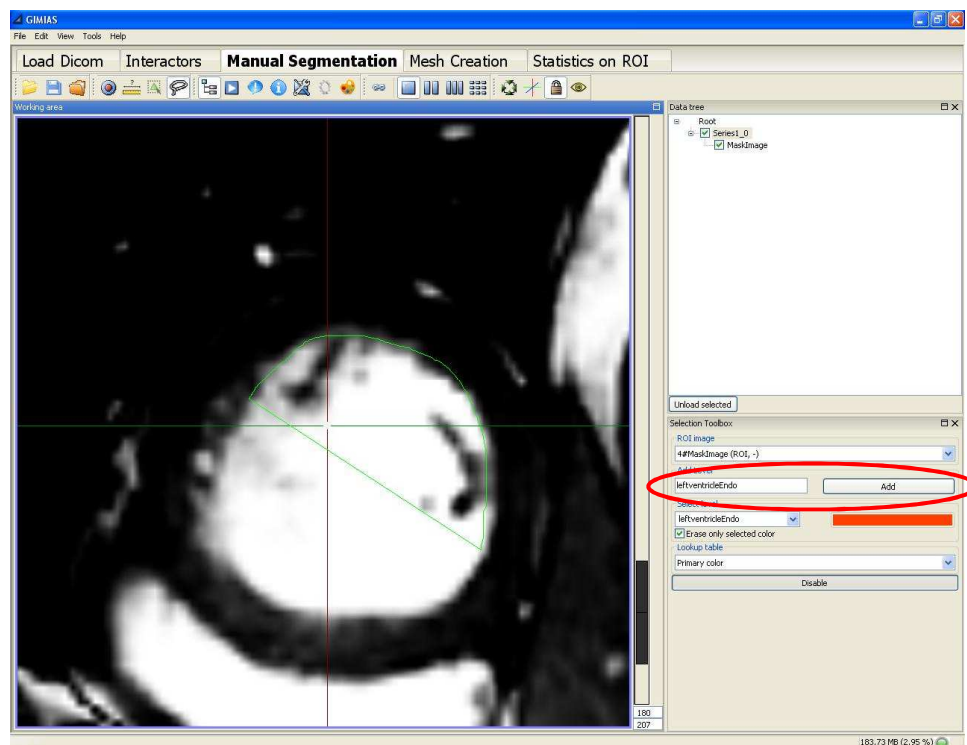
- c. Show time management bar using the toolbar



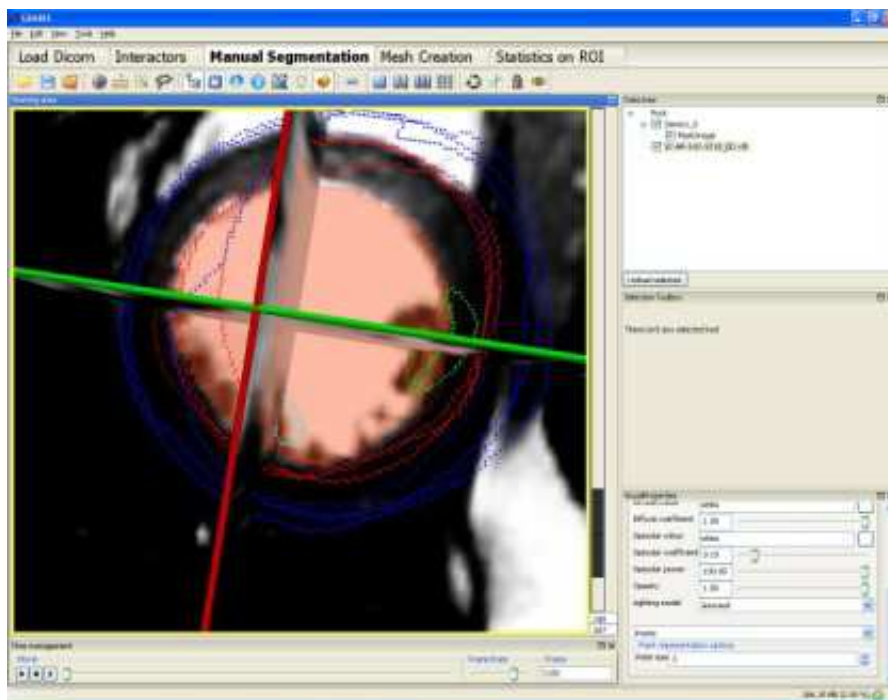
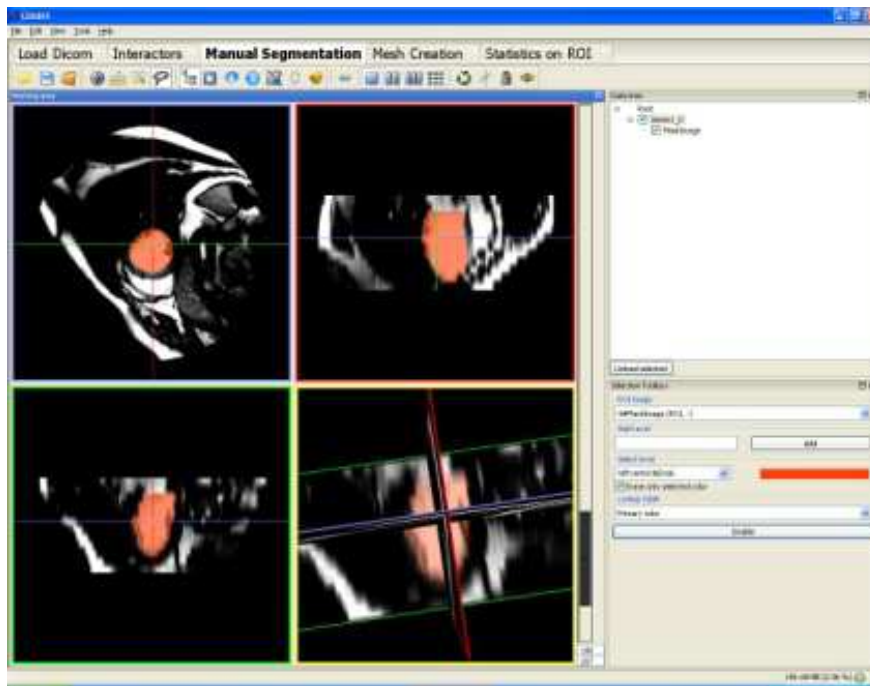
- d. Go to time step 33 using the time management bar.
- e. From the Selection Toolbar Selection click on the Manual Segmentation button.



- f. In the Selection Toolbox write in the Add Level text box the name of the region you are going to segment (e.g. LeftVentricle endo) and press Add



- g. Click on the image with LEFT MOUSE BUTTON, while the LEFT MOUSE BUTTON is PRESSED, drag to draw the region of interest.
- h. Apply corrections to the ROI by pressing CTRL+LEFT CLICK and dragging on the image to draw the border of the correction.
- i. Scroll with the **wheel mouse button to navigate** to another slice and draw another ROI.
- j. When finished to draw the ROIs for one image, press the Disable button.
- k. Compare the segmentation with the rest of the assistants to the workshop
- l. Open the downloaded cardiac segmented mesh from the folder **MRI_fitting_LV** and compare the results.

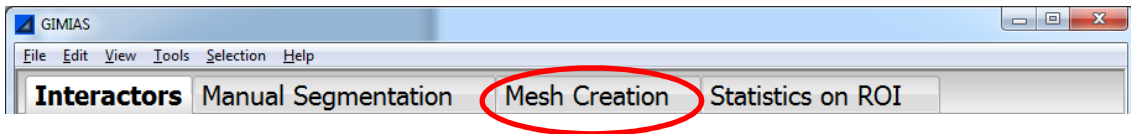


2. Save session

- a. Go to File->Save session and set the name "Session2" for the session. This will save all data you have generated until here and will allow to recover it later.

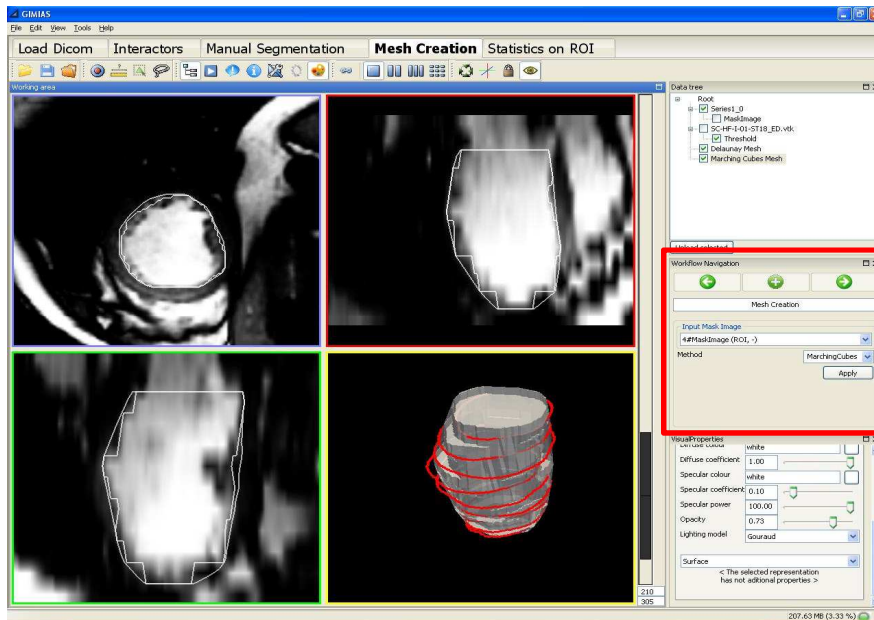
Step4: Mesh Creation

Open the **Mesh Creation** tab and perform the following steps.

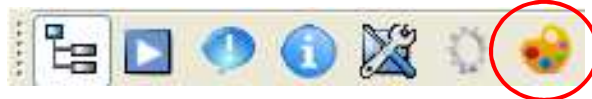


1. Generate mesh

- Select the time step where you have generated the manual segmentation (time step 33)
- Show the input image and the mask image
- In the Mesh Creation tool set the Mask Image (ROI) as input data, choose the Delaunay method and press Apply. A mesh will be generated from the ROI.

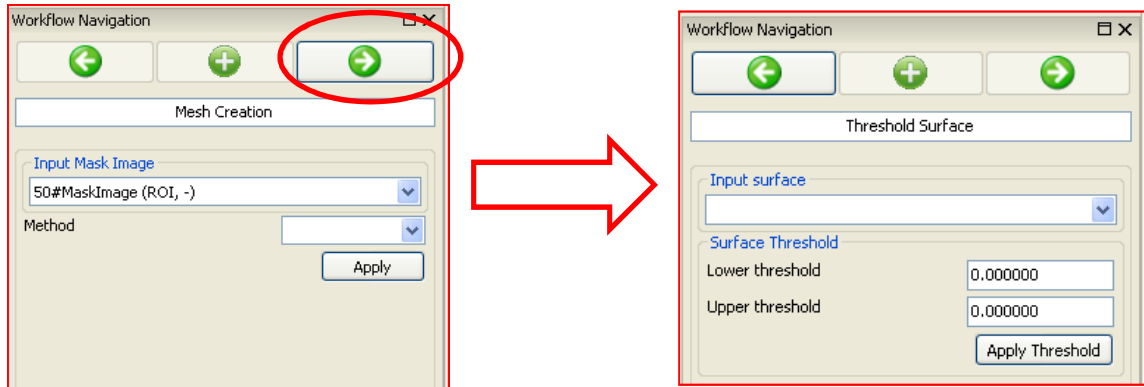


- Choose the Marching Cubes Method and press Apply
- Use the Visual Properties to see the difference. For example, set red color to Delaunay mesh and blue color to marching cubes mesh. Change opacity of Delaunay mesh to 0.5.

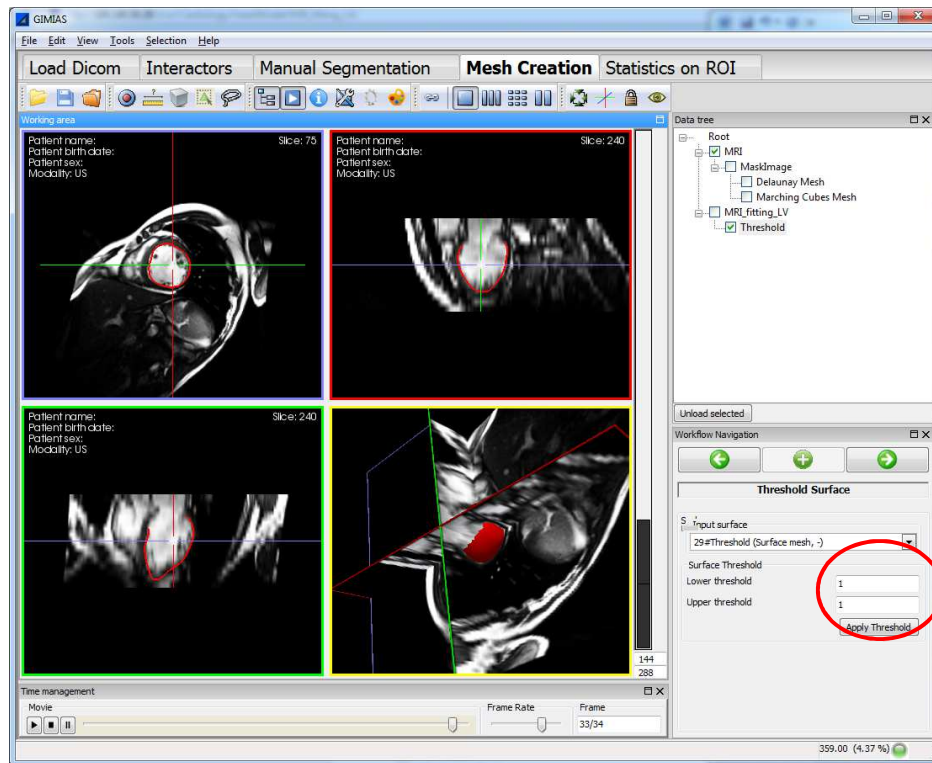


2. Apply Threshold

- Press the right arrow to go to the next processing step.

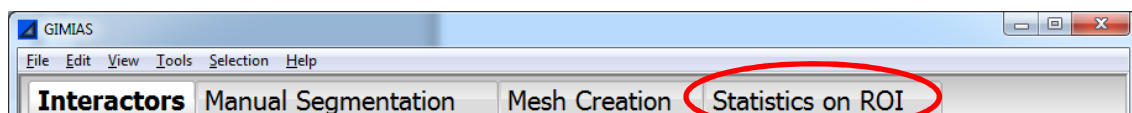


- b. Set the previously loaded data as input (MRI_fitting_LV) in the Threshold Surface tool, set both Lower and Upper Thresholds to 1.
- c. Press Apply. Only the segmentation of the LV endocardium will be visualized.



Step5: Statistics on ROI

Open the **Statistics on ROI** tab and perform the following steps.



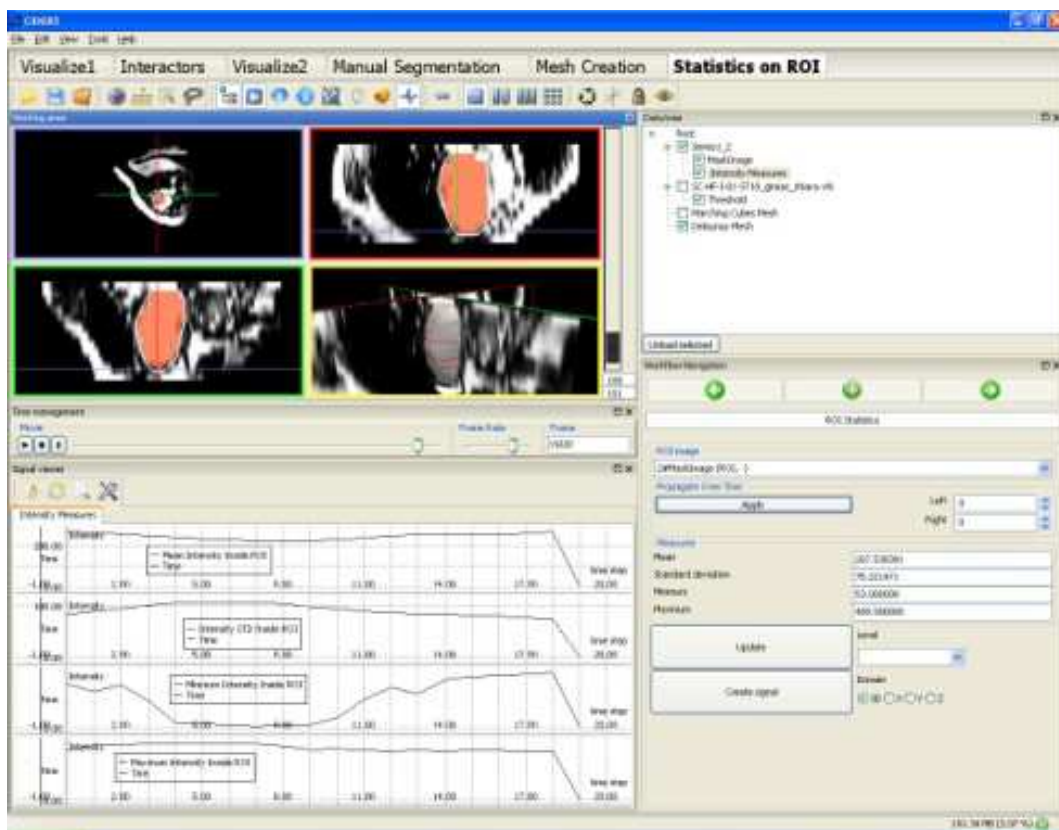
1. Propagate ROI in time

- a. Select the time point 33 using the time slider. You should see mask image you have created.

- b. In the ROI Statistics tool, set the Mask Image as input data, (ROI image), set left to -33 and right to 1 and press Apply. The ROI will be copied to all timepoints.

2. Measurements in the ROI

- a. Select the level leftVentricleEndo and press Update. The mean, standard deviation, minimum and maximum intensity values of the image corresponding to the selected level and time step are computed. You can change the level using the combobox and the time step using the time management bar. When you click update the values are refreshed with the selected level and time step.
- b. Press Create signal: The curve showing the evolution of these values over time is computed and visualized in the signal viewer.



3. Save session

- a. Go to File->Save session and set the name "Session3" for the session. This will save all data you have generated until here and will allow to recover it later.