Clinical Training for Visage 7 Cardiac
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Example Usage

Visage 7 supports multi-phase cardiac CTA workflow. The usage of the application can be described with these examples:

Overview

Loading large multi-phase cardiac CTA study. Auto-segmentation of chest wall for all phases.

Coronary Workflow

Generate Curved Plane, Lumen and Cross-Section views from vessel centerline and quantify stenosis.

Left Ventricle Analysis

Automatic segmentation of left ventricle. Calculate parameters such as Stroke Volume and Ejection Fraction. Includes graphic display of findings.

Coronary Calcium Scoring

Semi-automated identification of coronary calcium. Results are placed in a comprehensive coronary calcium report.
Cardiac Workflow Protocol

Select desired viewer layout from the layout tabs located above the viewers. Note: *Thin 4D* layout displays a comprehensive view of a single phase. A different phase can be selected by using the right/left arrow keys or by clicking the red folder on any viewer and selecting the desired phase from the list.
Remove Chest Wall

Select the *Remove Chest Wall* tool from the toolbar or tool palette. This will remove the chest wall from all loaded phases.
Edit Chest Wall Removal

Select the **Freehand Crop** tool from the toolbar. There are two options for manually removing anatomy. This is done by simply drawing a line around an object. Selecting the *Remove Inside* option removes anything inside the line drawn. Selecting the *Remove Outside* option will remove anything outside the line drawn. If a mistake is made click the *Reset* button to return to the original image.

Select **Remove Inside**

Select **Remove Outside**

Select the **Apply to all Phases** button from the **Freehand Crop** toolbar, to include the current crop in all phases.
An object is created in Visage 7 during a segmentation such as removing the chest wall. Once objects are created, they can be manipulated individually in the **Object Display** popup.
Selecting Optimal Phase

Loading all phases allows for selection of the optimal phase for viewing each of the coronary arteries. Toggle through each phase by using the right/left arrow keys or select a specific phase by clicking the red folder in any of the viewers. Note: The phase indicator is typically seen in the annotation on the viewer (in this example, the phase 0.0% is shown at the bottom of the VRT viewer).
Thick Slab MIP

The more traditional approach to interrogating coronaries is using a thick MIP and rotating or “walking the dog” around the vessel.

Select a slice thickness from either the popup menu in the viewer controls or click on the current slice thickness in the viewer controls, and type the desired thickness.

Select the 3D Rotate tool from the toolbar or tool palette. This is enabled on the left mouse button.

Re-center rotation point by moving crosshairs to new position, then either selecting F10 (default) or the Center View tool (seen to right) from the toolbar or tool palette. Now continue to drag along vessel path.
When analyzing the vessels in angiography, it is sometimes difficult to follow the path of the lumen in order to identify stenosis and calcifications. Since a manual segmentation would be much too time-consuming, an automatic algorithm is provided that helps in following the vessel along its path. The vessel can then be viewed in different modes, among them, Curved Plane Reformat (CPR); VRT (3D); stretched out (Lumen) view and Cross-Section view.

Curved Plane Reformat

Cross-Section View

VRT (3D)

Stretched Out (Lumen) View
Vessel Analysis / Vessel Trace

There are two vessel tools available for large and small vascular anatomy. The small vessel algorithm is better suited for coronary arteries. The large vessel algorithm is better suited for large vessels such as the iliac or femoral arteries.

Multiple vessels can be traced, labeled and analyzed. Over the next two pages, the following steps will demonstrate a single vessel trace on axial MPR view.

1. First, select the desired vessel from the list; in this example RCA.

2. Next, click the Edit button.

3. Next, scroll the axial image to the top of the heart and click on the proximal RCA, in this example, as indicated by the pink dot in the vessel lumen. This is the start point for the vessel trace.

4. Now, scroll down towards the bottom of the heart and click on the distal end of the RCA. Note: You can drop multiple points along the vessel if the vessel is tortuous.

Finally, click on the Small Vessel tool from either the floating toolbar, located at the bottom of the viewer or on the Vessel tool card.
A poor vessel trace can be the result of a tortuous vessel or severe narrowing of vessel lumen. Typically, dropping multiple points during the initial trace will combat this. To edit a poor vessel trace, complete the following steps:

1. Click the Edit button in the Vessel tool card or the toolbar and move the displaced vertices (points) back into the vessel lumen.
2. It may be easier to follow the trace in the MPR view. Toggle off the Show All Vertices button. This will now only demonstrate a few vertices at a time. Scroll through the image to follow the vertices, making corrections along the way.
3. Move all desired vertices (points) into vessel lumen then re-trace by clicking the Small Vessel button from the Vessel tool card or the floating toolbar in the viewer.
Interact with the *Curved Plane Reformat* by placing the mouse cursor on the image, then left click and drag, horizontally, across the image. This will cause the image to rotate along the long axis.
The **Lumen view** demonstrates the entire traced centerline as a straight or stretched view. The vessel can be log rolled by left click and drag up or down in the **Lumen view**. Use the mouse wheel to scroll through the vessel. The two vertical blue lines represent a **Cross-Section view**. These lines can be moved along the vessel with the corresponding **Cross-Section view** displayed in the upper left viewer.

The **Cross-Section view** demonstrates a view of the lumen perpendicular to the long axis of the vessel.

In this view, use the mouse wheel to scroll along the vessel path or click and drag either blue reference line in the **Lumen view**.
Stenosis Measurement

Stenosis measurements can be made by using the Lumen and Cross-Section views. The following steps demonstrate the stenosis measurement workflow.

On the Lumen view (above), move one of the blue lines to desired “normal” lumen reference. Note: The active blue reference line is indicated by an orange triangle at the bottom of the reference line.

Create a diameter measurement, in the Cross-Section view, by using the Distance Measurement tool.

Now, move the second blue line, in the Lumen view, to the area of suspected stenosis.

Again, create a measurement on contrast lumen, using the Distance Measurement tool. The Diameter and Ratio % is noted in the Lumen view.

To change from Ratio % to Stenosis %, right click on the Ratio % annotation in the Lumen view, then select Stenosis %. To create a measurement between the two reference lines, click the white arrow on the viewer control (lower right of Lumen view) select Segment Length from the popup menu.
Left Ventricular Analysis

Using a multi-phase CT of the heart, LV Analysis will generate long/short axis and 4 chamber views. Segmentation of the left ventricle will allow for functional analysis including Stroke Volume; Ejection Fraction; End Diastolic/Systolic Volumes and Cardiac Output. Dynamic images of the beating heart can be viewed anytime a multi-phase CT of the heart is loaded.

The following two pages will demonstrate the LV Analysis workflow by using the LV Analysis tool card.

Find Axis automatically aligns the viewers so that they lie along the axis of the left ventricle. A long axis, short axis and four chamber views are displayed along with the 3D image.

To begin, simply drag the crosshair center point on an MPR view (coronal, in this example). Now, select the Find Axis button from the LV Analysis tool card.
Adjusting Valve Plane

Adjusting the valve annulus plane will ensure a proper segmentation of the left ventricle. Adjustments can be made on both the four chamber and long axis views.

First, rotate the long axis reference line (orange). Small dots are located at the bottom and top of that line. Click and drag to rotate this reference line.

Once the long axis (orange) reference line has been adjusted to desired position, grab and rotate the valve plane reference line (pink) to align with the valve annulus. This can be done on both long and four chamber views.

Finally, confirm the orientation of the axis and valve plane adjustments, click the Apply (red check mark) button on the floating toolbar at the bottom of the active viewer.
Once the valve plane has been adjusted, the left ventricle can be automatically segmented. The segmented left ventricle is displayed in yellow in the MPR views.

First, click the **Find LV (All Phases)** button in the *LV Analysis* tool card. It is recommended that the segmentation is verified in all phases. Use the up/down toggle to step through the phases. If segmentation was not satisfactory in a phase, click the **Clear LV (Current Phase)** to clear this phase then it will not be considered during the results calculation.

**Clear LV (All Phases)** will clear all phases which allows for adjustment of valve plane before re-run of segmentation.

Note: The left ventricle segmentation is colored in yellow on the MPR views.
Adjusting the valve annulus plane will ensure a proper segmentation of the left ventricle. Adjustments can be made on both the four chamber and long axis views.

After successful LV segmentation, you can display the results of the analysis by selecting the *Results* button on *the LV Analysis* tool card.

The end diastolic phase (ED), and the end systolic phase (ES) are selected automatically. They can be adjusted by moving the sliders labeled “ED” and “ES”.

Change graphic parameters by using the drop down and select from various graphic representations.

*Bull’s Eye view* displays a colored view of left ventricle segments.

*Graph view* displays measurements in relation to phase.
LV Analysis II

The display of the Bull’s Eye view and the Graph view can be changed by selecting a different results display from the drop-down box below the Bull’s Eye. The following results can be displayed:

- **Global Volume**
  In the Bull’s Eye view, the Ejection Fraction of the segments is displayed and the Graph view shows the overall volume of the left ventricle. This is the default view.

- **Regional Volume**
  In this view, the Bull’s Eye view is also showing the regional Ejection Fraction but the Graph view shows the regional volume of the segments over the time phases.

- **Wall Motion**
  In this view, the Bull’s Eye view shows the color-coded accumulated motion of the myocardium wall. The Graph view shows the distance that the regions moved during the phases.
Calcium Score Workflow

Quantification of calcified plaque is calculated using the Agatston Score by using the Calcium tool card.

Workflow is initiated by selecting the Calcium Scoring button in the Calcium tool card.

All anatomy measuring 130 HU (Agatston base-line) or more will be displayed in yellow. Only these voxels are considered for the quantification.

In Multi Slice Mode, both voxels in the selected slice and adjacent voxels in adjacent slices, are assigned to a plaque.
Calcium Score Lesion Selection

The workflow is designed to step through each vessel, selecting lesions as you go. This will allow for a thorough interrogation of each vessel.

First, select the vessel to be interrogated. Each vessel is assigned to a particular color.

Left click on a lesion (initially highlighted in yellow). Once the lesion is selected, its color will change to that of the selected vessel.

The score for each lesion will be displayed to the right of the vessel selected. Note: In this example, 3 lesions were scored from a single click as a result of Multi Slice Mode selecting this lesion in 3 contiguous slices.

At a bifurcation, select the vessel button from tool card, then left click and drag (draw) around one branch.

Next, select another vessel button and draw around the second branch.

Note: Each branch selected will be displayed in the color of the vessel button selected.
A comprehensive Calcium Scoring Report can be generated to ethnicity and risk assessment, as well as any desired screen captures.

Once all lesions have been selected/scored, select the patient’s ethnicity and confirm correct gender and age. Click Report and switch to the Export window to generate the report.

Patient demographics and scan information

Table of score results and screen captures

Ranking guide and ethnicity diagram