White Paper

BioAcoustic Technology

ACUSON Sequoia Ultrasound System

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siemens-healthineers.com/sequoia

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The new ACUSON Sequoia™ ultrasound system was designed from the beginning to provide ultrasound users with an integrated user experience, with detailed and information-rich images that dramatically improve the way ultrasound is performed today.

Introducing important design elements that are built in rather than added on, the ACUSON Sequoia system overcomes limitations and design compromises of previous ultrasound system technology. These design elements integrated into the ultrasound imaging engine will carry far into the future as applications expand and computing technology continues to advance.

An important design goal for the ACUSON Sequoia system was to introduce an ultrapremium ultrasound system that meets and exceeds demanding requirements in four critical clinical capabilities:

- **Breakthrough B-mode, color flow Doppler, and spectral Doppler image quality** to reduce operator dependence and provide consistently high exam quality across operators in an ultrasound lab or practice
- A total **user experience** to enhance productivity in very busy labs
- A new level of **quantitative shear wave elastography (SWE)** performance, with excellent precision and accuracy over a large population of patients
- Superb sensitivity and specificity in contrast imaging to reliably provide definitive answers

ACUSON Sequoia BioAcoustic System Architecture

The new ACUSON Sequoia system is the result of more than three decades of experience in ultrasound engineering. Engineers that specialize in acoustics, low-noise analogue and digital RF design, computer and graphics design, artificial intelligence, software architecture, and advanced visualization set out to address the fundamentals that would result in ultrasound images with extremely high signal-to-noise ratio (SNR) and reduce the limitations of traditional beamforming.

Attention to detail was paid to every step in the ultrasound signal processing chain, starting with a new low-noise dual-transmit power supply and carrying those benefits through the system with additional low-noise design elements and precision clocking throughout the system. 14-bit analogue-to-digital conversion has increased dynamic range by more than 18 dB over prior-generation systems*, improving penetration, Doppler and contrast sensitivity as well as image contrast-to-noise ratio.

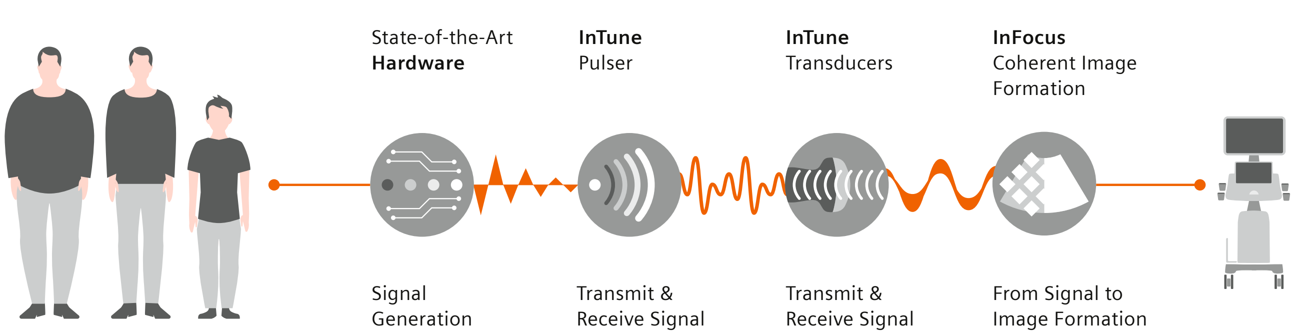


Figure 1: ACUSON Sequoia system imaging engine with BioAcoustic™ imaging technology.

* *Compared to ACUSON S3000 and ACUSON Sequoia 512 ultrasound systems*

Eliminating weak links in the critical data path that can create noise and electronic distortion in the ultrasound image, results in increased image fidelity with higher dynamic range and processing speed than ever before. Massive parallel-receive beamforming provides high beam bandwidth, i.e. the ability to densely sample large areas of anatomy simultaneously with a single transmit. Digital RF information throughput during acquisition that is **equivalent to 3 DVDs each second** provides high-resolution images at high frame rates, even in mixed modes.

Another key aspect of the ACUSON Sequoia system's architectural design is the partitioning of the compute engine from the ultrasound imaging engine. This enables the system to continually take advantage of CPU and GPU processing power developments over time that will continue to enhance the capabilities of the overall system, including the imaging engine. In the future, these improvements will extract even more information from the ultrasound signal.

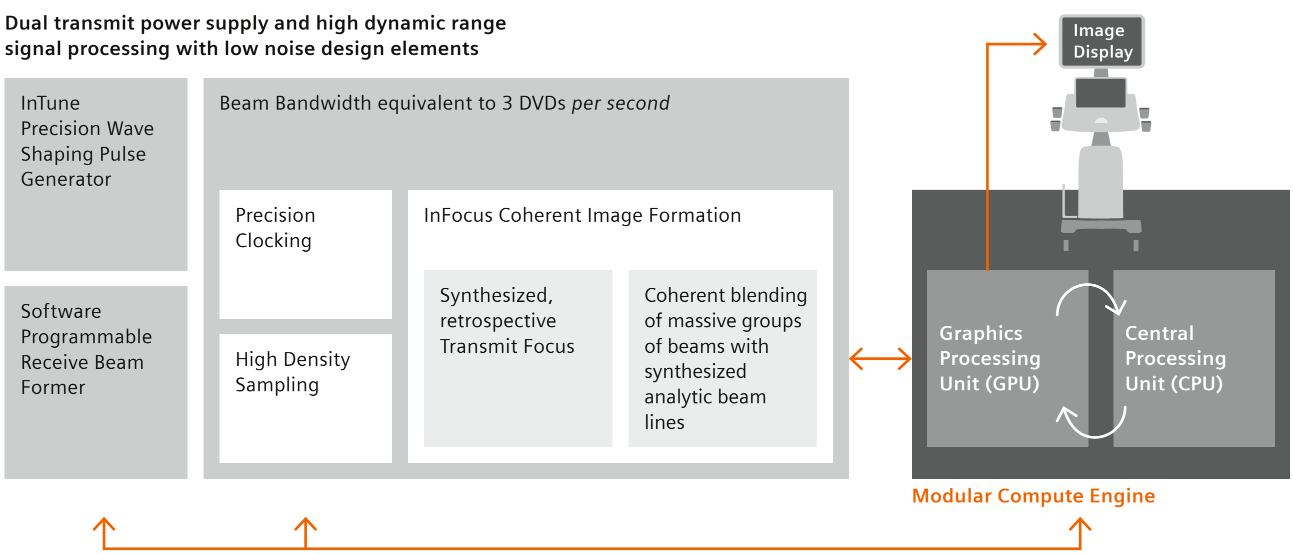


Figure 2: Partitioning the ACUSON Sequoia system's compute engine from the ultrasound imaging engine is a key aspect of the system's architectural design. The modular compute engine allows frequent upgrades to the latest computing technology over the expected lifecycle of the imaging engine, maximizing return on investment.

The new system architecture of the ACUSON Sequoia system dramatically reduces size, electronics and system weight, allowing technicians to easily transport this unique ultrasound technology to a patient's bedside or any other point of care.

One of the most important factors in ultrasound image quality is the transducer. The ACUSON Sequoia system offers several new transducers that take ultrasound sensitivity to a new level by using new materials and construction techniques. When coupled with high SNR signal processing, the ACUSON Sequoia system yields penetration improvements in harmonic imaging of up to 65% over prior systems with comparable transducer types. Next-generation micropinless transducer connectors maintain low noise and signal fidelity and are easy to use. The system architecture is the foundation of present and future performance breakthroughs.

Imaging Performance

The increasing prevalence of obesity in many countries 1,2 can present a problem when evaluating technically difficult patients with ultrasound as a first line imaging modality. Concerns about long-term effects of radiation exposure from X-ray and computed tomography (CT) scans, have made the ability to image large patients more important than ever. One of the breakthroughs introduced with the ACUSON Sequoia system is the **Deep Abdominal Transducer (DAX).**

With the ability to penetrate as deep as 40 cm, DAX will expand the population of patients that can successfully be diagnosed with ultrasound. The benefits extend to all imaging modes, including contrast and shear wave elastography, making DAX a powerful transducer for larger and technically difficult patients.

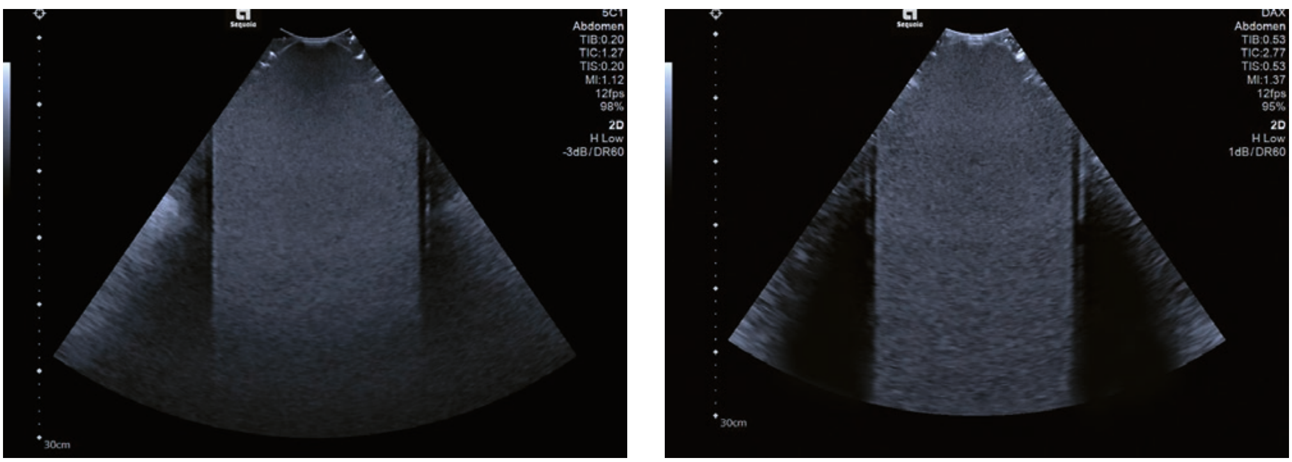
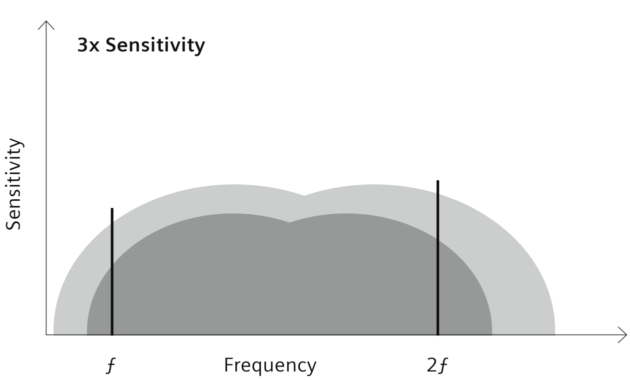


Figure 3: The DAX transducer provides a 30 % improvement in penetration for imaging larger patients, as shown in this comparison between a standard 5C1 transducer (left image) and DAX (right image) using a tissue-equivalent phantom.

InTune Coherent Pulse Formation



Key acoustic performance elements in contrast and harmonic imaging are the agile, dual-linear transmitters of the ACUSON Sequoia system. With the flexible programmability of the InTune™ pulse former that can closely approximate arbitrary waveforms, ultrasound pulses can be precisely tuned for superior harmonic performance and penetration on all transducers. For example, in 4.0 MHz harmonic mode, sensitivity is increased 3 times over previous systems through precision transmit wave shaping and higher receive sensitivity. This allows harmonic imaging to be used as a default mode for most ultrasound exams, improving spatial and contrast resolution.

InTune Coherent Pulse Formation is a key factor in improved harmonic and contrast imaging

InTune coherent pulse formation is also an important factor in contrast imaging, with increased tissue cancellation and maximum bubble response for higher specificity. Extremely low distortion of the transmit pulse and precise phase control achieve 10 times the acoustic fidelity of previous systems.

Support for a wide frequency range improves high-frequency imaging and allows third harmonics imaging on some transducers for improved near-field contrast resolution. Another design improvement is the ability to maintain a constant and sustainable energy delivery over deep depths and with long pulses, such as those used in shear wave elastography employing Acoustic Radiation Force Impulse (ARFI) techniques. A capable transmit power supply helps overcome many limitations of conventional systems to provide uniform, consistent acoustic energy over the field of view. This results in better contrast studies and more accurate, repeatable and reproducible stiffness measurements.

InFocus Coherent Image Formation

Coherent image forming was first pioneered on the original ACUSON Sequoia 512™ ultrasound system by using phase and amplitude information to improve signal quality at the focus and suppress unwanted signal away from the focus. The system was the first high-quality parallel-line imaging system in the industry, gathering "twice the information in half the time."

Powered by the software acceleration of the new ACUSON Sequoia system's graphics processing unit(GPU), a new standard for coherent image formation was created. It supports a new level of beamformer performance with InFocus coherent image formation.

InFocus uses synthesized, retrospectively focused transmit beams throughout the field of view.

Massive parallel beamforming in combination with the new coherent image formation maximizes information from the transducer to the image display. Frame rates can be maximized in coherent image forming by a coherent blending of massive groups of beams (image forming rather than simple beamforming). Analytic lines can be synthesized rather than acquired. Tuned filters and diffraction-effects compensation also help to address image distortion.

InFocus coherent image formation focuses the image at all depths and exploits high beamformer output capacity, which increases image uniformity compared to prior systems. More information is harvested from the usual transmit sequence, using massive overlapping multi-beam groups rather than individual or close parallel beam lines as in conventional systems. This secondary beamforming enabled with InFocus, physics-based delay, phase and amplitude corrections can be made across transmit events to significantly sharpen the image and improve spatial resolution beyond what is typical for a given transducer frequency.

The ACUSON Sequoia system image former delivers many other benefits, such as adaptive gain processing, which eliminates the need for frequent gain adjustments by the user. The blending of fundamental and harmonic imaging improves both penetration and resolution, delivering more detail with extraordinary clarity.

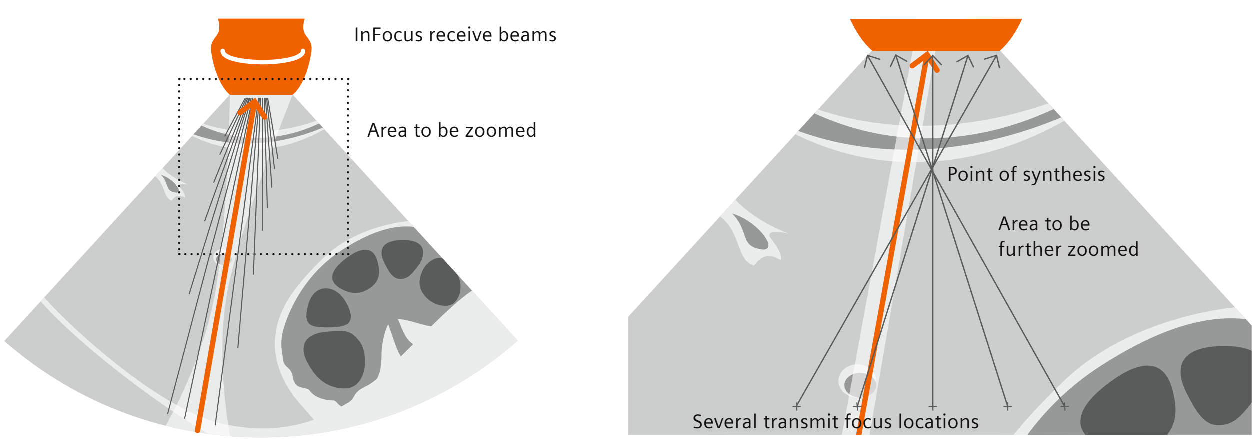


Figure 4: InFocus utilizes multiple simultaneous receive beams covering a region with a single transmit (left). Many receive beams per transmit event leads to many interrogations per image point (right).

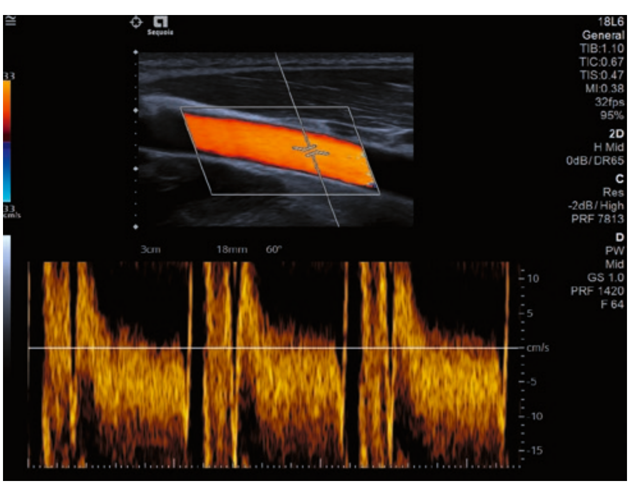
The blending of tissue harmonic imaging with third order harmonics adds more information to the image for better visualization of anatomical detail. Additional advantages include adaptive artifact reduction and the support of spatial compounding in mixed modes and panoramic imaging. This eliminates the need to compromise B-mode image quality when performing exams using color flow Doppler, triplex mode, contrast mode, or E-mode.

InFocus coherent image formation produces high-resolution, uniform images and improves image acquisition workflow

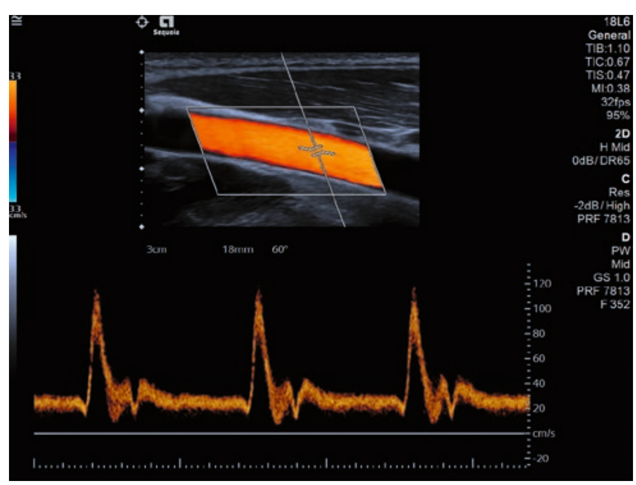
The high information density of acquired image data is preserved all the way from the transducer to the image display in all imaging modes. Benefits in color flow mode include higher sensitivity and greater penetration, higher frame rates with higher spatial resolution, fewer motion induced artifacts and reverberation artifacts, as well as improved visualization of flow dynamics. Anatomy-specific flow states automatically optimize color flow parameters for higher-quality, more consistent exams. In pulsed Doppler, continuous wave Doppler, high-PRF pulsed Doppler, and tissue Doppler modes, similar improvements in sensitivity and penetration are also realized. In live duplex mode, higher B-mode frame rates are achieved along with cleaner audio and spectral quality.

The image former of the ACUSON Sequoia system also provides significant benefits to the Doppler workflow. Its new AutoTEQ™ tissue equalization technology automatically optimizes relevant parameters so that operator adjustments are kept to a minimum. Several acquisition parameters such as gain, velocity scale, wall filter, AutoTEQ, and other post-processing parameters can now be adjusted on a frozen sweep before images are saved to PACS.

The sensitivity and accuracy of auto-trace flow statistics can be improved with gain control after the display is frozen. Doppler tissue imaging (DTI) is now also available on all transducers in fetal echo exams.



AutoTEQ Off



AutoTEQ On

Figure 5: Workflow automation with Doppler AutoTEQ reduces user interaction and improves exam consistency.

UltraArt Universal Image Processing

A truly unique new capability among diagnostic ultrasound systems, UltraArt™ universal image processing allows the operator to select preferred image parameter settings before they are applied by choosing an image from several choices directly on the touch screen. B-mode, color flow mode and pulsed Doppler image post-processing parameters can be selected with a single touch to instantly optimize images for different patient types. This allows quick and easy matching of the ACUSON Sequoia system's BioAcoustic parameters to individual patients. The effects of several parameter changes are displayed on the touchscreen monitor before they are applied.

Siemens Healthineers ultrasound engineers have worked closely with sonographers in the clinical practice to eliminate a common cause of exam quality variability among users by eliminating the complexity, redundancy and interplay of conventional image post-processing features. By unifying multiple parameters into optimal settings for each individual patient, UltraArt patient-specific image processing improves the contrast resolution of different organs and supports the visualization of small or isoechoic lesions. UltraArt™ universal image processing improves exam quality and consistency across different users by avoiding improper combinations of individual post-processing parameters. Reading physicians can look forward to enhanced exam quality standardization.

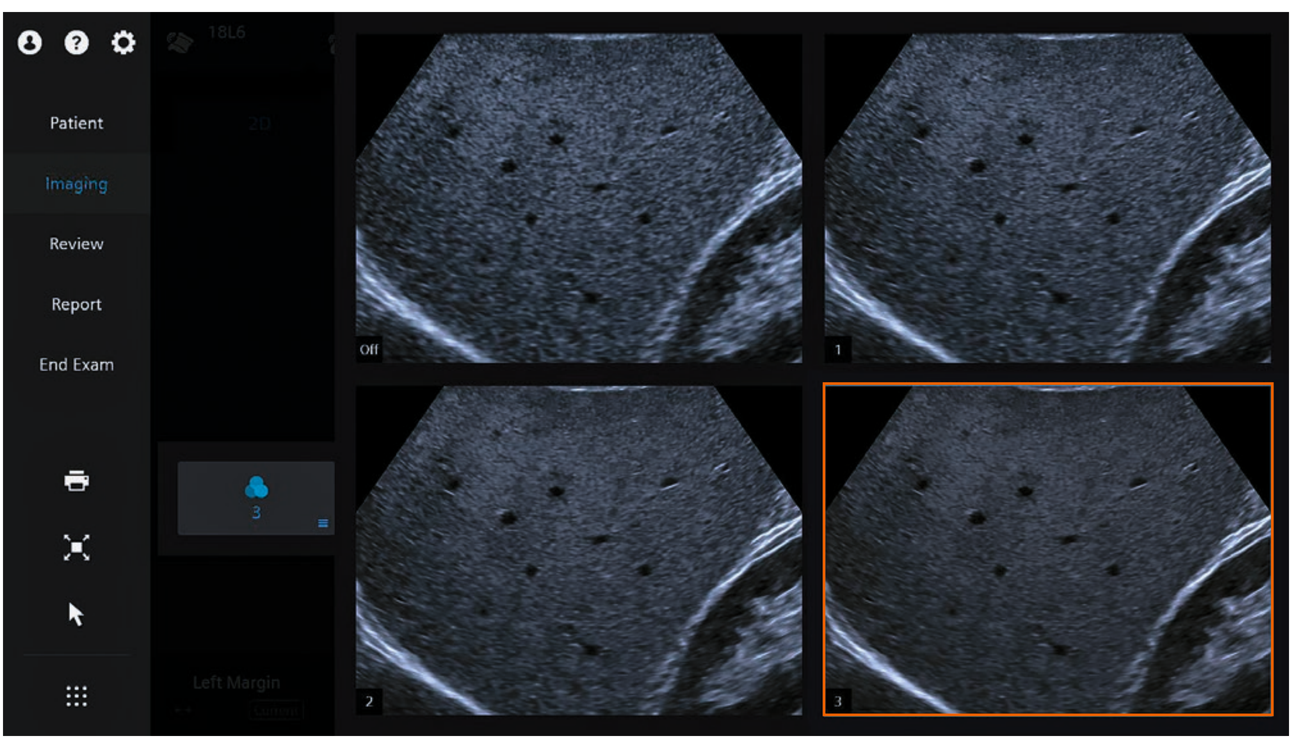


Figure 6: Touchscreen display in UltraArt-enabled mode. Operator selection of the image that best matches the patient's bioacoustic characteristics. This helps to avoid manual adjustment of multiple individual image parameters, reducing exam time and improving exam quality.

Advanced Visualization

The entire critical data path of the ACUSON Sequoia ultrasound system has been optimized from transducer to viewing monitor. To realize the benefits of the acoustic signal processing improvements, a 21.6-inch OLED high-dynamic range viewing monitor with pure black and high viewing contrast is standard. Careful calibration of the monitor characteristics to the video signal maintains linearity over a large dynamic range.

Extended cineloop memory with "raw data" post-processing and post-freeze measurement capabilities expands workflow flexibility. Present and future advanced visualization features and image rendering are supported by a fast and flexible graphics processor (GPU), minimizing the occurrence of many workflow delays during the exam.

InTune Transducer Technology

One of the key advances of the ACUSON Sequoia system's transducer technology is the addition of single-crystal piezoelectric transducers for both cardiac and general imaging. Piezoelectric material is at the heart of any transducer, transforming electricity into ultrasound, and then back into electrical image signals. When compared with standard piezoelectric elements, the latest generation single-crystal designs offer wider bandwidths for better harmonic imaging and axial resolution, and greater sensitivity for deeper penetration and clearer imaging.

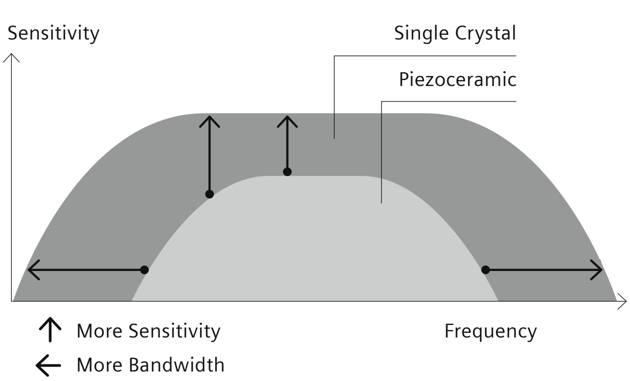


Figure 7: The latest generation single-crystal designs offer wider bandwidths for better harmonic imaging and axial resolution, and greater sensitivity for deeper penetration and clearer imaging.

The use of single-crystal material provides extra capability where it is most needed in each clinical application for abdominal and cardiac transducers (5C1 and 5V1 respectively), providing improved sensitivity and bandwidth compared to their predecessors. Advanced processing methods to match the quality of the material were developed, with the transducer built around the single crystal, each component carefully scrutinized for performance and reliability.

The ACUSON Sequoia system's InTune transducer technology was developed to produce the best acoustics for each clinical use case. With advanced materials, simulation, manufacturing and testing, the acoustic matching between transducer and patient was optimized, together with the electrical signal path between transducer and system cart, resulting in the highest signal fidelity throughout.

A limiting factor in transducer design has been temperature. The Food and Drug Administration (FDA) and other international regulatory bodies that define transducer performance requirements allow the ultrasound probe to only warm by a few degrees to protect both patient and sonographer. By concentrating on the thermal design of the transducers, incorporating novel thermal technology, and optimizing acoustic stack design, the new transducers operate significantly cooler compared to their predecessors for any given ultrasound signal.

With ultrasound being the most operator-dependent imaging modality, Siemens Healthineers considered biological and technological aspect, and user-dependencies when creating the new InTune transducers. Special focus was given to their industrial design to improve patient experience, scan experience and imaging needs of sonographers, with the goal to obtain a clinically useful image in the shortest possible time. Molding the InTune transducer casing to fit the hand of a sonographer, the use of textured plastics for grip, and the redesign of cables help to reduce strain and repetitive stress for the operator while increasing comfort and accessibility.

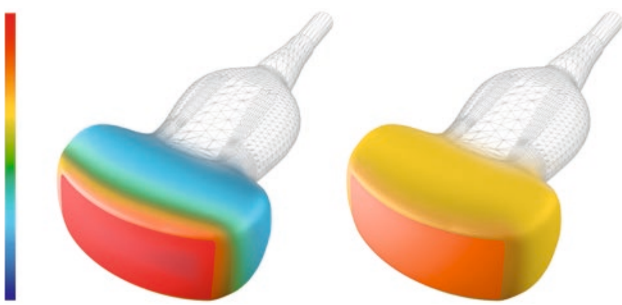


Figure 8: Thermal images show the concentration of heat build-up in the transducer footprint in the left image, and a cooler footprint with better heat distribution into the transducer housing in the right image, resulting in improved transducer efficiency.

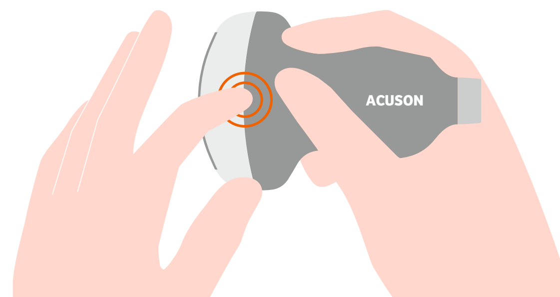


Figure 9: The unique gesture detecting technology recognizes sonographer interaction with the transducer to support clinical workflows.

Performed many times a day and often multiple times throughout a single patient exam, the continual need to select transducers for imaging is one of the common challenges for sonographers. To resolve this challenge, several of the ACUSON Sequoia system's InTune transducers feature gesture detecting technology. Incorporating advanced accelerometer technology and proprietary software, gesture detecting technology recognizes sonographer interaction with a transducer. This can support clinical workflows by reducing unwanted keyboard interactions allowing sonographers to increasingly focus on the patient.

Taking advantage of ongoing transducer advancements, signals are able to penetrate deeper into the body enabling, in parallel, the visualization of smaller regions of interest, such as small vessels and focal lesions. Minimal elevation slice thickness throughout is necessary to achieve excellent imaging performance from shallow through deep regions of interest. On this account, Siemens Healthineers has expanded its portfolio of Multi-D and high-element density transducers to allow a dynamic elevation aperture change according to imaging needs.

Especially important for use in high-BMI patients, the new deep abdominal transducer (DAX) addresses deep-depth imaging by enabling imaging throughout a 40-cm-depth range. This is made possible by employing an advanced form of Multi-D beam formation that controls the beam thickness and beam formation in both transmission and receive phases.

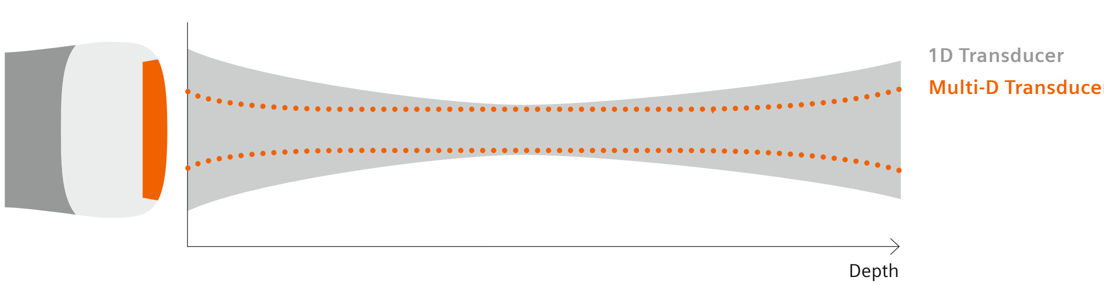


Figure 10: The advanced Multi-D beam formation of the Deep Abdominal Transducer (DAX) enables thinner slice thickness enabling imaging throughout a range of up to 40 cm.

User Experience

The unified user experience concept of the ACUSON Sequoia system allows new users to simply walk up and use the system due to an enhanced articulating touchscreen user interface, simplified control panel, improved on-screen messaging and feedback as well as a trackball hot zone designed for both left- and right-handed use.

The system's user experience is the result of five years of research with professional scanners (both sonographers and physicians) as well as leading ultrasound researchers across North America, Europe, and Asia. User research occurred in realistic clinical settings, third party usability laboratories and engineering environments to maximize the understanding of today's workflows and user needs.

The system's large, easy-to-read articulating touch screen is a key element of the user interface design. Designed to integrate future applications, the large screen area can be expanded as applications evolve and innovative features are developed. The design of the touch screen features a consistent and predicable structure so operators can immediately find what they need for a specific exam. The touch screen also provides controls in logical groupings based on frequency of use, similarity to other features and easy access for the operator. In addition, the system uses state-of-the-art gesture functionality for initializing transducers to reduce strain and optimize reach.

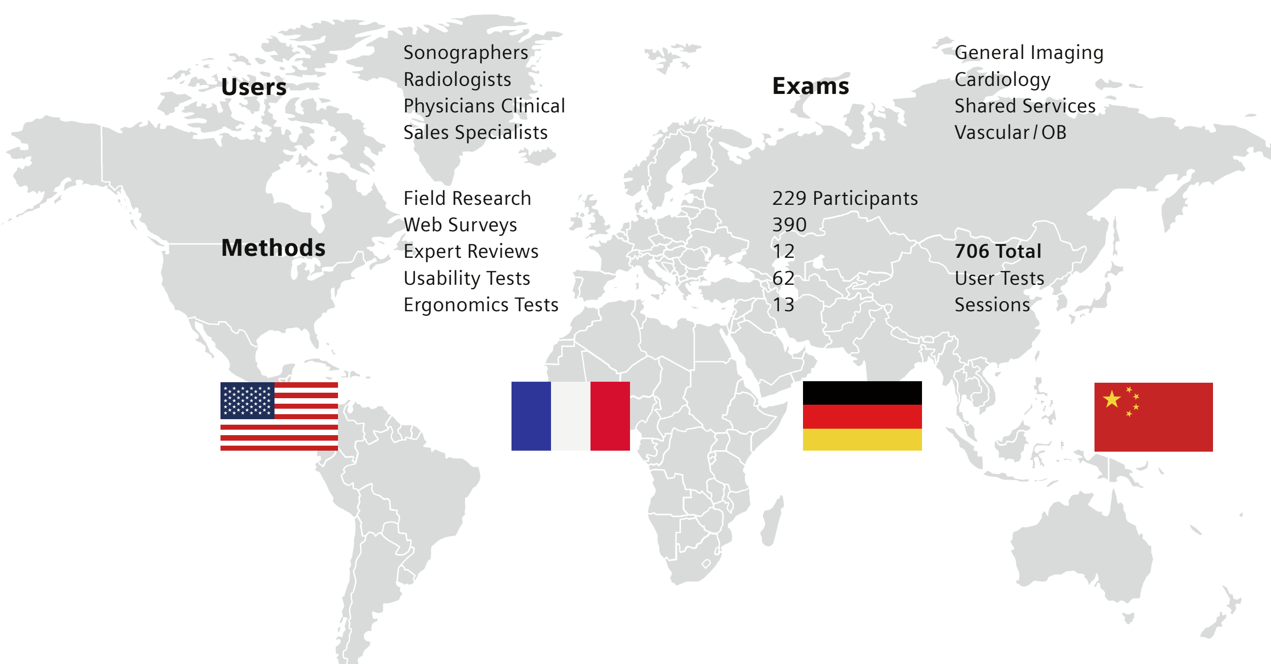


Figure 11: 706 user test sessions were conducted over the period of five years in the United States, China, Germany, and France to comprehend and include findings to improve today's clinical workflows and adapt to user needs in ultrasound.

Figure 12: Minimalistic design of the ACUSON Sequoia control panel reduces complexity and promotes ease of use. The functions of the control panel are close to the operator to reduce strain and improve reach.

The control panel, designed to reduce complexity, contains only the most important functions that support clinical workflow and diagnosis. The remaining functions reside on the touchscreen for those who want more control over image acquisition and visualization. The trackball hot zone contains two select buttons along with some of the most frequently used functions Clip, Image, Update, Caliper, and Annotations. This allows operators to get through the main portions of an exam without needing to move their hand away from the hot zone.

Overall, the functions on the control panel have been moved closer to the operator to reduce strain and improve reach.

The main display was designed to accentuate the diagnostic image by muting the color palette and brightness of the surrounding user interface to allow the clinician to concentrate on the ultrasound image. The main display contains minimal user controls for reduced complexity and clutter. It also features an improved trackball feedback area to let the user observe and control trackball movements at a glance. Areas are also reserved for future applications, features, and functions.

New exam protocols enable greater standardization in busy ultrasound departments. New factory protocols include cardiac exams with a full suite of cardiac measurements. Series measurements are supported in all exam types. Operators can program their own options and ease-of-use enhancements that best fit their exam workflow. A new capability for an offline protocol editor allows a centrally designed protocol to be easily deployed across multiple ACUSON Sequoia systems using a USB drive for departmental standardization.

Clinical Applications

Contrast Imaging: Overcoming Technical Barriers

10x Acoustic Fidelity

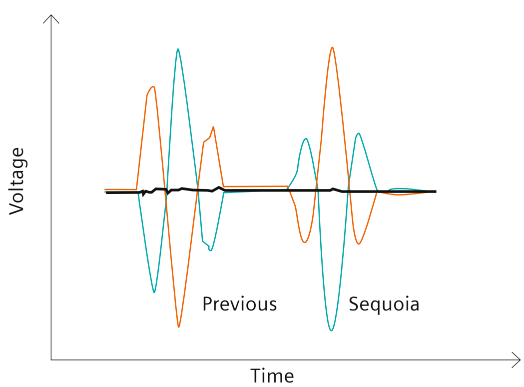


Figure 13: Tissue cancellation has been improved ten times over the original ACUSON Sequoia S512 system resulting in improved acoustic fidelity.

Average Contrast Sensitivity as a Function of Time
1:50000 Dose of Sonovue / Lumason

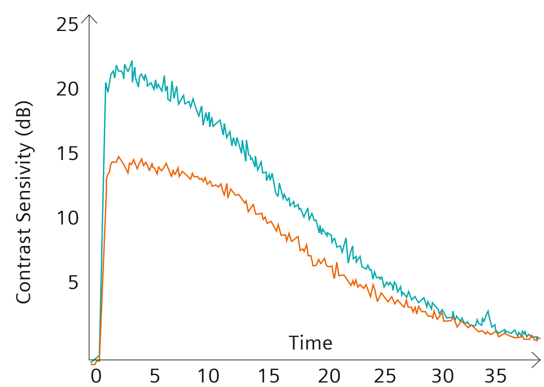


Figure 14: The ACUSON Sequoia (blue line) has approximately 6 dB (2 times) more sensitivity at depth in contrast imaging than its predecessor, the ACUSON Sequoia S512 system (orange line), in the first 10 minutes post-injection, with 10 times better tissue cancellation, potentially leading to higher diagnostic confidence.

The enormous architectural power of the ACUSON Sequoia system can provide visualization of contrast deeper and with greater clarity than ever before. Tissue cancellation has been improved ten times over even the original ACUSON Sequoia S512 ultrasound system. This is achieved with InTune pulse formation and dual transmit power supplies with high-voltage scale agility, contributing to a high linear response rejection ratio.

Contrast sensitivity two times higher than the original ACUSON Sequoia 512 system allows the visualization of small vessel perfusion, and in many cases the ability to visualize a diagnostic level of contrast agent for a much longer late-phase contrast perfusion assessment. This may increase diagnostic confidence by offering a differentiation of focal liver lesions using the contrast-enhanced ultrasound (CEUS) LI-RADS algorithm[3]. (Figure 15)

Multiple independent transmit beams using massive parallel beamforming are used for a more uniform insonation, minimizing inadvertent bubble destruction from localized higher- intensity zones that would otherwise occur with conventional technologies. The InTune coherent pulse former also improves waveform generation fidelity which significantly reduces undesirable harmonics and other transmissions while precise transmit apodization better suppresses off-axis echoes.

Flash sequencing with tissue motion stabilization using proprietary algorithms produces images with better small-vessel arterial phase imaging. (Figure 16)

Independent coherent image formation with signal paths and control parameters separated from B-mode allow contrast images to be independently optimized, resulting in high quality B-Contrast live dual mode images without B-mode image degradation.

Elastography

Ultrasound elastography using strain imaging techniques was once a research area. The number of users has recently grown from a small group of "super users" in radiology to a large installed base of users in different clinical specialties. With the advent of less user dependent quantitative shear wave measurement techniques, ultrasound elastography has become an important tool in the assessment and management of disease.

Operator, patient and system differences are all confounders that can influence measurement results using shear wave technology. In fact, system differences across the industry have created awareness that measurement results from different systems are not interchangeable with respect to a patient's condition. For this reason, the Radiological Society of North America (RSNA) formed a Quantitative Imaging Biomarker Alliance (QIBA) Technical Committee that focuses specifically on shear wave speed measurement in liver fibrosis as the first quantitative marker. A goal of the committee is to partner with academic research institutions, regulatory bodies and industry representatives to solve problems that are hindering the adoption of new quantitative imaging technologies. A planned outcome of the SWS Technical Committee is the establishment of a profile for shear wave speed with proposed standards of measurement accuracy, repeatability and reproducibility. In this way, QIBA compliant systems can then be trusted to produce similar and satisfactory results in the hands of trained operators.

The ACUSON Sequoia system is designed to meet the new QIBA profile for shear wave speed measurements in the liver, with design improvements intended to solve many of the earlier problems with shear wave technology.

One of the design elements built into the ACUSON Sequoia system specifically for shear wave elastography is dedicated hardware in the dual linear transmitter. This provides more consistent energy transmission in ARFI transmit modes used in shear wave imaging. While the mechanical index limit mandated by regulatory agencies is never exceeded, the longer-duration "push pulses" required to generate shear waves in tissue require a large amount of energy from the transmit power supplies. Without an adequate transmit power supply, the transmit voltage can decay from the beginning to the end of the transmit pulse, deteriorating the amplitude of tissue displacement and resulting in more measurement variability.

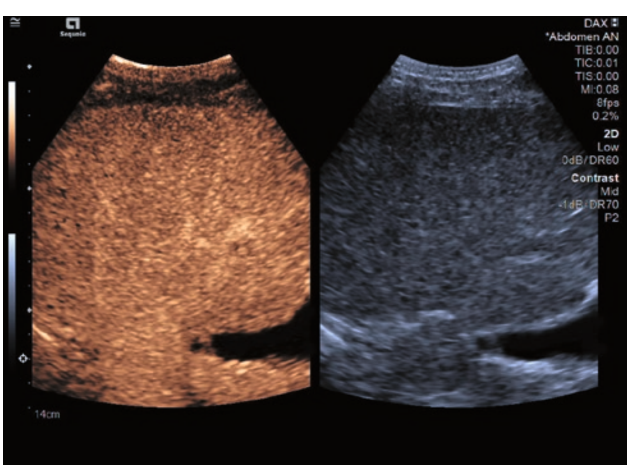


Figure 15: Extended late phase contrast ultrasound of cirrhotic liver.

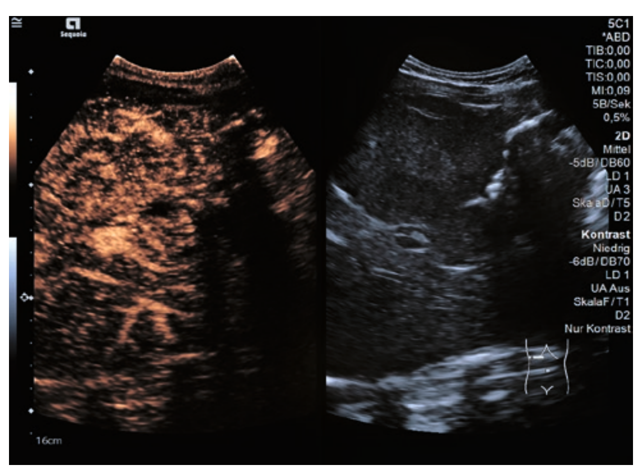


Figure 16: Focal nodular hyperplasia (FNH) in the arterial phase using flash sequencing technology.

As an example, typical B-mode transmit pulses use about 7.7 millijoules (mJ) of energy, while Siemens Healthineers proprietary Virtual Touch™ shear wave technology push pulses demand a much larger amount of energy. ACUSON Sequoia system ARFI pulses can consume several hundred times the energy of B-mode pulses.

Therefore, a dedicated Virtual Touch technology power bank was implemented. It uses 35 capacitors that can quickly store about 15 Joules of energy and provides more than 6 times the energy storage capacity when in pSWE or SWE mode. More push energy is deposited over a deeper range in tissue than ever before, resulting in better accuracy and precision over a larger patient population.

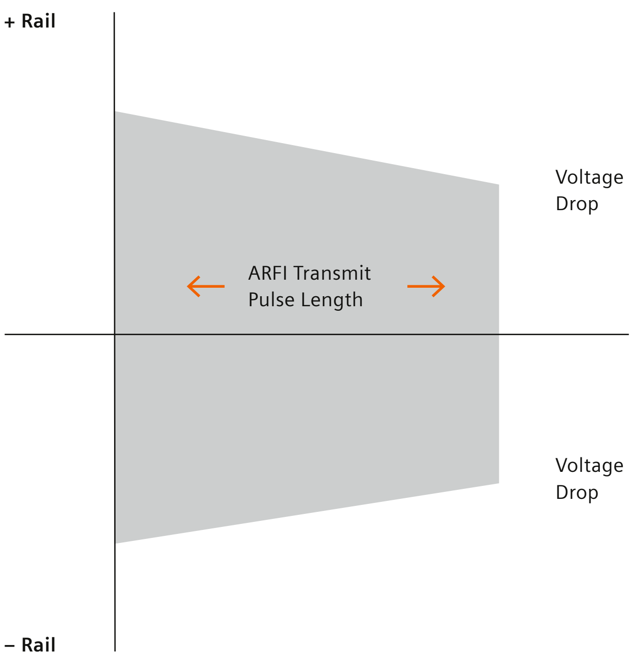


Figure 17: In a traditional ultrasound system, transmit voltage drop during ARFI push pulses can deteriorate SWE results, especially in technically difficult patients.

6x Energy for Shear Wave Imaging

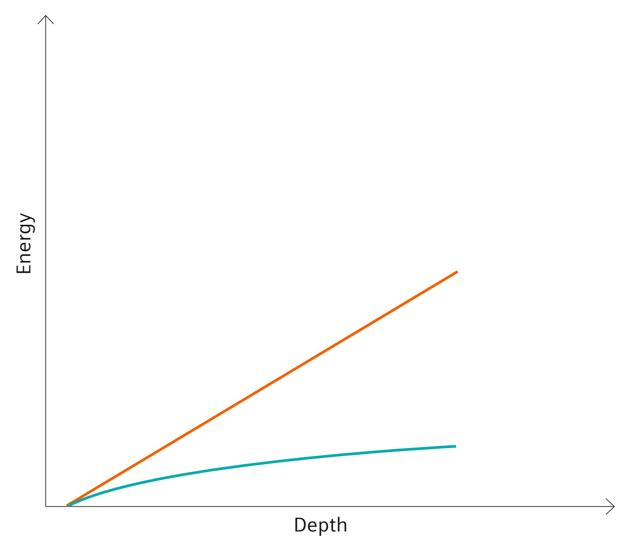


Figure 18: Dedicated E-mode hardware for sustainable energy delivery in shear wave elastography.

Massive parallel receive beamforming enables more samples to be acquired for a given area with less variability of measurements over the depth range in homogeneous tissue, such as liver and spleen. Robust tracking of shear waves in viscoelastic tissue, where higher shear wave frequencies are first attenuated, helps to overcome patient dependent variability. As in all ACUSON Sequoia system mixed modes, independent B-mode, ARFI, and, shear wave signal processing prevents degradation of the B-mode reference image during acquisition and recording.

In Virtual Touch pSWE, bench-tested accuracy and precision over the depth range in elastic phantoms has been improved from ± 20% of the reference value of prior systems to within ± 5% within the clinical range of shear wave speeds in the liver. The ACUSON Sequoia has superior accuracy and precision, as measured in bench testing using the same phantoms and equivalent transducer types.

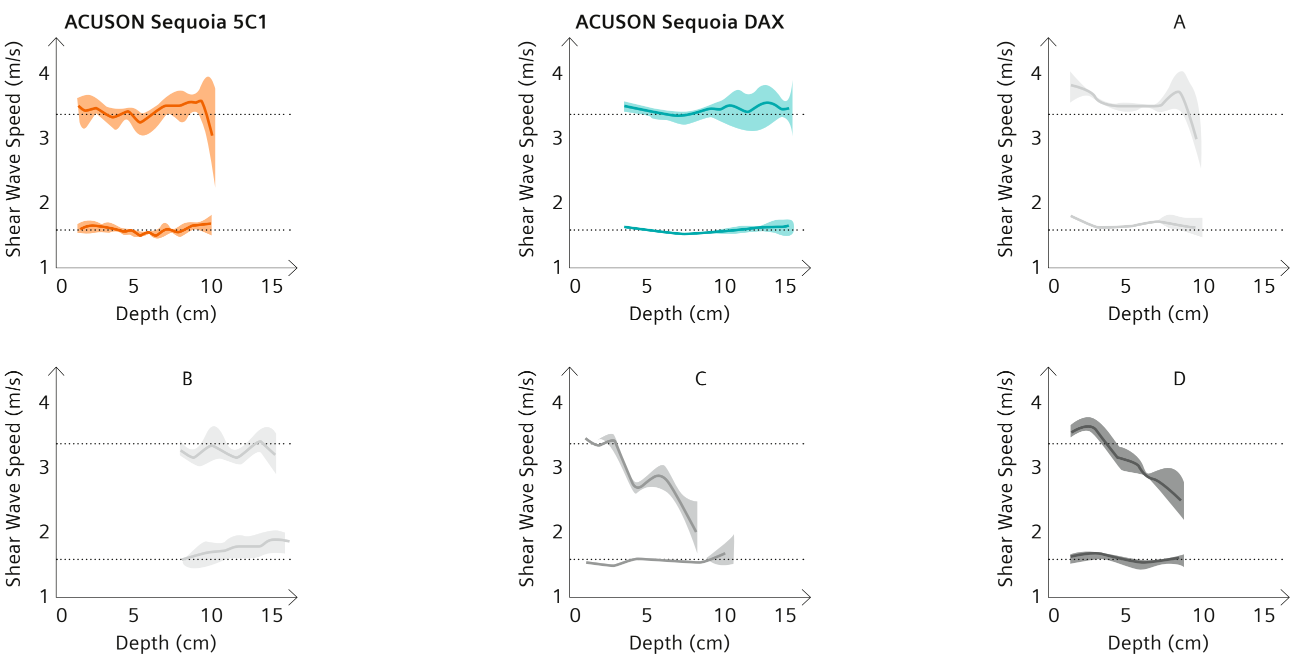


Figure 19: Accuracy and precision with minimal bias of the ACUSON Sequoia system pSWE compared to four premium ultrasound systems with current software available at the time of writing (A-D). Note that DAX allows shear wave speed and stiffness measurements 75% deeper than conventional systems and transducers. The dotted lines represent the calibrated elastic phantom reference values.

In Virtual Touch technology 2D SWE, high sampling density provides high spatial and stiffness resolution for imaging focal lesions and heterogeneous tissue, such as in breast and in thyroid nodules. Stiff lesions as small as 3 mm can be clearly visualized with less background variation than in the prior system, increasing diagnostic confidence. Reduced artifacts provide for better visualization of stiffness variations in the body. A quality map is important in interpreting the reliability of shear wave measurements, with high confidence estimations indicated by green areas of the quality image and yellow to red areas indicating areas where the shear wave displacement signal-to-noise ratio was too low to produce a reliable estimate. The displacement map has been updated in the ACUSON Sequoia system to represent the ARFI on-axis displacement magnitude at the location of push pulses, rather than off-axis shear wave amplitude. This dramatically improves the dynamic range of the displacement image, which can be helpful in visualization of lesion boundaries compared to the B-mode image.

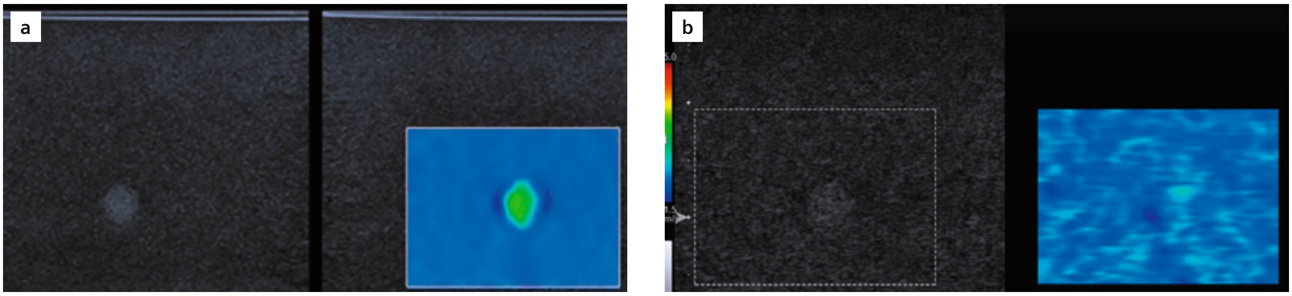


Figure 20: SWE improvements have made it possible to visualize small stiff lesions, such as in this example. In this elastic phantom with a 3 mm target, the elasticity difference is clearly seen in the ACUSON Sequoia system image on the left (a), compared to a predecessor system using a similar transducer type on the right (b), where the target is difficult to discern from the background.

In addition to improved shear wave elastography images, fast and flexible workflow minimizes measurement time during the ultrasound study. Measurement labels can be quickly selected on the touch screen and the acquisition time for measurements has been reduced.

Fewer steps are involved in performing the elastography study and measurement results can be displayed and reported as stiffness in kiloPascal (kPa) or as shear wave velocity in meters per second (m/s).

Workflow Support in Radiology

To improve workflow in radiology departments, ultrasound systems must interface well within a modern networked environment. The ACUSON Sequoia system is fully DICOM-compliant, and provides the ability to send Structured Report (SR) data to select network nodes at the end of the exam. Data can also be transferred to the report or configured for a Nuance™ reporting configuration. Both LAN and Wi-Fi support is provided, so the system can be used in portable studies without interrupting its network connectivity. DICOM SR measurements have been expanded for all exam types, so more flexibility is available for a wider variety of local measurement protocols. In addition, SR routing can be applied to multiple destinations.

The network configuration of the ACUSON Sequoia system is easy and uncomplicated, enabling the local IT staff to perform network setup without a technical service engineer. A single-screen location contains all worklist configuration settings, and storage commitment can be configured for a different storage server.

Minimizing security risks and protecting medical equipment from cyberattacks have become crucial in today's connected healthcare environments.

The ACUSON Sequoia complies with current MDS2- and DoD requirements. Account management uses a unique BIOS and administrative password scheme in which individual users have a unique name and password. "Hardening" of the system is accomplished without interruption to workflow. To protect from security threats as well as malware and intrusion, the ACUSON Sequoia system uses strong firewall rules, system memory protection and McAfee™ application control for virus protection. System hard drive encryption ensures secure system boot-up. A kiosk mode prevents access to the operating system and hard drives by eliminating the command line and task bar interface. A dashboard view for the security configuration is provided on one consolidated location, making it easier to manage security settings. Finally, the server and the ACUSON Sequoia system exchange security certificates in the background to help guard against Man In The Middle (MITM) cyberattacks. All of these features always run in the background and will only be noticed by the user when logging into the system.

Conclusion

The ACUSON Sequoia system is a technically advanced ultrasound system that supports current and future advanced diagnostic capabilities. Purpose-built from the ground up, it is the result of a close collaboration between ultrasound users in the clinical practice and Siemens Healthineers ultrasound engineering teams. The accumulated know-how of decades of premium ultrasound design and development has been leveraged to produce unmatched image quality, user experience, contrast imaging and elastography capabilities in the industry. The longevity of the imaging engine hardware and flexible upgrade path design of the computing engine ensures the integration of future diagnostic ultrasound technologies to enhance system performance and investment protection.

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Notes

Notes

Standalone clinical images may have been cropped to better visualize pathology. The products/features mentioned in this document may not be commercially available in all countries. Due to regulatory reasons, their future availability cannot be guaranteed.

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