TN-1 Think bubbly on LOGIQ ultrasound

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LOGIQ diagnostic ultrasound systems (GE Healthcare) have several kinds of contrast pulsing sequences to extract nonlinear signals exclusively from microbubbles. We will explain some of major technologies on contrast imaging, and show some latest clinical images taken by our latest transducer technology called XDclear.

Amplitude modulation (AM) method generates “nonlinear fundamental” components from microbubbles, which is less generated from soft tissue, or less by other method such as phase inversion.

Coded Harmonic Angio (CHA) is a unique method which makes use of loss of correlation phenomenon in gray scale coded harmonics. Although it is a momentary imaging method which derives transient signals at high mechanical index (MI), the image would show “existence of bubbles” much precisely with higher spatial resolution and penetration. Automatic switchover from AM imaging mode at low MI to CHA mode at high MI (a.k.a. Flash-replenishment sequence) is expected in both of two images to show efficient diagnostic information.

Image post-processing is not always “cosmetics” but sometimes worthy of reconsidering the image. “Raw data” can be thought like undeveloped film, and one can reprocess the images years later to get even better results. For example, Speckle reduction imaging (SRI) has several variations of processing. Some type of SRI enhances edges of the small vessels so as to observe the details, and some type reduces granular pattern by statistical degree of similarity which makes it better contrast resolution. Raw data also contributes to the quantification software. Time intensity curve measurement utilizes numeric values in Raw data which are not affected by post-processing.

TN-2 Technical approach to advanced contrast-enhanced ultrasonography

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ARIETTA 70 was released as a new ultrasound platform that pursues improvement of image quality with greatly enhanced usability. It offers applications specific to the region of diagnosis, which include Real-time Virtual Sonography (RVS), Real-time Tissue Elastography and eTRACKING.

Two methods are available for Contrast Harmonic Imaging (CHI), i.e. Pulse Inversion method and Amplitude Modulation method which can offer a high contrast-to-tissue ratio. In addition to Contrast B-mode display, the system can display a contrast enhanced image as a color overlay on the fundamental image for easier understanding of the relationship between the region of interest and the contrast enhanced area.

Accumulated display which improves visibility of the contrast enhanced image – Motion-Compensated Micro-bubble Trace Imaging Mode – calculates displacement by each set of multiple small regions between frames and performs accumulated display while compensating the displacement. As a result, compensation is possible for the relative parallel translation including movement of the body and the probe and also rotation and deformation. The displacement is calculated in real-time, enabling accumulated display with little blur.

The analysis software which utilizes raw data installed in the system provides quantitative analysis. The system is installed with Time Intensity Curve (TIC) which can plot time vs. brightness after injection in a local area as well as Inflow Time Mapping (ITM) which permits color map display according to the inflow time difference of the contrast agent. These functions allow observation of the blood flow objectively and visually, offering the potential to support tumor characterization.

4-split-screen display is possible using RVS, allowing display of a real-time contrast-enhanced ultrasound image simultaneously with 3 arbitrary virtual images of CT, MRI or US reconstructed from a stored volume data set. This makes understanding of the position of the target lesions easier and facilitates spatial position alignment by using vessels as a reference point.

We would like to show some images and introduce the above technologies.

TN-3 Technical advances in contrast enhanced ultrasound

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The session will cover the benefits of using both Contrast Pulse Sequencing (CPS) and Contrast Harmonic Imaging (CHI) in the diagnosis of focal liver lesions. Technical implementation differences are explained as well as the response of different contrast agents with these imaging techniques. Case studies with liver masses of different etiologies will be presented to demonstrate visual and quantitative wash in and wash out characteristics in arterial phase through late phase contrast imaging.

TN-4 Ultrasound diagnosis using Aplio500

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Since 2004, contrast-enhanced ultrasound (CEUS) with the contrast agent (UCA) SonoVue®, using non-linear imaging at low acoustic power, has been widely applied in China. Every year, more than 100,000 examinations were performed in a large variety of clinical regions. CEUS is one of the most important imaging techniques used in China for diagnosis of tumors and clinical targets such as abdomen, thyroid, breast and superficial regions are the most significant regions of interest.

The general situation of CEUS application and the diagnosis of breast, thyroid and abdomen in China will be discussed.

Toshiba's Aplio™ 500 delivers innovative technologies such as Micro Flow Imaging (MFI), 4D CHI with TIC evaluation, Fly Thru, and Superb Micro-Vascular Imaging (SMI). All these technologies allow the diagnosis in different prospective.

MFI helps visualizing details of vascular structures in tumors for tumor discrimination and investigating diffuse liver diseases such as cirrhosis and fibrosis.

4D CHI, overcomes the orientation limitation of 2D, provides a better view of vascular structures in tumors and increases the accuracy for examining the effect of treatment.

Fly Thru allows the exploration in cavities, ducts and vessels. By adding cross-sectional ultrasound information to the plain surface data, it allows the exploration of lesions and ingrowing masses.

The experience and diagnosis results of the above technologies will also be discussed.

The recently introduced SMI technology provides extremely low flow information by minimizing motion artefacts and thus increasing clinical confidence. We will show SMI studies, with and without CEUS, in different applications and discuss their clinical benefits.

TN-5 EPIQ: An ultrasound platform designed for Sonazoid microbubble contrast imaging

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Over the last decade, microbubble contrast agents have found widespread use in a variety of cardiology and radiology applications. Key image quality attributes that can aid the clinician in making confident diagnosis with contrast enhanced ultrasound (CEUS) include tissue cancellation, sensitivity, bubble resolution, image uniformity, agent lasting time and penetration. Although a lot is known about the behavior of contrast agents in acoustic fields, it is not clear if commercial ultrasound systems of today have harnessed this information to optimize CEUS image quality. In the first quarter of 2014, Philips released EPIQ Premium ultrasound system in Japan that now includes a fully featured Sonazoid CEUS package with significantly improved contrast imaging performance compared to its predecessor, the iU22. In this abstract we describe the design philosophy and some of the key hardware capabilities that were added to EPIQ specifically for Sonazoid imaging.

To allow precise control of transmit waveforms so that different bubble sizes may be excited, EPIQ has a dedicated low voltage transmitter arbitrary apodized wave shaping capability. On receive, a wide-dynamic range amplifier and analog to digital converter (ADC) allows EPIQ to receive small non-linear acoustic signals from microbubbles without running into amplifier and ADC saturation issues from strong specular reflectors which cause bright nearfield artifacts. Pulsing schemes such as pulse inversion (PI), power modulation (PM) and combinations like PMPI are supported on the platform. Image processing algorithms such as Micro-Vascular Imaging (MVI) have been improved and tuned for imaging Sonazoid microbubbles.

nSight Imaging is a proprietary technology that uses massively parallel beamforming technology to retrospectively dynamically reconstruct transmit beams. The resulting increase in SNR is especially significant for late phase contrast imaging where only a fraction of the injected microbubbles remain in blood circulation. Workflow and usability studies were conducted to design CEUS touchscreen layouts for ease of clinical use.

In conclusion, we would like to share Sonazoid imaging capabilities of EPIQ with the larger clinical community at annual meeting of Japan Society of Ultrasonics in Medicine and invite inputs on unexplored applications of this imaging platform.