GE Healthcare
VividClub

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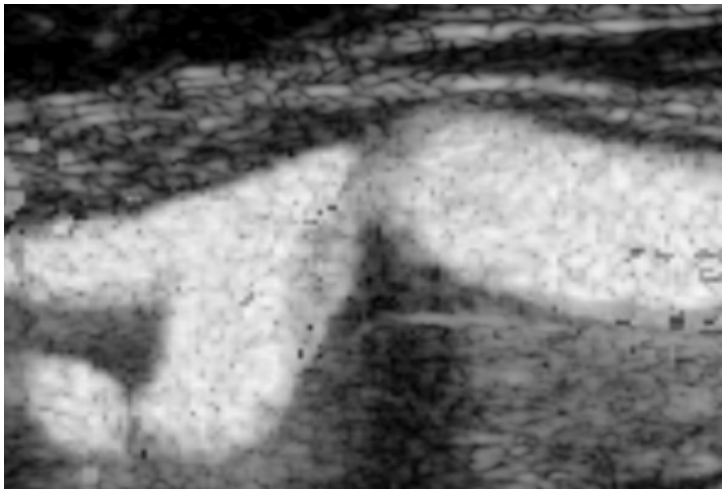
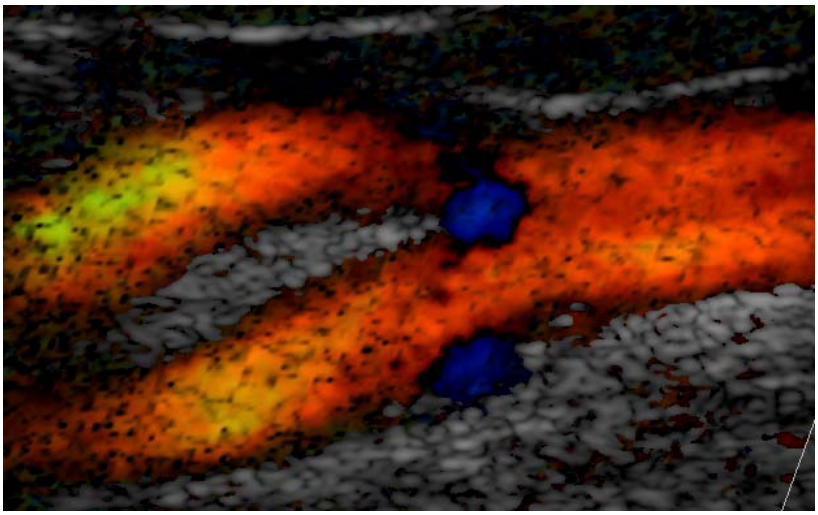
Application News

GE imagination at work

B-Flow and BFI
Technical backgrounds and Operation





Content

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

Background

Conventional colour Doppler imaging has become a routine standard and accepted method for the non-invasive imaging of blood flow through the vessels, by displaying blood flow data on a B-Mode image. A new clinical tool, called Blood Flow Imaging (BFI), utilizes a unique signal-processing algorithm for visualizing blood flow data on the Vivid™ 7 Dimension system. To understand the benefits of BFI, it is necessary to review the basic principles of colour-flow Doppler imaging. To obtain a colour Doppler image, multiple pulses are transmitted along each scan line of the image. For each sample volume in the image, there is a packet of data samples available for estimating parameters describing the blood flow (see Figure 1). The first step in processing is to remove the clutter noise originating from stationary and slowly moving tissue. Using this filtered packet, the mean blood velocity can be estimated by calculating the mean phase shift from sample to sample in the packet. In addition to the mean velocity, the amplitude of the echo from blood, as well as the variance of the velocities around the mean, can be calculated. Large accelerations and turbulent flow patterns result in a broad distribution – and large variance – of velocities. To obtain robust estimates of the flow parameters, substantial temporal and spatial averaging is performed on the data. This averaging blurs potential clinically valuable flow details in both the temporal and spatial dimensions. As a result of the physics of ultrasound imaging, a distribution of sound scatterers inside the body produces an image with spatially varying amplitude. The variation in amplitude is called a speckle pattern, and is a well-known phenomenon in regular B-mode images. The spatial averaging performed in conventional colour Doppler imaging smoothes out the amplitude variation, and the speckle information is not clearly seen in the colour image. Following the wall filter, but prior to collapsing the acquired packets to a one colour image, the resulting set of images display the flow with both high spatial and temporal resolution. Each image is a snapshot of the speckle pattern produced by the spatial distribution of the red blood cells at the instant the image was acquired. With displacement of the blood cells from image to image, there will be a corresponding displacement of the speckle pattern from image to image. When a series of such images is displayed, the user perceives a movement in the speckle pattern, corresponding to the movement of the blood cells producing the speckle flow information.

Blood Flow Imaging (BFI)

The BFI technique attempts to maintain the available details in the echoes from the red blood cells. The concept in BFI is to combine these images with the conventional colour Doppler images (see Figure 2). In BFI, the speckle amplitude modulates the colour intensity level. The resulting images include the conventional colour information, as well as a flowing speckle pattern corresponding to the direction and magnitude of the velocity in the blood flow. The benefit is more hemodynamic information and increased visual differentiation between true blood flow and wall motion artefacts. BFI enhances the conventional colour-flow mode. Similarly, the BFI Angio mode enhances the conventional Angio mode. With BFI Angio, the speckle signal modulates the colour intensity in the Angio display. The result is an Anglo display with flow directional information.
The B-Flow mode builds upon the BFI Angio mode. In B-Flow mode, there is no tissue/flow arbitration, i.e., no hard decision whether tissue or flow information should be displayed in a given pixel. Instead, the tissue and flow signals are added. The resulting image displays a transparent

flow with the underlying tissue visible through the flow signal. The main benefit of this display technique is reduced bleeding of blood flow information into the tissue, resulting in better visualization of the interface between blood flow and vessel wall.

Benefits of BFI

- Better visualization of blood flow dynamics.
  BFI provides a qualitative tool to assess and appreciate the hemodynamics of turbulent flow seen in certain carotid plaque morphology.
- The ability to visualize small collateral blood vessels.
  BFI demonstrates minimal bleeding of colour information compared to colour Doppler imaging.
- Better definition of vessel wall to blood tissue interface.
  BFI provides a unique clutter filtering technique in removing blood flow from wall motion artefacts.

How to operate

B-Flow

B-Flow provides an intuitive representation of non-quantitative hemodynamics in vascular structures. B-Flow enables visualization of complex hemodynamics and highlights moving blood and tissue. There are no artefacts such as bleeding, blooming, or aliasing.
B-Flow is available in Colour flow mode with linear probes only.

Using B-Flow

While in **Colour** flow, press the assigned key **B-FLOW**.
You may adjust the following settings (may vary for different systems)

- Adjust the soft menu control **TEXTURE GAIN**. Increased gain enhances hemodynamic.
- Adjust **Flow speckle**. Increased Flow speckle enhances hemodynamics.

The greater the speed, the better the image scatter density and size. If the scan direction is the same as the flow direction, then the image scatter is elongated; if the scan direction is the opposite as the flow direction, then the image scatter is tighter. Therefore, have the scan direction opposite to that of flow direction. Switch the way you hold the probe, with the probe orientation marker inferior to maintain correct orientation on the monitor. Flow starts from where the focal zone is located.

Blood flow imaging

Blood flow imaging (BFI) is a Colour flow mode with added speckle information. The speckle information visualizes the blood flow direction.
Note: When scanning in BFI triplex mode it is normal to have a time delay between the Doppler display/Doppler audio and the BFI colour display.

Using blood flow imaging

While in **Colour** flow, press the assigned key **BFI**.
You may adjust the following settings (may vary for different systems)

- Adjust the soft menu control **BFI GAIN**. Increased gain enhances hemodynamic. Adjust Flow speckle.
- Increased **Flow speckle** enhances hemodynamics.