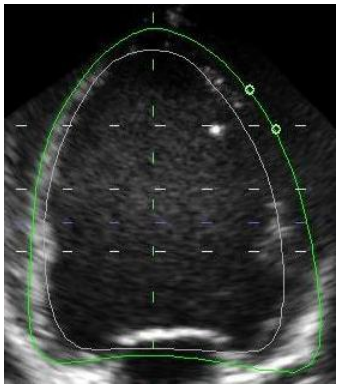
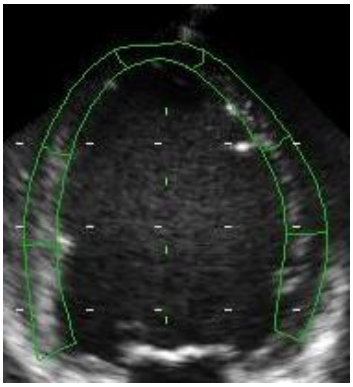
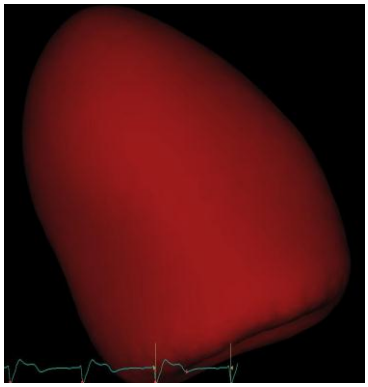
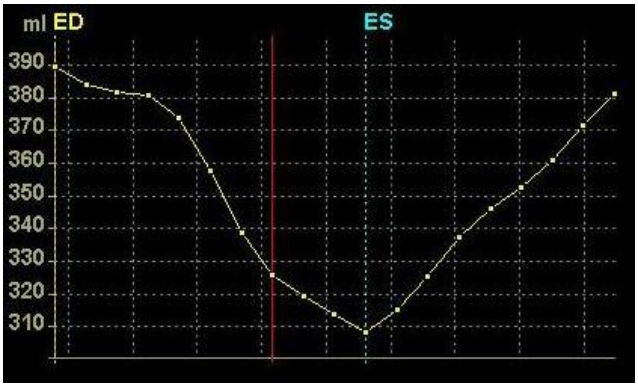
From EF- to Mass –to 4D Strain

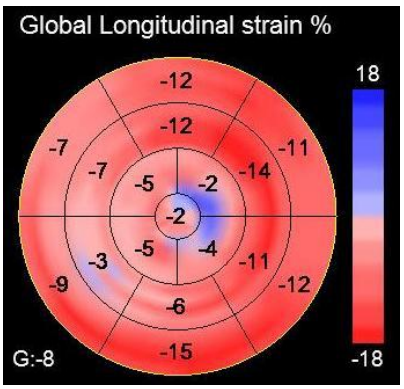
Tips and Tricks











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NOTE

This hand out is additional training material.
For more information please refer to the user manual and/or reference manual.

General information

This application note describes the workflow on Vivid E9 BT 11 software.

ECG

As always it is mandatory to have a proper ECG applied!

Volume rate

For **Ejection Fraction** it is recommended to have at least **12 volumes per second**.
For **4D Strain** the limit is higher and the recommendation is having **more than 25 fps** at a heart rate around 60.
Note: for **4D Strain** the volume rate should be around **40% of the heart rate**.
If using Lower frame rates for analysis, results may not be accurate.

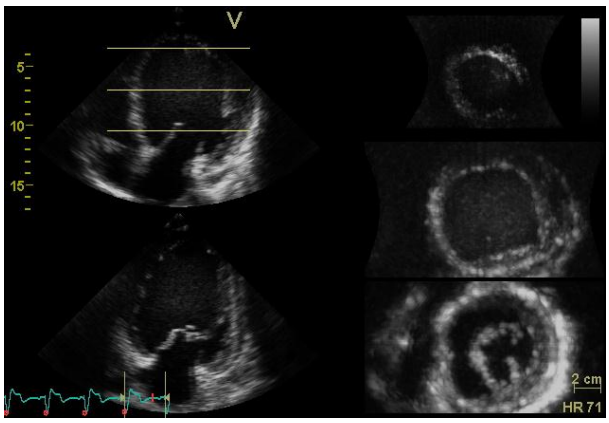
Myocardium

As in 2D Strain, make sure the entire myocardium is visible throughout the whole heart cycle. Check especially in end-diastole if you still have the epicardium visible.

Image acquisition

4D acquisition

Enter the 4D acquisition by using the **4D** button on the keyboard or the assigned keys (medium, large) on the touch panel.
Enter the **multislice** mode in order to get a comprehensive overview on how the LV fits into your chosen 4D sector size. Try to align the image as good as possible.
The result has to be that the entire myocardium including the epicardium is visible in all views during the entire heart cycle.



Tip

You may change to different Layouts of the multislice mode by using the buttons (5-slice, 7slice...) on the touch panel.

To adjust the size of the 4D volume use the most left rotational knob for Volume size.

Important

Volume rate needs to be checked accurately. See recommendations above.

If volume rate is too low, use the **multibeat** acquisition.
Select number of **heart cycles** until you are satisfied with the volume rate (fps).
You may ask the patient for a breath hold in order help to avoid stitching artefacts.
Increasing temporal resolution by simply using the frame rate button will decrease the spatial resolution; therefore the data analysis will lose in quality.
You need to find a good trade-off between temporal and spatial resolution.

The measurement

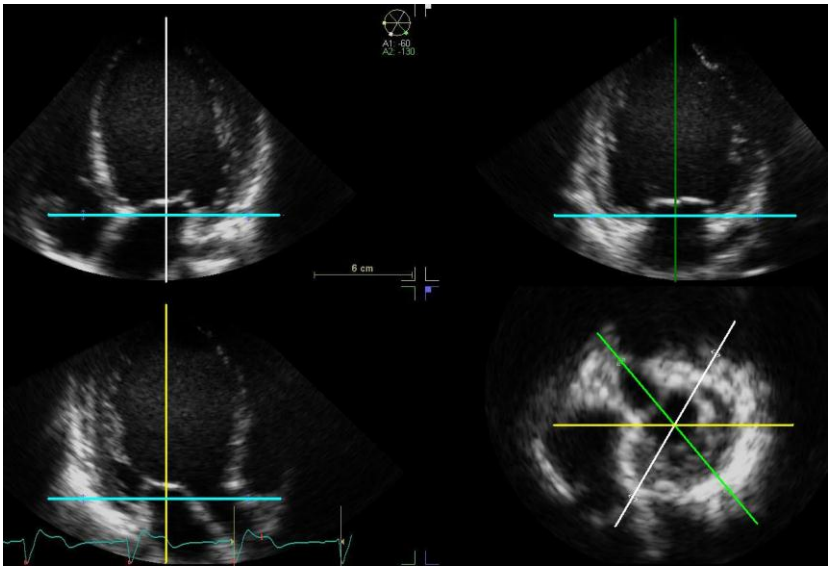
Recall a 4D dataset with appropriate volume rate.
Open the **measurement** package
Select the **Volume** folder
Start by clicking on **4D Auto LVQ**

Alignment

The system will automatically align the image, but there is still the possibility to align the image manually by using the rotation knobs or trackball.

Note

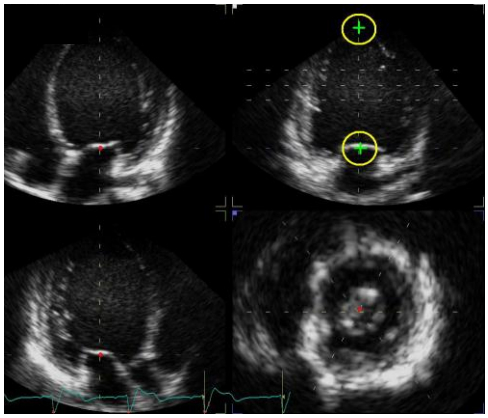
The apex has to be centred in all apical images.
The dataset needs to be aligned in a way that the ventricle is centred around the lines on the screen.
The blue line has to be positioned at the mitral valve annulus.



Once the image is aligned properly press the **EDV** button on the touch panel

Define endocardial border

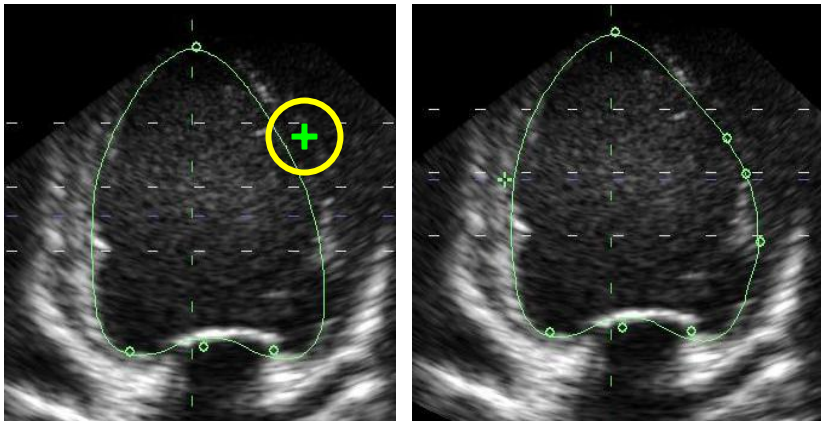
The system will automatically start with an end-diastolic frame, selected by using the ECG.
The tracking algorithm works best when the MV is closed. If the MV is slightly open the algorithm may track too far into the LA since there is not clear border.
Make sure the MV is closed in the ED frame (otherwise change manually by using the most left rotational knob).
Initiate the tracking by using the two- point's method.
Choose one of the apical views and place one point at the apex and one point at mid-basal area.
The system will now track the endocardial border automatically.



Note

Alternative you may choose the auto or manual (set two basal and one apical point in all apical images) from the soft keys.

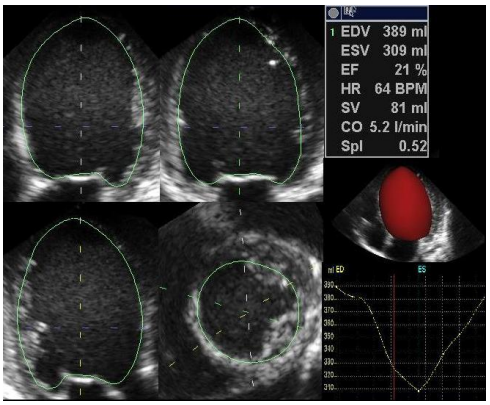
Review the border detection carefully!
You may adjust the tracking by clicking with the cursor at the correct endocardial position. The system will then readjust the region of interest. Adjust until you are satisfied with the endocardial tracking.



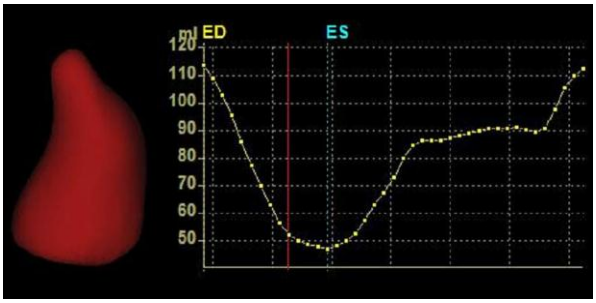
Select **ESV** from the touch panel and redo the same procedure for the end-systolic frame.
Check that MV is closed (same principle as for ED)!
In this frame you should use the same method (2-point, manual or auto) for endocardial tracking in as you have used in end-diastole.

Volume and ejection fraction

When satisfied with the contours press the **Volume waveform** button on the touch panel.
The system will start the analysis of the entire LV and you will get the results for end-diastolic and end-systolic, ejection fraction, cardiac output, stroke volume and *sphericity index*.
Be aware: The end-diastolic frame is now selected by the frame with the biggest volume; the end-systolic frame is now selected by the frame with the smallest volume. You may want to adjust by using the rotational knobs on the touch panel.
Press **image store** in order to store the loop with the tracking and the volume curve.



Press the **Layout** button on the keyboard to get the red mesh model in big together with the volume curve.



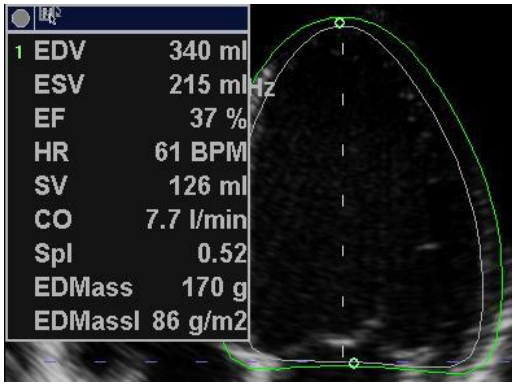
If you want to finish your measurements here press Approve and Exit.
Or move ahead with the analysis.

4D LV Mass

Select **4D LV Mass** from the touch panel.
In the end-diastolic image the epicardial contour will appear automatically.
Review it carefully and adjust if needed.

Note

You may switch between endo- or epicardial border or both by using the according rotational knob. The contour in green is the active one.



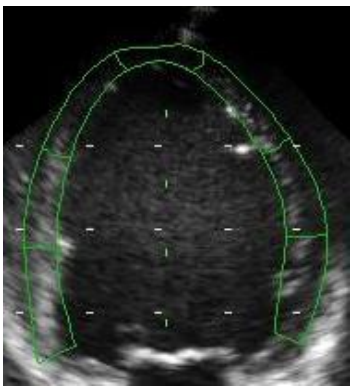
The mass and the mass index (Mass/BSA) are displayed immediately on the screen.

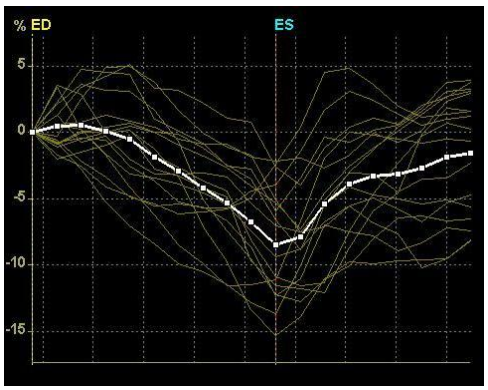
Press **image store** in order to store the loop.
If you want to finish your measurements here press Approve and Exit.

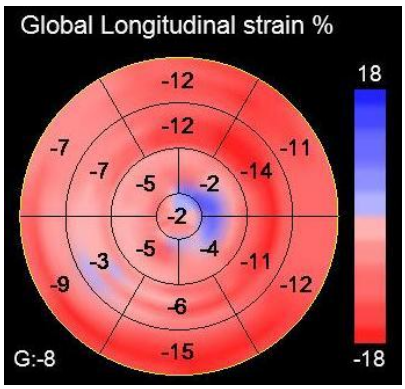
4D Strain

Select the **4D ROI button** on the touch panel.
The system now displays the end-systolic image.
You may adjust the region of interest, if necessary.
Press the **4D Strain results** in order to start the analysis of the entire heart cycle.
Remember that frame rate is recommended to be higher than 25 fps (or 40% of the heart rate).

In the result screen the system displays all regional strain curves and the global curve.
A bull's eye plot is present for a complete overview.







First parameter shown on the screen is longitudinal strain.
Use the buttons on the touch panel in order to change from **longitudinal** to **radial** – **circumferential** or **area** strain.

You may use the rotational knob for selecting single **segments**.
If one curve is not appreciated well it can be removed from the analysis by using the **reject segment** control. Rejected segments will be displayed in grey color on the grey scale image ROI and on the bull's eye.
If 4 or more segments are rejected the global strain value will not be calculated any longer.

Use the **Layout** button in order to get the apical views displayed bigger on the screen.

Important Note: Colors of the bull's eye are always reflecting the value of each curve from the frame that is displayed at the time. While pressing the Freeze button the system automatically shows the ES frame, you can scroll frame by frame if needed.