TIC Analysis

(Time Intensity Curve Analysis)

International Clinical Application Team

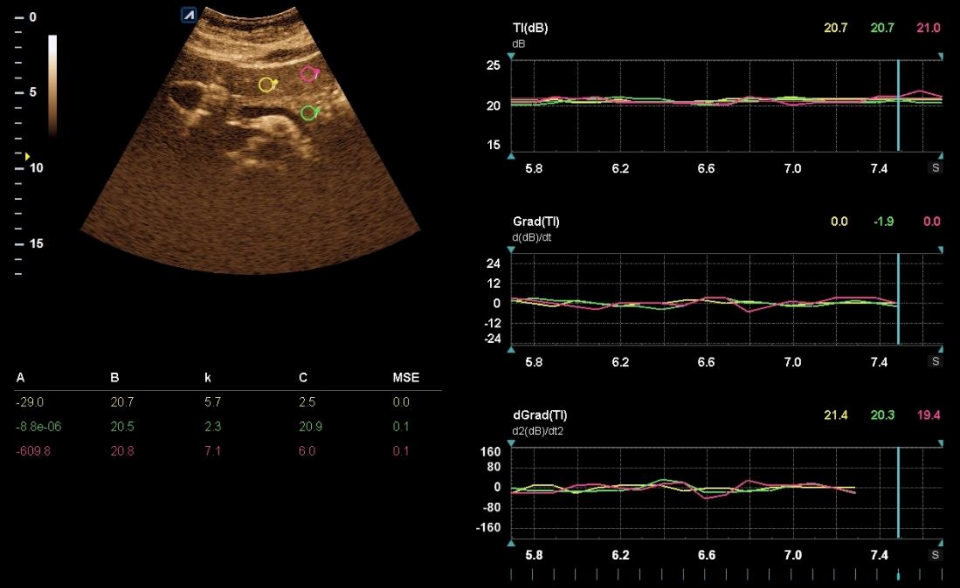
Hailey Lee

ALPINION
MEDICAL SYSTEMS

- **What is TIC (Time Intensity Curve)?**

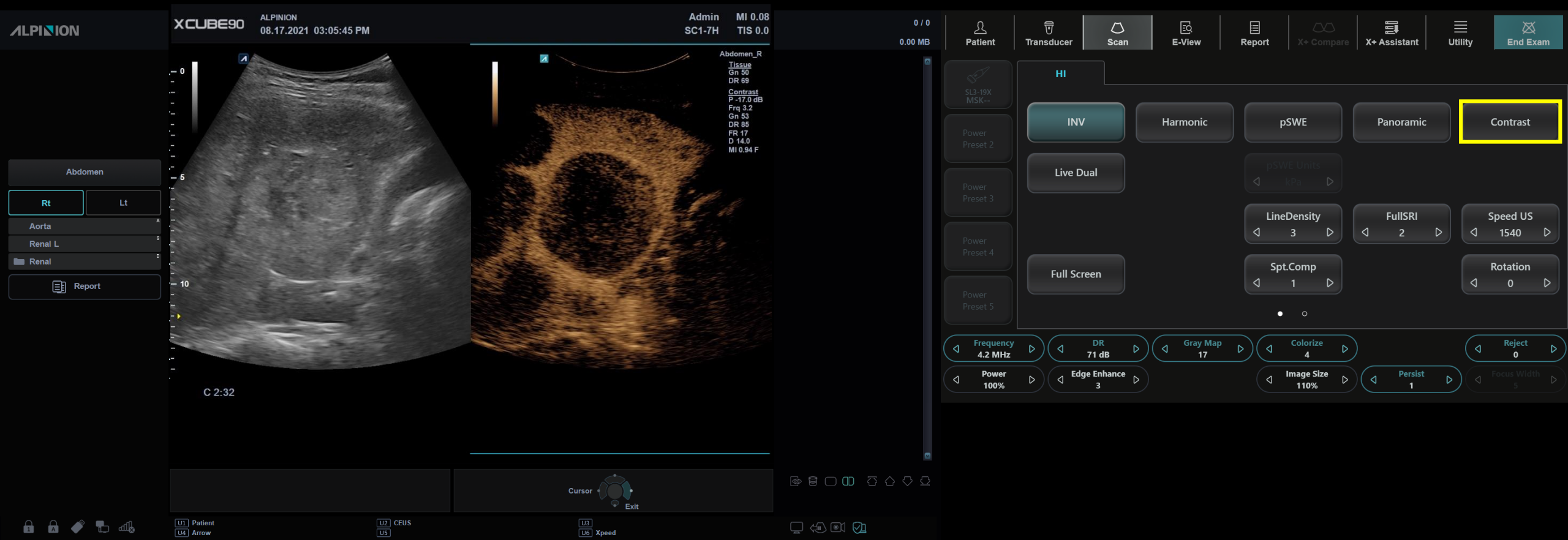
  : Quantitatively describes the dynamics of the intravascular ultrasound contrast media, and thereby provide a quantitative assessment of tissue vascularization.

- **Clinical Benefit**
  - ✓ Time intensity analysis allows instant time-intensity calculation from up to 8 regions of interest.
  - ✓ Curve fitting analysis for research studies of contrast agent concentration rates.



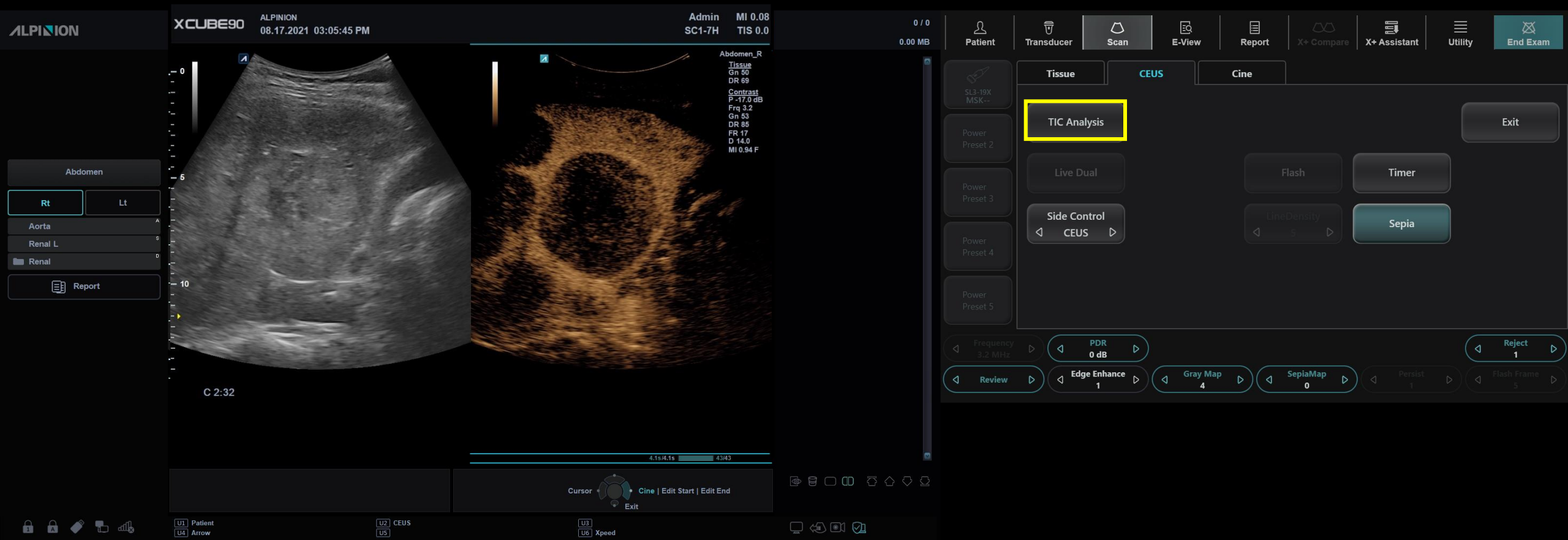
• Workflow

1. Activate CEUS mode by pressing **Contrast** button.
2. Scan the patient after injecting the contrast agent.
3. Observe the agent flow through the anatomy of interest.



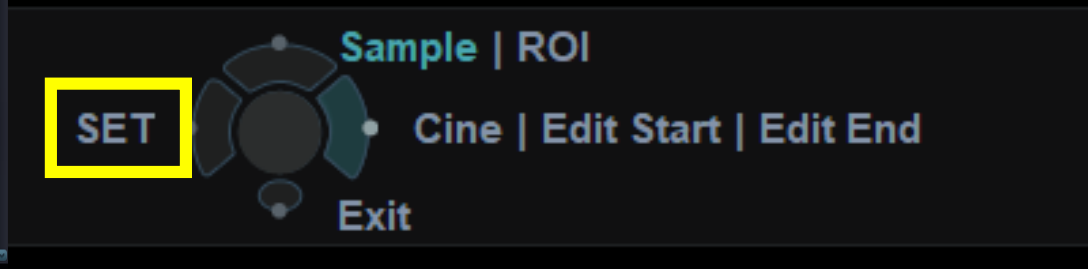
• Workflow

3. When the desired contrast effect has been visualized, press the **Freeze key** to freeze the image.
4. **TIC Analysis** button is displayed on the touch screen.



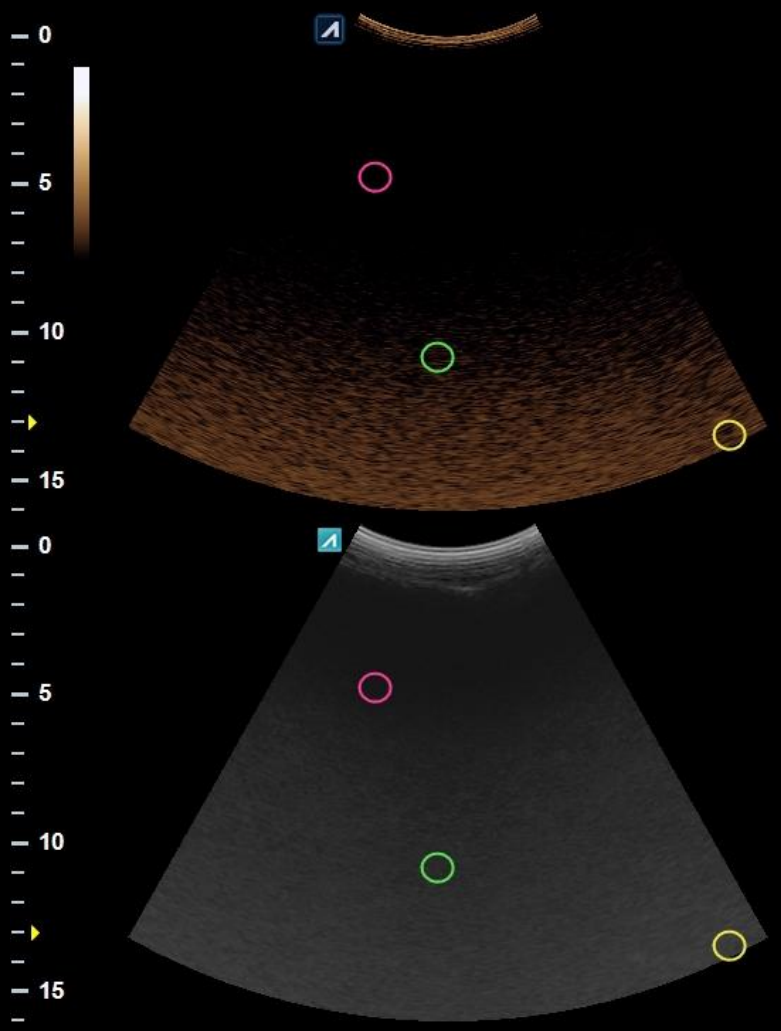
• Workflow

1. Use Trackball to position an ROI on one of those images and press **SET** button (on the left side of trackball.
2. The system calculates the ‘mean pixel intensity’ with that ROI for all frames in the user designated loop and plots the resulting data as a function of time.
3. If necessary, press the **print key** on the control panel to print TIC data.
4. The system captures a single still frame onto the clipboard.

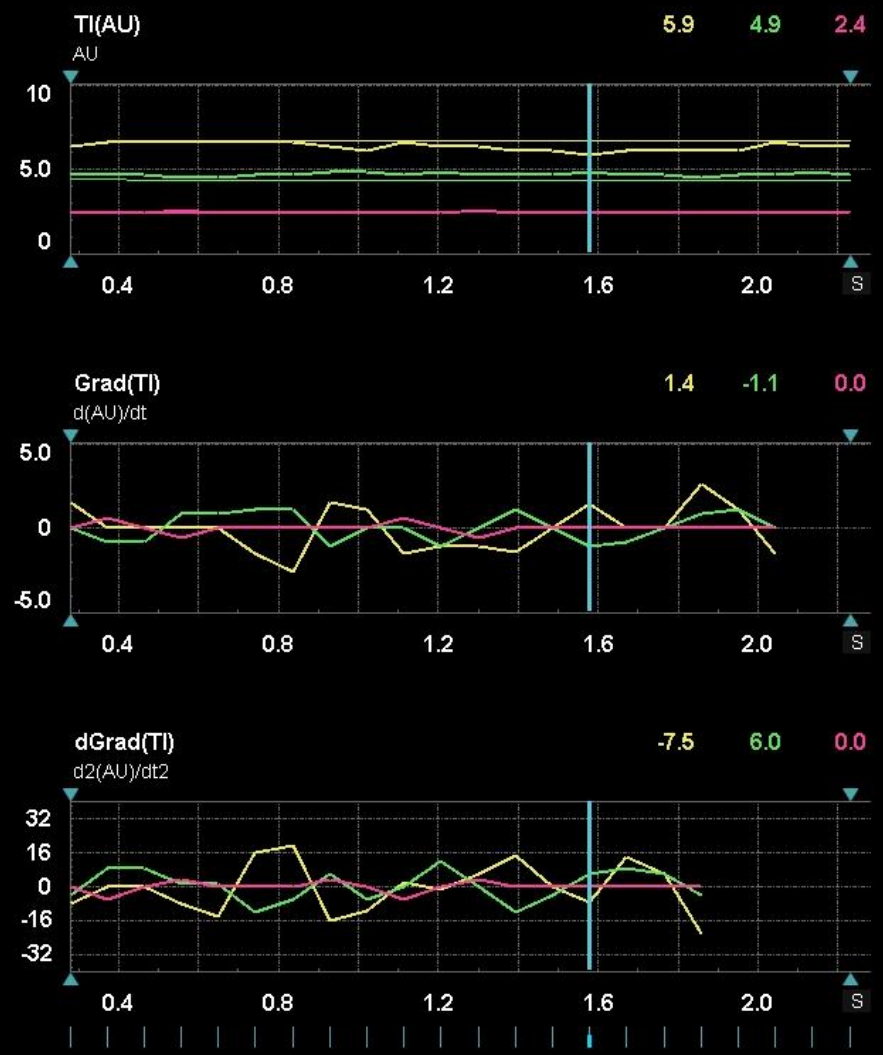


• Display

Cine Loop Window



Analysis window – TIC graph

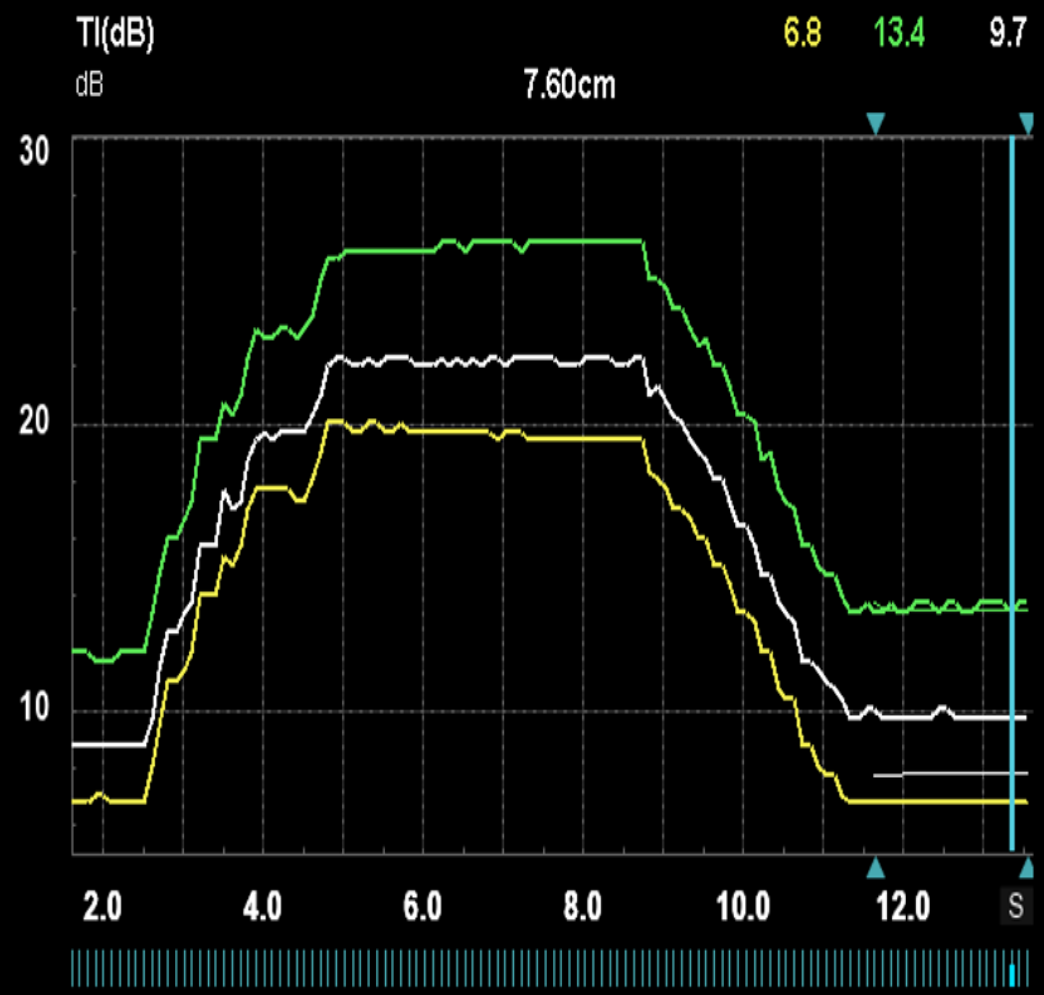


Sample area drawing tools

Graph layout tools

Cine control tools

• Display



Introduction of graph

- X axis: Times(s), elapsed time from previous frame.
- Y axis: Intensity scale(dB) or linear acoustic(AU). Press the **Y Unit** soft key.
- Current frame (Blue Bar): the current frame marker and the start and stop for the cine loop. And blue arrow head is start/end frame
- The time-intensity value of the Current frame is displayed at the top of the graph.

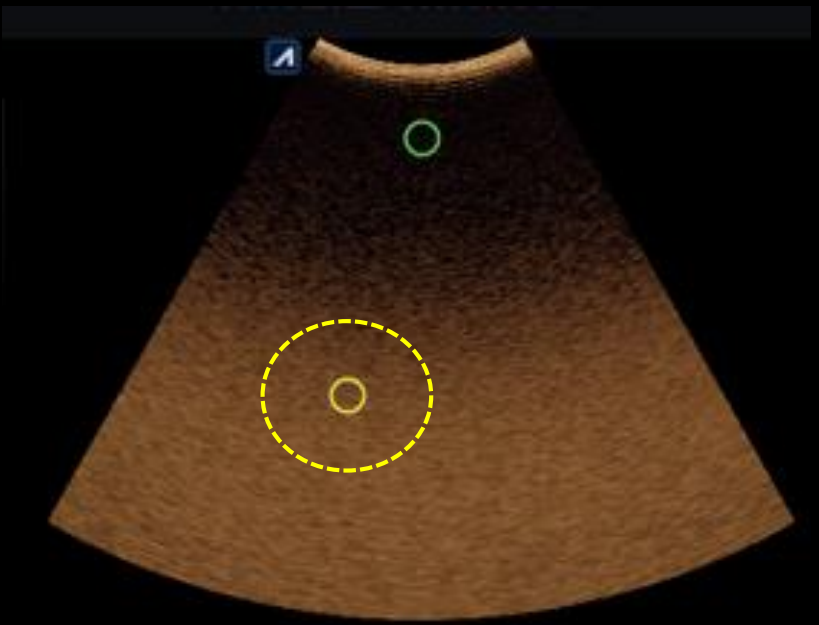
Disable/Enable the frame

- Use the **trackball** to move the cursor to the frame on the frame marker which you want disable.
- Press the left **Set** to disable the frame. The frame marker is changed from green to gray to indicate the frame has been disable.

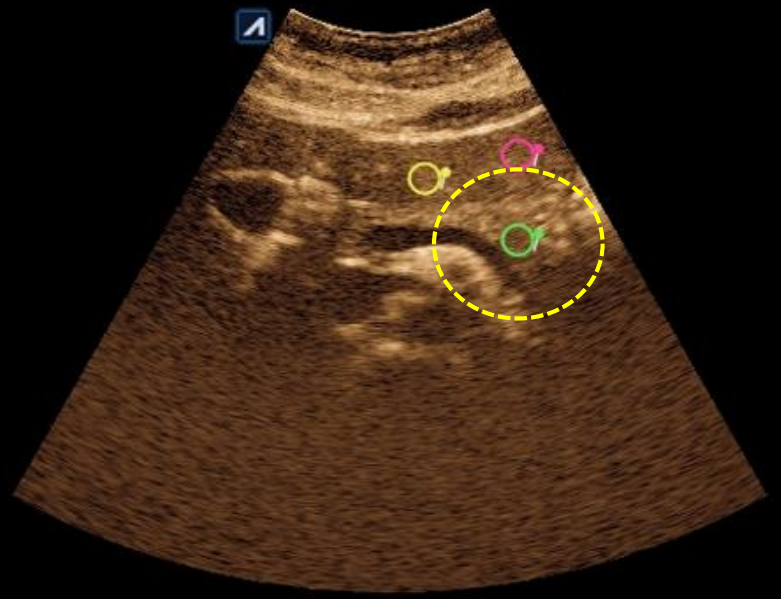
• How to Set Sample Area

1. Move trackball and freely place a sample area over a region of interest by pressing the **Set** key.
2. Up to 8 traces can be generated.
3. For dynamic anchored the sample area press **Motion Tracking** button on the touch screen then press **Run/Stop** button. (Anchored the sample area: automatically, adjust the sample ROI's placement across multiple frames in order to accommodate patient breathing or body movements)
4. If necessary, select add sample to new additional sample area and repeat the above procedures.

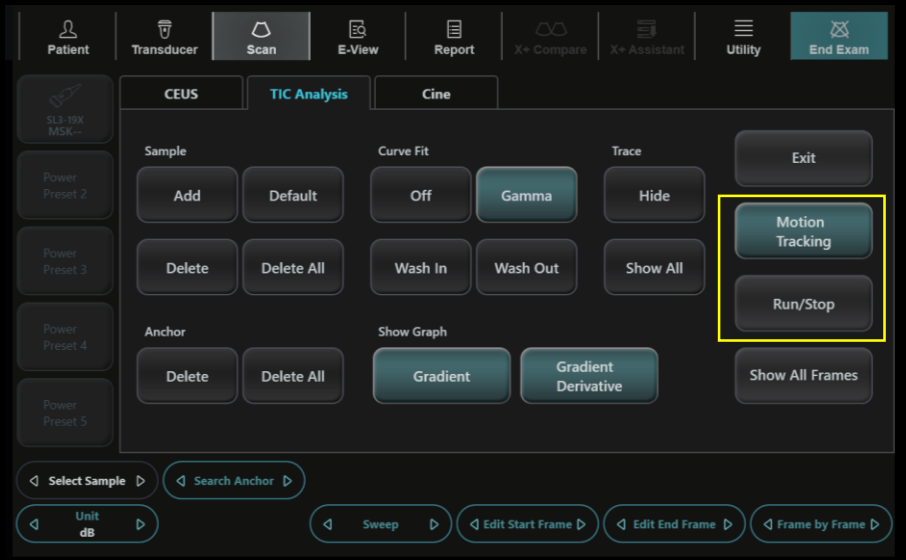
Static Sample Area



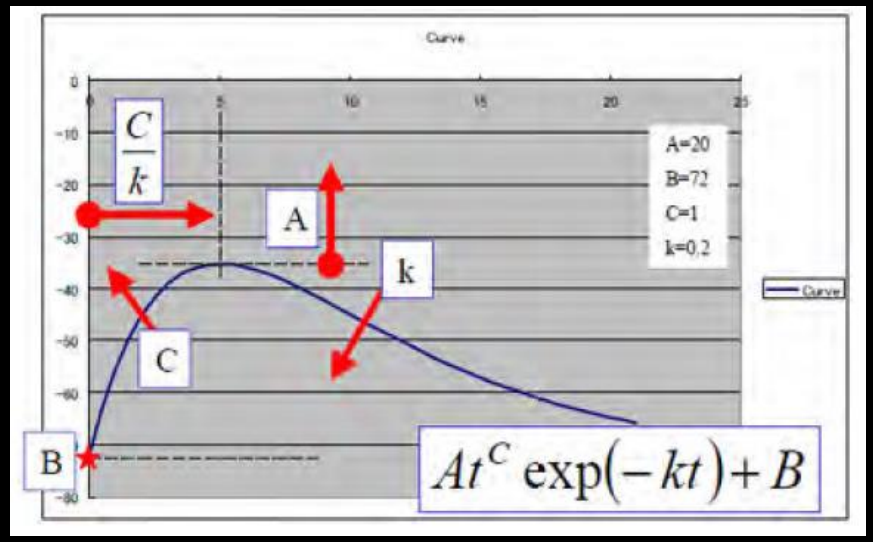
Dynamic anchored sample area



TIC Analysis Touchscreen



• Trace Measuerment & Parameters



- **A: Peak intensity**

  The amplitude scale factor, it describes the peak at time t = infinity for wash in (that is were exp(− kt). If the curve is still rising at the end of the fit, the A value will be higher than the peak at the last frame.

- **B: Intercept intensity at t=0**

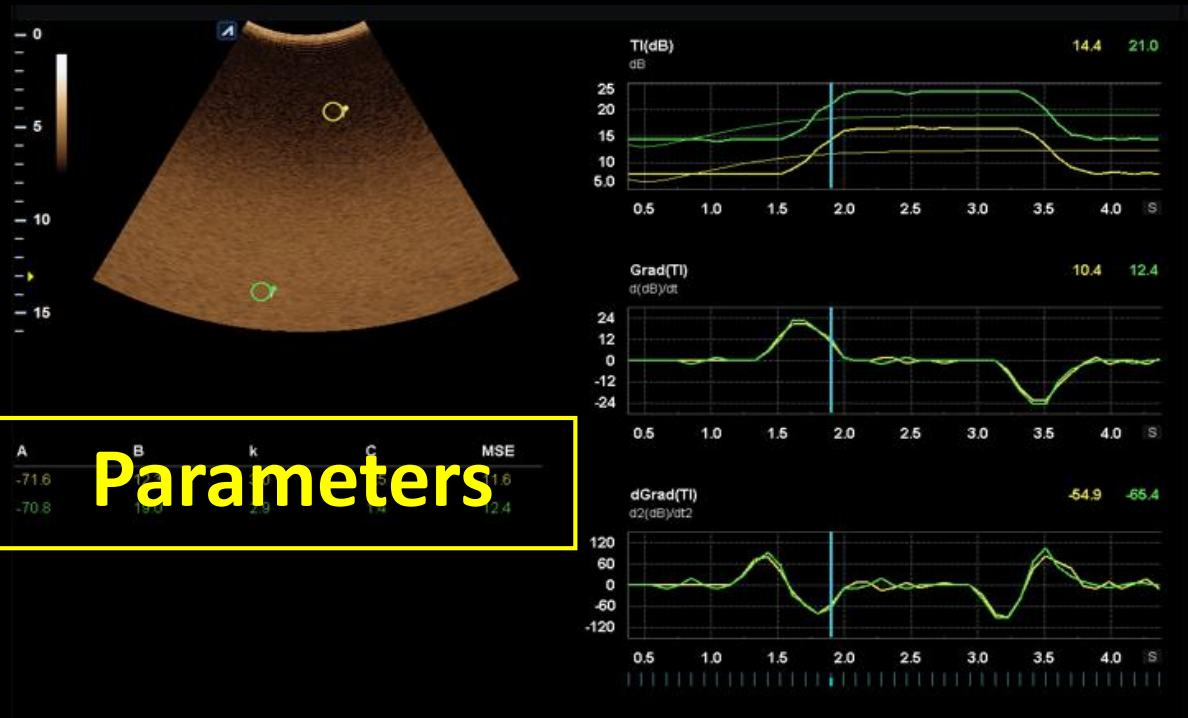
  It should represent the data value at the time-of-arrival

- **k: Exponential decay factor**

  k just tells it how fast that will happen. So a wash in curve uses 1 − exp(− kt), this expression starts at 0, and ends at 1 (times the scale factor A).

- **MSE: Mean Square Error**

  If the MSE is small, the difference of actual data and the fitted curve is small.



• Trace Measurement

Curve fit

- **Gamma**: Display the gamma curve. Used to find and estimate the gamma variate.
  $Y(t)=At^{c}exp(-kt)+B$
- **Wash In**: Display the Wash in curve. Used to find and estimate the local perfusion rate using the contrast agent.
  $Y(t)=A(1-exp(-kt)+B$
- Wash Out: Display the Wash out curve. Used to find and estimate the local wash-out rate.
  $Y(t)=Aexp(-kt)+B$

Show Graph

- **Gradient:** Two graphs plot TIC and TIC gradient.
- **Gradient Derivative:** Two graphs plot TIC and TIC gradient derivative.