GE Healthcare
VividClub

No. 04 - 2007

Application News

GE imagination at work

Tissue Velocity Imaging

TVI

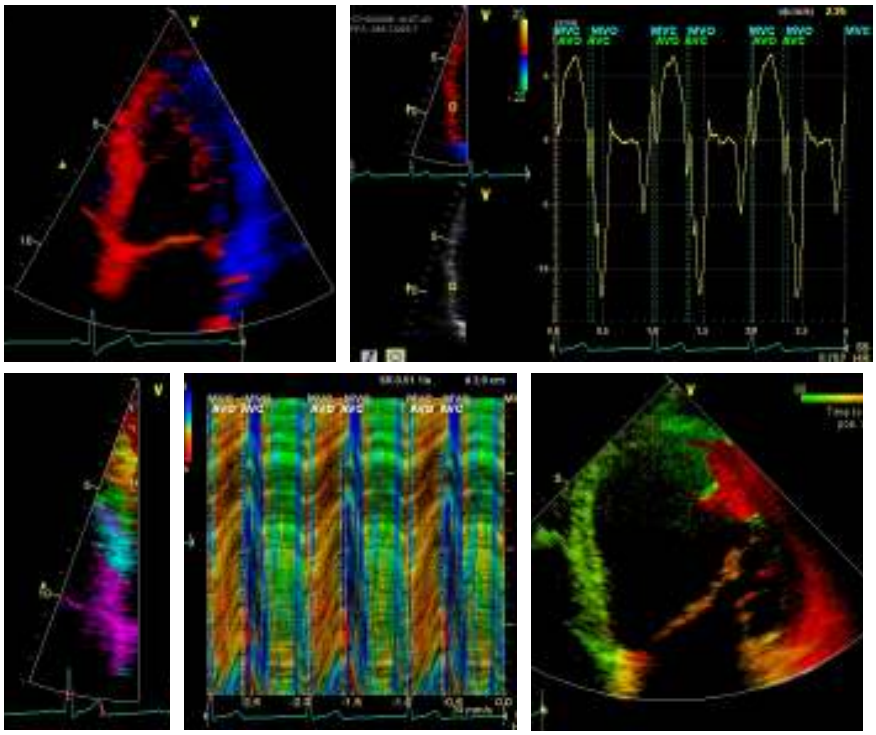
Vivid 7

EchoPAC (analysis)

Vivid S6 (acquisition)

Vivid i (acquisition)

Data acquisition and analysis



Content

NOTE

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

The ECG

General information

It is crucial to have the ECG applied properly when you want to work with TVI data!
It is needed for the Event Timing measurement and for some triggered modes.
Therefore make sure to have a proper and stable ECG.

Colour coding

Put on the ECG stickers following the colour codes:
Red: right arm
Yellow: left arm
Green: left leg

Press the **Physio** button.
On the LED bars you can select the following settings for optimisation:

ECG Lead

Lead I:	red / yellow	right and left arm
Lead II:	red / green	right arm and left leg
Lead III:	yellow / green	left arm and left leg

Gain: Changes the amplitude.
Position: Moves the ECG curve up and down on the screen.
Horizontal sweep: Adjusts the sweep speed.

How to optimise TVI images

Preparation

Applie a proper and stable ECG.

Optimising the image

- Concentrate on one wall or take the whole LV inside the sector (when it is necessary to compare opposite walls i.e. TSI).
- Walls have to be aligned with the beam (remember this is a doppler technique).
  - Move probe
  - Use tilt function
- Narrow sector width
- Adjust frame rate
- Check for aliasing
  - Take PW in basal segment to check highest velocities.
  - Then adjust your TVI scale
- Breath hold might be necessary if the heart is moving too much during in/expiration.
- Store a loop with 3 heart cycles.
- Store MV and AV Doppler for event timing (look for valve clicks)

Acquisition

Do the adjustments for all views or walls and store 3 heart cycles each time.
Do every time the same order when storing single walls, that makes it easier in the analysis later on.
Here an example:

4 CH

- Septum
- Lateral wall
- RV free wall

2 CH

- Anterior wall
- Inferior wall

PLAX

- Posterior wall
- Anteroseptal wall

How to perform the measurements for event timing

General information

- The event timing measurements can be done in M-Mode or in Doppler.
- The system will measure the time from beginning of R- wave on the ECG to the measurement point set by the user.
- This time will be stored in ms in the worksheet.
- Mitral valve opening and –closure (MVO and MVC)
- Aortic valve opening and –closure (AVO and AVC)

Note

The system is detecting the beginning of the R- Wave on the ECG.
Therefore it is crucial to have a proper ECG Signal.
If the patient has arrhythmia this can lead to improper results, because the cycle length of each heart cycle is completely different. There is no algorithm in the event timing to compensate for this. The measured time is a fixed value. Be aware of this fact when you do your analysis.

Measurements

M-Mode

1. Acquire a nice M-Mode signal where the valve opening and closure is clearly visible.
2. Press **Measure.**
3. Open the folder for **Event Timing.**
4. Select the desired valve.
5. **Set** the marker at the opening.
6. The system automatically jumps to the measurement for the closure.
7. **Set** the marker for the closure.

Doppler

1. Acquire a nice doppler signal; most likely including the valve clicks.
2. Press **Measure**.
3. Open the folder for **Event Timing**.
4. Select the desired valve.
5. **Set** the marker at the opening.
6. The system automatically jumps to the closure.
7. **Set** the marker for the closure.

Now the measurements are stored in the worksheet and will be used for TVI Q-Analysis and AFI.

How to work with the Q-Analysis package for TVI data

Preparation

It is crucial to have the ECG applied properly when you want to work with TVI data!
Measure the event timing before starting the analysis. This will help to correlate the curves with the timing in the heart cycle.
Recall a TVI loop from the archive.

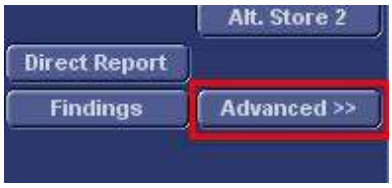
Start the analysis

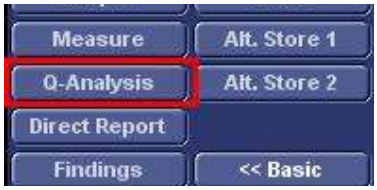
On Vivid 7:

Press the button for Q-Analysis from the assignable buttons below the LED.

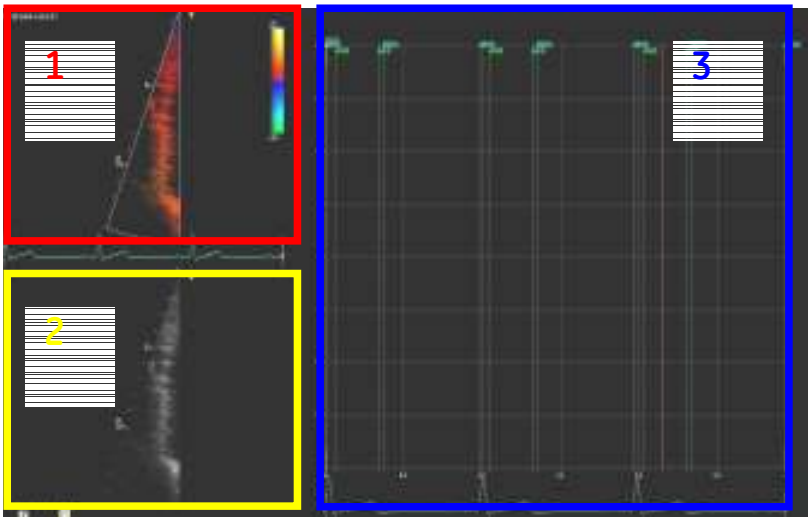
On EchoPAC:

Press the Advanced button on the right side menu to get all options.
Then you will get the button for the Q-Analysis to click on.



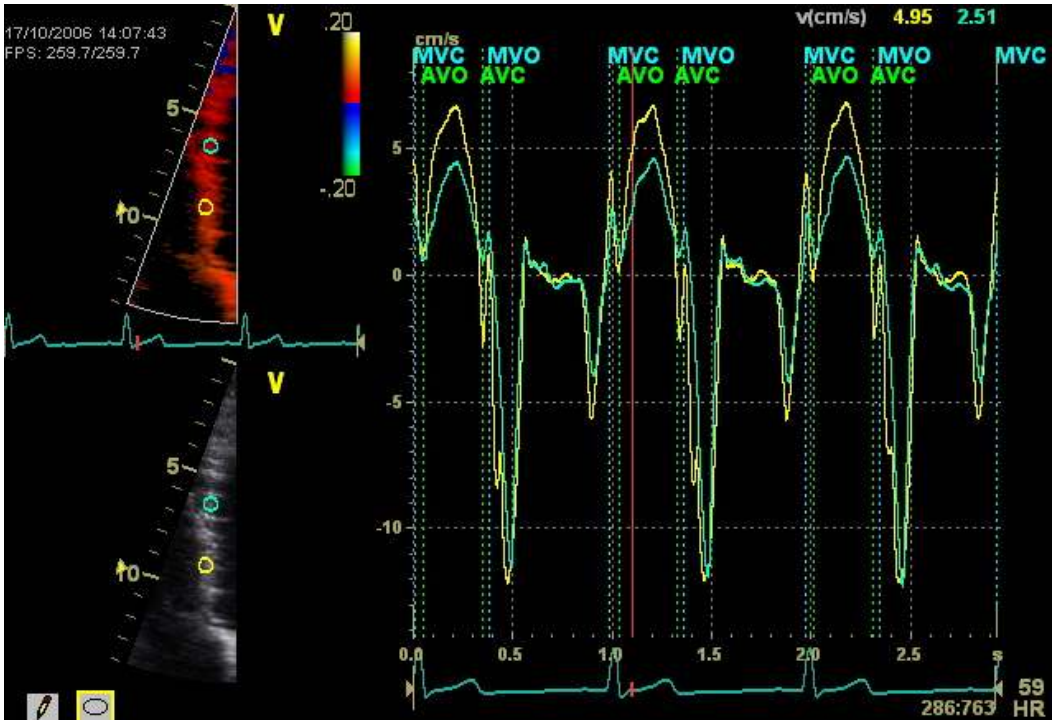


The screen has three major parts.
The upper left image shows the TVI loop (**1**).
The lower left image shows the 2D greyscale loop without TVI data (**2**).
The main part is taken for the curve display (**3**).



Place the ROI

Place your cursor in one of the images (2D or TVI) inside the myocardium.
Immediately the curve will be displayed. To fix the ROI (region of interest) simply press the left mouse key.
Another ROI appears and can be set to another place.
It is possible to set up to 8 ROIs. Each ROI will be represented by another different colour.



Move the ROI

If you want to move a ROI to another place move the cursor over the ROI until it changes to a hand symbol.

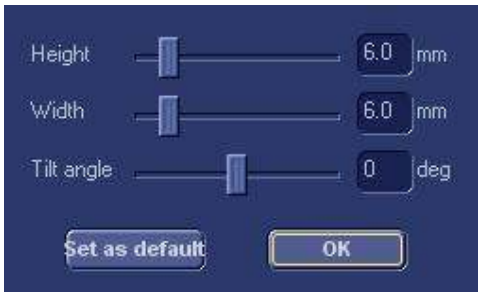
Click once on the ROI. The ROI can be moved now to another position.
To set the new position you need to press the left mouse key.

Delete the ROI

Scroll over the ROI until the hand appears. Press the left mouse key and hold it. Move the ROI out of the image sector.
Second possibility: Scroll over the ROI until the hand appears. Press the right mouse key. Select **delete sample area** (or delete all sample areas) from the menu.

Change ROI size

Scroll over the ROI until the hand appears. Press the right mouse key.
Select from the menu: **set sample area shape**.
A window opens with the possibilities to change the height and width.
The new settings can be stored as default to apply it to all curves unless you change it again.
Note: The sample area shape can be differently adjusted for each mode (velocity, strain, strain rate..).



Press **Ok** to save the changes.

The different modalities

Different modes are available:

TVI	Tissue Velocity Imaging	= velocity
TT	Tissue Tracking	= distance of motion
SRI	Strain Rate Imaging	= speed of deformation
SR	Strain Rate	= regional deformation
TSI	Tissue Synchronization Imaging	= time to peak velocity

Change the mode

On Vivid 7:

Press on the assignible buttons (below the LED) to change between the different modes. It might be necessary to press the More button to get all modes.

On EchoPAC:

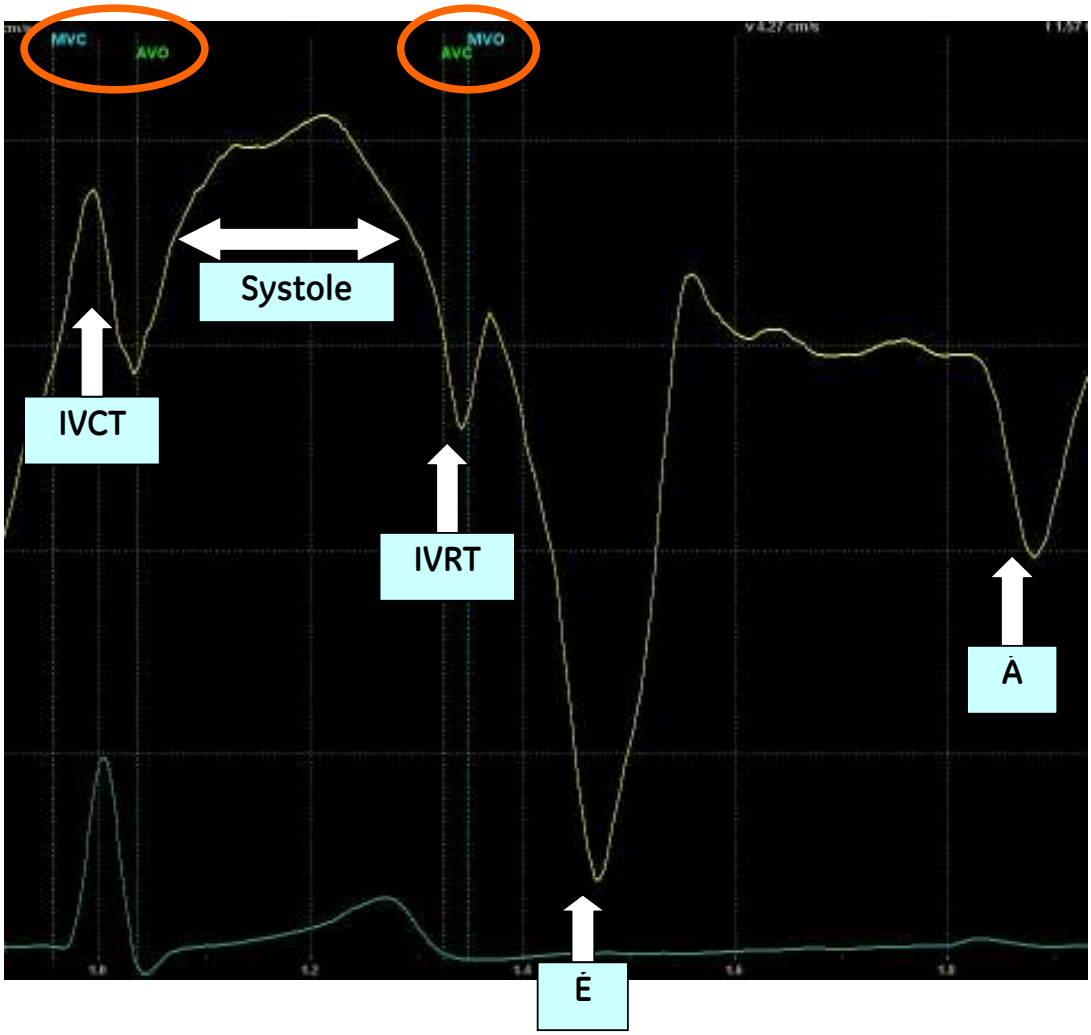
In the menu on the right side you will find for each mode a button to click on.

Tissue Velocity Imaging (TVI)

Displays the velocity of the myocardial movement.

Colour code:
Red: movement towards transducer
Blue: movement away from the transducer
Aliasing: green or white

Unit: cm/s



Tissue Tracking (TT)

Indicates the distance the myocardium moves during systole.
There is a variation of colour's to delineate the different distances.

Colour code:
See the rainbow colours beside. The numbers at the scale can be adjusted by changing the scale.

Unit: mm

The parametric image is triggered on systole. You will see how the colour bar will build up. In diastole the image is a still frame to better visualise the end systolic maximum distances.

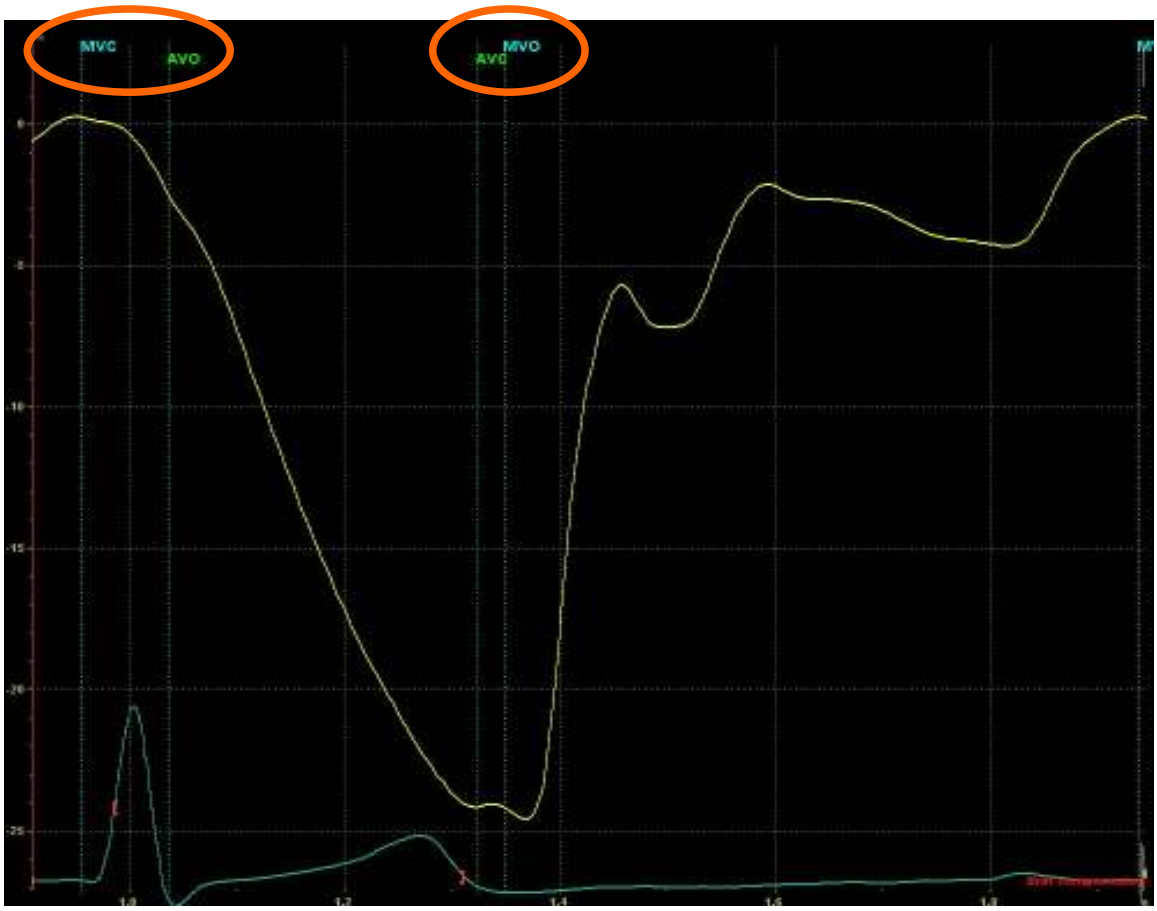
Strain Imaging (SI)

Measures the percentage of regional deformation of the myocardium.
The difference of velocities between two points is measured during the heartcycle and from this the shortening or lengthening is calculated.

Colour code:
Red: shortening
Blue: lengthening

Unit: %

The parametric image is triggered on systole. Maximum deformation will be displayed in end-systole and shown as a still frame during diastole.

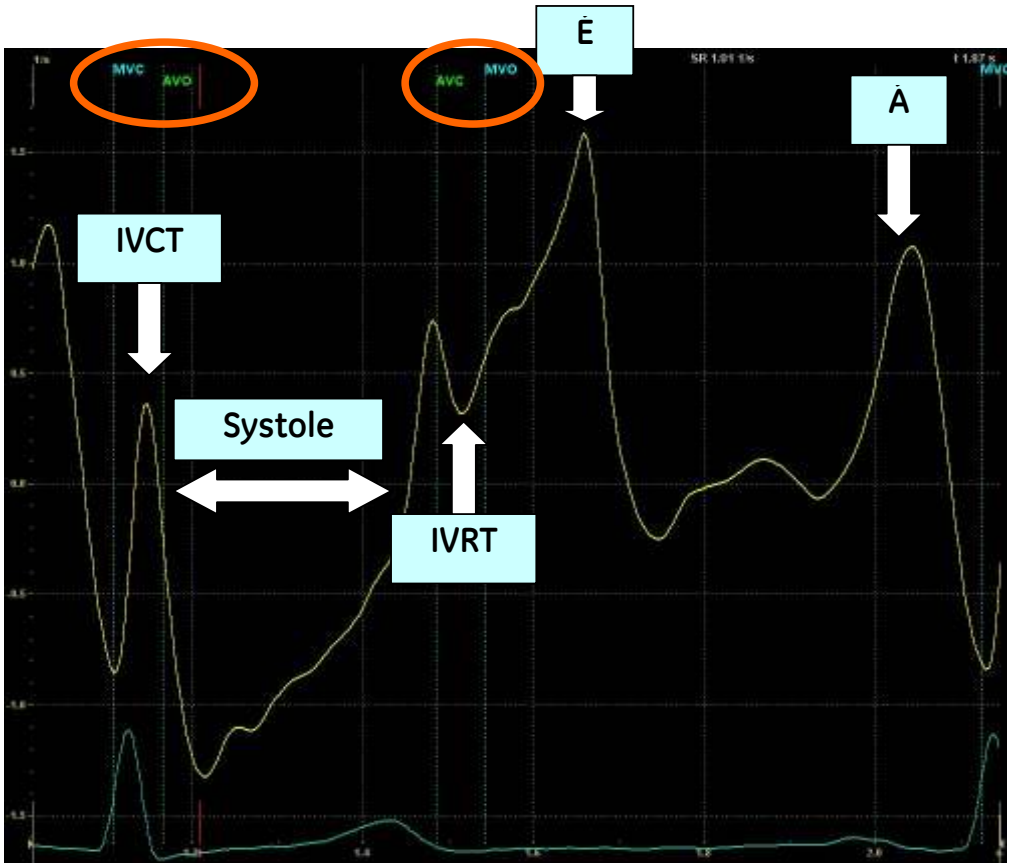


Strain Rate Imaging (SRI)

Measures the speed of regional myocardial compression (deformation).
The difference of velocities between two points is measured during the heartcycle and from this the speed of deformation is calculated.

Colour code:
Red: indicates how fast the shortening is happening
Blue: indicates how fast the lengthening is happening
Green:no change

Unit: 1/s



Tissue Synchronisation Imaging (TSI)

Measures the time to the detected maximum peak positive velocity within a specified period of the cardiac cycle.

Colour code:
Green: the peak velocity is very early
Red: peak velocity is at the end of the specified cardiac cycle
Unit: ms

For those who are red/green blind there is another colour map where red is changed to blue.

When to use...

... TVI, Tissue Tracking, Strain, Strain rate, TSI

Global systolic function:

- TVI
- Tissue Tracking

Regional systolic function:

- TVI
- Tissue Tracking
- Strain
- Strain rate

Diastolic function – relaxation abnormalities:

- TVI

Asynchrony

- TSI

What can we use the mode for

TVI

Global systolic function
Regional systolic function
Diastolic function – relaxation abnormalities

Tissue Tracking

Regional wall motion abnormality
Global systolic function

Strain

Evaluation of ischemic heart disease
Analysis of a specific piece of myocardium

Strain rate

Evaluation of ischemic heart disease
Analysis of a specific piece of myocardium

TSI

Assessing asynchrony

For further information please refer also to the white paper
GE quantitative analysis for left ventricular function.