Introduction to Ultrasound Imaging Modes

Feature/Mode availability varies for different products and geographical regions. Please consult your user manual for feature functionality and your local GE Sales Office to determine feature availability for your region.
B-Mode

- B-Mode stands for Brightness mode
- Brightness is the strength of the returning echo
- The stronger the returning echo, the brighter the dot (pixel)
B-Mode Optimization

- **Depth** - allows you to scan deeper or more superficially
- **Frequency** - balances resolution and penetration
  - ↑Frequency = ↑Resolution & ↓Penetration
  - ↓Frequency = ↑Penetration & ↓Resolution
- **Focal Position** - focus of the ultrasound beam, area of highest intensity, sweet spot, optimized image
- **Focal Number** - in theory provides a more uniform image with increased resolution
B-Mode Optimization

- **Gain** - increases/decreases overall brightness
- **TGC** - increases/decreases brightness to specific area on image
- **Auto Optimize** - optimizes contrast resolution

ADD IMAGE OR ANIMATION
Split screen with video
B-Mode

The best 2D image is obtained when the ultrasound transducer is perpendicular to the structure of interest
Median Nerve - Perpendicular incidence

Median Nerve - Anisotropy
Doppler Mode

Common Carotid Artery

Femoral and Saphenous Vein
Arteries

• Thick Walls
• Three Layers - Intima, Media, & Adventitia
• The lumen is anechoic
• Pulsatile Blood Flow
• Feeds Supplies oxygenated blood to organs and tissues
Veins

- Thin Walls
- Three Layers - Intima, Media and Adventitia
- Lumen is anechoic
- Contain Valves
- Slow, steady, phasic flow
- Drains organs & tissues
Arterial vs Venous Flow

Arterial Flow

Venous Flow
Doppler Ultrasound

- Doppler can help assess the presence or absence of flow
- Provide information on flow hemodynamics
- Help determine direction of flow
- Determine velocity of flow
B-Mode vs Doppler

- When using Doppler, if the probe is not parallel to the flow of blood, an angle is needed between the transducer and blood flow.
- If the transducer is perpendicular to flow, no flow will be detected.
Color Doppler
Color Doppler

- When there is motion in the field of view, there is a shift or difference in frequency
- Color represents the velocity and direction of blood as it travels through the body
- The system matches the color with the shift caused by the motion
- The color is superimposed onto a B-Mode image
Color Doppler

The result is an image with colors representing the average velocities (color is an overlay over the B-Mode image).

The colors in the image match the colors of the color Bar, blue away, red towards.

General Direction of ultrasound beam

Jugular Vein Flow away from the Transducer (from Left to right)

Carotid Artery Flow towards the Transducer (from right to left)
Color Doppler

Remember the acronym BART
- Blue Away
- Red Towards
Color Doppler

- Color Doppler is available on imaging probes that are compatible with systems that support Color Doppler imaging
Optimizing Color Doppler

- **Gain** - overall sensitivity to flow signals, provides more or less color on the image
- **Scale (also called pulse repetition frequency)** - low scale for low velocities, high scale for high velocities
- **Color Box Size (scan area)** - larger area reduces frame rate
- **Color Box Angle** - steering the “box” (more) parallel to the vessel enhances sensitivity
Power Doppler Imaging (PDI)
Power Doppler Imaging (PDI)

- Uses **intensity** to map the flow information
- Does not provide velocity information
- Is less angle dependent than Color Doppler
- Is not subject to aliasing
- It appears to be more sensitive to slow flow states and flow in small vessels
- Can help answer the question – **Is there flow?**
Power Doppler Imaging (PDI)

Power Doppler is available on imaging probes that are compatible with systems that support Power Doppler imaging.
High-Res PDI

- Based on GE Patented Coded Technology
- Helps provide the user the ability to visualize slow flow and flow in small vessels all the way to the skin line
- Helps the user detect early signs of inflammation (within the 1st cm)
- May be used to evaluate rheumatoid arthritis (RA), tumors or clotting in both adult and pediatric patients
High-Res PDI vs PDI

- Better axial resolution
- Higher Sensitivity and Specificity capable of detecting smaller and shallower vessels than PDI
- Enhanced ability to estimate vessel size
- Minimal tissue overwrite compared to PDI
High-Res PDI feature available on the Next Generation LOGIQ*e

- **9L-RS** - low frequency linear
- **12L-RS** - high frequency linear
- **L4-12t-RS** - high frequency linear with four programmable buttons
- **L8-18i-RS** - high frequency linear “hockey stick”
- **L10-22-RS** - ultra-high frequency probe
Optimizing PDI and High-Res PDI

- **Gain** - overall sensitivity to flow signals, provides more or less color on the image
- **Scale (also called pulse repetition frequency)** - low scale for low velocities, high scale for high velocities
- **Color Box Size** - larger area reduces frame rate
- **Color Box Angle** - steering the “box” parallel to the vessel enhances sensitivity
- **Focus** - color flow image optimized at focal zone
Pulsed Wave Doppler (Spectral Doppler)
Pulsed Doppler

- The transducer crystals alternate between sending and receiving the ultrasound signal (recall pulsed echo technology).
- Echoes come only from the area being investigated (sample volume gate).
- Pulsed wave Doppler is unable to measure very high velocities.
Pulsed Doppler

- **Velocity**
  - PS 74.93 cm/s
  - ED 28.34 cm/s

- **Red - Bloodflow Towards the ultrasound beam**

- **Color Bar**
  - Blue away
  - Red Towards

- **Waveform Above Baseline Flow Towards**

- **Sample Volume Gate**

- **Angle**

- **Scale**
Optimizing Spectral Doppler

- **Gain** - overall sensitivity to flow signals - causes the pulsed wave display to be brighter or darker
- **Scale** (also known as pulse repetition frequency) - low scale to assess low velocities, high scale to assess high velocities
- **Baseline** - varies the position of the spectral waveform
- **Enter (update)** - alternatively pauses the spectral waveform, updates the image and reactivates the spectral waveform
Optimizing Spectral Doppler

- **Angle/Steering** – steering the Doppler gate (more) parallel to the vessel enhances sensitivity.
- **Display Format** - changes the horizontal/vertical layout between B-Mode and M-Mode.
- **Sweep Speed** - changes the speed at which the timeline is swept.
- **AUTO Optimize** – optimizes the spectral data. Adjusts the velocity scale/PRF and baseline.
Optimizing Spectral Doppler

- Apply Measurements
- Adjust Angle
- Adjust Gain
- Adjust Sweep Speed
- Adjust Baseline

Corrected Image
Optimizing Spectral Doppler

Initial Spectral Doppler of CCA

Auto Optimize/Auto Angle Correct Spectral Doppler of CAA
Spectral Doppler

Doppler is available on imaging probes that are compatible with systems that support Doppler imaging.
M-Mode – Motion Mode

- A way of displaying depth and time of echoes
- Commonly used for cardiac exams and lung imagining
Optimizing M-Mode

- **MD Cursor** - displays the area that motion information is being gathered from
- **Gain** - overall sensitivity to flow signals - causes the M-mode display to be brighter or darker
- **Sweep Speed** - the speed at which the timeline moves across the image
- **Display Format** - changes the horizontal/vertical layout between B-Mode and M-Mode
M-Mode

M-Mode is available on imaging probes that are compatible with systems that support M-Mode imaging.
Continuous Wave Doppler
Continuous Wave Doppler

- Continuous sound 100% time
- 2 crystals: one for sending and one for receiving the returning echoes
- Can be used with duplex probes supporting the application
- Cannot determine depth of flow
- All ultrasound signals along the entire length of the beam are shown
Continuous Wave Doppler

Advantages:
• Has the ability to measure very high velocities without aliasing
• Small probe size
• Uses high frequencies

Disadvantage:
• All Doppler shifts displayed so it is difficult to display specific vessels
Optimizing Continuous Wave Doppler

- **Gain** - overall sensitivity to flow signals - causes the CWD display to be brighter or darker.
- **Sweep Speed** - the speed at which the timeline moves across the image.
- **Scale** - allows the system to accommodate faster/slower blood flow velocity (determines pulse repetition frequency [PRF])
Continuous Wave Doppler

Available on sector probes

PD2

3Sc-RS

6S-RS