ACUSON Sequoia Ultrasound System

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The ACUSON Sequoia™ 512 ultrasound system embodies the power of the Sequoia core architecture, which is based on fundamental scientific advancements. This technology relies on four proprietary cornerstones:

- Coherent imaging technologies
- Innovative transducer technologies
- Advanced imaging technologies
- DIMAQ™ integrated ultrasound workstation

The Sequoia 512 system can be tailored to meet individual clinical needs and budget requirements, including general imaging and shared service applications with the cardiology option. The Sequoia 512 system allows continued expansion of capabilities and offers upgrades to meet future diagnostic needs.

GENERAL INFORMATION

Coherent Imaging Technologies

- Coherent image formation uses both phase and amplitude information to form an image resulting in:
  - Increased temporal and spatial resolution
  - Greater dynamic range and sensitivity
  - Increased frame rates
- Coherent pulse formation precisely controls the transmitted waveform for increased imaging performance
- Programmable waveform generator generates complex transmit waveforms enabling:
  - Native tissue harmonic imaging to eliminate body wall artifacts and acoustic noise
  - Chirp coded excitation for increased penetration at high frequencies with higher resolution imaging, and high frame rate while reducing motion artifacts
  - Dynamic Transmit Focus to dynamically focus the transmitted beam at multiple focal depths without decreasing frame rates

- Up to 57,344 coherent image formation processing channels which are the number of independent sources of information that the system uses to form an image
- Multiple beamformers with:
  - Tracking focus continuously, electronically reshapes the acoustic lens, on receive, to dynamically focus along each ultrasound beam
  - Tracking aperture continuously varies the size of the electronic lens aperture, on receive, for each beam, to maintain resolving power throughout the field of view
  - Tracking apodization dynamically varies the sensitivity of each channel to minimize sidelobes and maximize contrast resolution for each beam
  - Phase and amplitude of the ultrasound echo signal are uniquely preserved and encoded along each ultrasound beam in 2D mode

Matched Response Technology

Sequoia™ matched response technology measures and adapts to patients' individual acoustic properties for consistent, reliable exams. Matches transmit and receive functions to heighten clinical specificity, optimize diagnostic outcome and improve work-flow across applications.

Sequoia matched response technology incorporates visionary technologies that maximize information content. Programmable control over both transmit and receive phase and amplitude of ultrasound signal optimizes the image for patient specific acoustic properties through the use of:

- Coherent imaging technologies, including:
  - Coherent pulse formation with programmable waveform generator
  - Coherent image formation
- Hanafy lens acoustic technology
- Native™ patient specific imaging
- Data management & storage with digital dynamic clips in DICOM format using the DIMAQ™ integrated ultrasound workstation

Native Patient Specific Imaging

Native patient specific imaging (NPSI) is the only ultrasound technology to form images based on the individual signature of each and every patient. This revolutionary technology enables the ACUSON Sequoia ultrasound system to use a patient specific feedback loop, utilizing all available acoustic information (both phase and amplitude) to optimize to the patient's individual acoustic properties. The system detects, measures, and adapts in real-time, the transmit and receive functions offering unparallel image quality. The result is an ultrasound system that offers:

- Superior image optimization
  - Superior image quality resulting from the use of patient's individual acoustic "signature"
  - Consistently optimized images
  - Across the full range of clinical patients
- Superior ergonomics and workflow
  - Reduced keystrokes and repetitive hand motions while maintaining high image quality
  - Consistency in exam quality with increased patient throughput
  - Greater diagnostic confidence and improved clinical imaging

Ergonomics

- Compact size and high maneuverability for portable examinations
- Adjustable height for control panel and monitor
- Tilt and swivel monitor with locking mechanism
- Selectable 2-wheel pivot/4-wheel pivot/wheel brake, adjusted by foot pedal
- 3 active transducer ports for simultaneous transducer connection
- Connector for Auxiliary Continuous Wave (CW) transducer
- 2 transducer connector holders
- Removable gel bottle holder
- Gel Warmer
- Adjustable lighting of the keyboard controls for efficient operation in low ambient light
- High quality stereo audio speaker system
- Input and output connections on the rear panel
- Headphone connector
- Footswitch with 2 programmable controls (selection of 17 functions for each control)
- Back of system compartment for rear panel access and cable management
- Front compartment for storage of accessories
- Rear bay for system peripherals with left or right access
- Rear shelf for additional system peripherals
- Front and rear handles
- Quick connect/disconnect of external peripherals through a single cable port
- Easily removable and cleanable air filters
- Ethernet output for system service diagnostics

Control Panel

- Direct access to system functions through dedicated keyboard controls and monitor softkeys
- Central home position controls, including one trackball and two Select Keys, for minimum hand movements while controlling the system
- Trackball Select Keys provide shortcuts for many functions

- Functional grouping of keys, rotational knobs, push-and rotate knobs, toggle switches of different size and shape, for rapid access
- Positive feedback on control actuation
- Indicator lights identify activated keys
- Backlighting of control panel labels
- Direct access to current functions via multi-functional software-driven softkeys on the monitor
- Easy, intuitive image optimization with one-touch, dial-up image control for all patients and exam types
- Rapid return to 2D imaging via 2D only key
- Optional peripherals controlled through system keyboard
- Audio volume control
- Front access to system power on/off button
  - System runs self-diagnostics at power up
  - Automatic saving of current examination images and data at power off

MONITOR

Cathode Ray Tube (CRT) or Flat Panel LCD (optional) displays

CRT display

- 14" (36 cm) high-resolution non-interlaced computer color monitor; 11.8" (30 cm) viewable screen size
- Resolution:
  - PAL: 768 x 576, 50 Hz
  - NTSC: 640 x 480, 60 Hz
- Brightness control with quick return to a preset calibrated level
- Degauss control
- Monitor boost for high ambient lighting conditions

Flat Panel Display

- 18.1" (46 cm) high resolution flat panel monitor liquid crystal display with IPS (in-plane switched) technology
- Reduced glare in all working environments
- Flicker-free technology display
- Screen resolution 1280 x 1024
- High contrast ratio > 400:1
- Adjustable brightness controls (0 – 100%)
- 3 monitor tint options available, factory calibrated default settings
- Ambient lighting control for optimal image viewing under all lighting conditions (full light to dark)
- Variable monitor positioning adjustments (height, swivel, tilt)
  - Range of height 56.1 – 61.3 inches/142.5 – 155.8 cm (upright FPD)
  - Swivel: 45 degrees right, 45 degrees left Midline detent for centering
  - Tilt: +90 degrees forward, -10 degrees back
- Extended viewing angle: > 170 degrees (horizontal and vertical)
- Fold down for transport or portable exams
  - Minimum fold down height 46 inches/117 cm

Displayed Levels of Gray and Color

- 256 shades of gray, 8 bits
- 16,777,256 colors, 8 bits for each RGB component

Display Formats

- User selectable
- Underscan format
- Overscan format

Scan Formats

- Vector™ wide-view array imaging format
- Curved Vector wide-view array
- Linear array
- Steered linear array (for Color Doppler and spectral Doppler modes)
- Curved array
- RES™ enhanced resolution imaging
- Dual screen imaging and Live dual imaging on all transducers

Vector™ Wide-View Array Imaging Format

Siemens' patented Vector wide-view array image formation technology allows small footprint and curved array transducers to steer ultrasound beams from any point.

- Provides a wider field-of-view than delivered by same footprint non-Vector array versions
- Small footprint field-of-view formats available include:
  - Small footprint field-of-view
  - Curved footprint field-of-view (curved Vector wide-view array)

Expanded MultiHertz Multiple Frequency Imaging

Siemens' unique MultiHertz™ multiple frequency imaging capability provides the resolution and penetration of several transducers in one. At the push of a button, the user can change frequencies for 2D and color Doppler independently for optimal choice of image resolution and penetration or color Doppler sensitivity.

- Number of frequencies is transducer dependent
- Up to 8 frequencies in 2D and M-mode including Native™ tissue harmonic imaging (NTHI)
- Up to 6 frequencies in color Doppler modes
- Independent frequency selection in 2D and color Doppler modes
- Single frequency in High Pulse Repetition Frequency (HPRF) and CW spectral Doppler modes, independent from MultiHertz frequency selection
- Up to 2 frequencies in Pulsed Wave (PW) modes

System Dynamic Range

- > 160 dB

Acoustic Output Management

- User selectable, transducer and scanning mode dependent
- Dedicated Output Display on the control panel and system monitor display of output acoustic power level, as well as thermal and mechanical indices:
  - PWR – Output Power level range: 0 to -39 dB
  - MI – Mechanical Index
  - TIC – Thermal Index, Bone at Surface
  - TIB – Thermal Index, Bone at Focus
  - TIS – Thermal Index, Soft Tissue
  - TISF – Thermal Index, Soft Tissue at focus

Operating Modes and Displays

- 2D
- Native tissue harmonic imaging
- Transmit compounding
- Spatial compounding
- Spatial compounding *plus*
- Clarify™ vascular enhancement technology
- SST™ color Doppler (CD) imaging including:
  - CDV Color Doppler Velocity capability
  - CDE Color Doppler Energy capability
  - Convergent™ color Doppler capability (CCD color)
  - High Resolution Color Flow (HRCF)
  - DTI™ Doppler tissue imaging capability
  - DTI harmonics
  - Color harmonic imaging capability
  - Color Doppler M-mode
- Solo™ spectral Doppler imaging including:
  - PW (Pulsed Wave) and HPRF (High Pulse Repetition Frequency) spectral Doppler modes
  - DT (Doppler Tissue) PW spectral Doppler mode
  - CW (Continuous Wave) spectral Doppler mode
- M-mode/color Doppler M-mode
- Cadence™ contrast agent imaging technology
  - Cadence™ contrast pulse sequencing technology (CPS) for Cardiology and General Imaging
  - Cadence™ agent detection imaging technology (ADI) for General Imaging
  - Cadence power contrast imaging (PCI) for Cardiology
  - Cadence™ coherent contrast imaging technology (CCI) for Cardiology
- Supported combinations of modes and capabilities:
  - 2D
  - 2D/M-mode
  - M-mode
  - 2D/PW or HPRF (simultaneous or update)
  - PW or HPRF

- 2D/CW, simultaneous or update (for cardiac option)
- CW (for Cardiac Option)
- 2D/CDV
- 2D/CDV/PW or HPRF
- 2D/CDV/CW (for Cardiac Option)
- 2D/CDE
- 2D/CDE/PW or HPRF
- 2D/CCD
- 2D/CCD/PW or HPRF
- 2D/DTI
- 2D/DTI/DTPW
- 2D/CPS
- 2D/PCI
- 2D/DTI/Color Doppler M-mode
- 2D/CDV/Color Doppler M-mode

Dual Screen and Live Dual Imaging

- Available for all transducers
- Available in 2D, cadence contrast imaging technology and color Doppler modes
- Displays two images side-by-side
- Ability to display two frozen, one active/one frozen, or two active images
- Allows left/right switching of the active side of the display, while automatically freezing the other side
- Postprocessing adjustment affects both images at the same time
- Real-time dual image adjustments (e.g., depth, DELTA™ differential echo amplification, edge, etc.) automatically delete previously frozen image, by initiating new dual image display
- All measurements and calculations can be performed across combined dual images

Data Field Display

Data field content depends on the operating mode. The following parameters are displayed in the relevant modes:

- Patient name and ID number
- Date
- Time
- Transducer in use
- Center frequency in operation (2D, CD, PW, CW)
- NTHI level in operation
- Transmit compounding frequency selection
- TEQ™ ultrasound technology activation
- Native TEQ dynamic ultrasound technology activation
- TEQ ultrasound technology for spectral Doppler activation
- Image depth
- Exam and image name
- Frame rate (Hz)
- Imaging cine frame number
- Dynamic range (dB) in 2D, M-mode, CDE, CCD, spectral Doppler
- SpaceTime™ resolution control setting
- Edge setting in 2D, M-mode, CD, spectral Doppler modes
- Persistence in 2D, CD, spectral Doppler modes
- DELTA differential echo amplification setting in 2D
- Color DELTA amplification setting in 2D
- Postprocessing in 2D, M-mode, CD, spectral Doppler modes
- Gain settings: 2D, M-mode, CD, spectral Doppler modes
- Depth Gain Compensation curve (DGC)
- Spectral Doppler angle
- PW Doppler gate depth
- Gate in CD, PW
- Scale in CD, spectral Doppler modes
- Filter in CD, spectral Doppler modes
- Sweep speed in strip modes
- Heart rate
- Mechanical and thermal indices
- Protocol type (stress view and stage)
- Stress protocol stage timer
- VCR timer
- Stopwatch timer
- Trigger frame timing

Patient Demographic Page

Customizable patient and physician information for each study:

- Patient name
- Patient ID
- Study type
- Exam preset
- Patient's social security number
- Patient's date of birth
- Patient's age
- Patient's sex
- Patient's height
- Patient's weight
- Body surface area (calculated automatically when height and weight are entered)
- Patient's blood pressure
- Diagnosing physician's name
- Referring physician's name
- Sonographer's initials
- Indication for exam
- Ultrasound system ID number
- Comments
- Two additional customizable fields
- Patient name and ID entered on the demographic page is displayed on the screen during the examination

Image Annotations

- User-programmable annotation terms
- Factory preset standard annotation terms
- Single key annotation term entry or selection from the pop-up menus
- Annotation arrow
- Screen annotation capability through alphanumeric keyboard
- Two text layers of image annotation (can be displayed separately or overlaid)

Image Optimization Through Image Preset, Exam Preset and Exam Category Functions

The exam category, exam preset and image preset functions provide the user with customizable sets of image optimization parameters for instant image adjustments tailored to various applications.

- Image preset is a combination of image optimization parameters for a particular imaging mode, tailored to a specific application or image quality preferences
  - Independent image presets for different imaging modes
  - Dedicated image/menu push-and-rotate knob provides the user with instant adjustment of any currently active mode by dialing through the mode-specific imaging presets with generic intuitive names (e.g., high contrast, detail, soft, high frame rate, general, etc)
  - Factory and user-generated image presets that work well for all patients and examination types
  - Easy, intuitive user interface
  - Up to 20 image presets can be stored for each mode in each exam preset
- Exam preset is a collection of image preset lists specified for different imaging modes, including: 2D, M-mode, color Doppler, spectral Doppler
  - Appropriate exam preset can be selected when entering new patient information on demographic page, upon beginning the study
  - Dedicated exam presets key, for the selection of an Exam Preset from a pop-up menu and instant changing during the study
  - Exam presets may be configured, modified and stored by the user
  - Up to 100 exam presets can be stored
- Exam category is a collection of exam presets defined to clearly organize exam presets into more global ultrasound imaging applications
  - Up to 20 exam categories can be preset
  - Appropriate exam category can be selected when entering new patient information on demographic page, upon beginning the study
- Access to user-defined configurations of exam categories
- Exam presets and image presets through dedicated setup key
- Configurable default/power-up exam category, exam preset and image presets
- Factory-preset exam categories, exam presets and image presets are protected from alteration and deletion

- Backup storage and retrieval of the exam categories, exam presets and image presets through an MO disk

Image Size on the Display

10 image sizes supported:

- 5 underscan sizes
- 5 overscan sizes

Transmit Zone Enhancement

- User-selectable position and number of transmit zone settings through rotation of a two-level knob

Display Dynamic Range

- Clinically usable range: 20 to 100 dB
- User-selectable in 1 dB increments

2D Frame Rate

Dependent on transducer and scanning parameters.

- Maximum achievable: 943 Hz.
- Frame rate control is useful, for example, in reducing exposure of the contrast agent to ultrasound during the contrast agent studies

Invert Options

- U/D (Up/Down), R/L (Right/Left)

Depth Selection

- Transducer dependent
- Range: 2 to 36 cm

Depth Gain Compensation

- Eight slide-pot controls, equally spaced throughout the image
- Reassigned on RES enhanced resolution, depth and U/D invert adjustments

Image Processing Parameters

- 2D Gain: -20 to +20 dB
- Edge control is a proprietary two-dimensional spatial filter. It provides image smoothing (3 settings) or sharpening (3 settings). When smoothing, sharp borders are preserved while tissue texture is smoothed, thus further improving contrast differentiation
  - Up to 10 edge settings
- SpaceTime™ resolution control allows direct incremental adjustment of temporal and spatial resolution. Major increases in frame rate can be achieved with minimal sacrifice in detail resolution
  - Up to 4 SpaceTime control settings
- DELTA™ differential echo amplification is a patented, real time processing technique. It improves soft tissue differentiation by enhancing subtle contrast differences, particularly when the tissue dynamic range is large
  - Up to 6 DELTA amplification settings
  - Up to 6 Color DELTA amplification settings, for improving contrast resolution beyond DELTA amplification alone
  - Color DELTA amplification is available only for General Imaging transducers
- Persistence is temporal averaging for noise reduction and image smoothing
  - Up to 6 levels
- Postprocessing function assigns a certain grayscale map for displaying echo signal intensities
  - Up to 7 preset levels for General Imaging
  - Up to 8 preset levels for Cardiology
- B-color display function enhances the dynamic range the human eye can perceive by assigning a color to each grayscale level
  - Available for cardiac image and quantification package (cardiac option) only
  - Up to 7 B-color maps (including BLACK) for cardiology applications

RES™ Enhancement Resolution Imaging

When a more detailed view is needed, the computer re-optimizes and rescans the selected region to actually increase the acoustic information content of the image. RES enhanced resolution imaging areas can be defined on full size display in 2D and color Doppler modes, or on the images combined with a strip mode. Image improvements include:

- "True acoustic" image magnification
- Increased spatial and temporal resolution
- More efficient use of the space available on screen display
- Instant access to RES function at a push of a button
- Position and size of the RES enhanced resolution box are controlled by the trackball
- Selectable type of size control: fixed corner or fixed center of the RES enhanced resolution box

M-mode

- Simultaneous 2D imaging and M-mode with all transducers
- Selectable 1/3, 1/2, 2/3 combined 2D/M-mode display or full screen M-mode display
- Adjustable sweep speed: 25, 50, 100, 150, 200 mm/s
- Independent M-mode adjustments:
  - Display dynamic range: 20 to 100 dB, 1 dB increments
  - M Gain: -20 to +20 dB
  - Edge: 3 settings
  - Postprocessing: up to 5 settings
  - B-color: 8 settings

Calipers and Generic Measurements

- 6 pairs of 2D calipers available. Screen display:
  - Depth for single calipers
  - Distance between calipers for each pair
- Ellipse function: Up to 6 pairs of calipers. Displays for each pair of calipers include:
  - Distance between calipers
  - Ellipse circumference
  - Ellipse area
- Trace function. Displays:
  - Caliper depth
  - Trace circumference
  - Traced area
- Minimum distance between calipers:
  - Transducer type, depth and RES enhanced resolution setting dependent
  - 0.003 cm

SST Color Doppler

The Sequoia system's SST color Doppler technology is characterized by multiple beam formation. It provides the following color Doppler capabilities:

- CDV Color Doppler Velocity
- HRCF High Resolution Color Flow
- CDE Color Doppler Energy
- CCD Convergent™ Color Doppler* (available on the 3V2c transducer, requires advanced imaging option)
- DTI™ Doppler Tissue Imaging* (available on selected transducers, requires DTI Doppler Tissue Imaging Option)
- Color Harmonic Imaging*
- Increased sensitivity to low velocity and low intensity flow states
- Convenient switching between different color Doppler capabilities at the push of a button

** Available only for cardiac imaging*

Multivariate Motion Discrimination

- Analyzes multiple aspects of ultrasound echoes to differentiate blood flow from moving tissue
- Allows the display of blood flow within the moving tissue while reducing tissue motion artifacts
- Substantially reduces motion artifacts without sacrificing low flow information
- Allows the display of moving tissue without introducing artifacts from the blood flow

CD Color Doppler Frame Rate

- Transducer dependent, scanning parameters dependent
- Maximum achievable: 245 Hz

Color Doppler RES Box

- Adjustable position and size
- Selectable full-height or truncated color Doppler RES box
- Size and position of 2D and color Doppler RES boxes can be tied together in a variety of ways, so that one RES box can effect the other
- Left/central/right steering of the full-height or

truncated color Doppler RES box in the linear array imaging format
- Color Doppler information can be removed or redisplayed on a frozen or cine image

CDV Color Doppler Velocity Capability
CDV Color Doppler Velocity capability displays information on velocity and direction of blood flow, as well as velocity variance.

Displays
Display in any of the following combinations:
- 2D/CDV
- 2D/CDV/PW or HPRF
- 2D/CDV/CW (for cardiac option)
- 2D/CDV/color Doppler M-mode (for cardiac option)

Image Processing Parameters
- CD level: independent signal threshold adjustment
- Gate: 3 transducer dependent settings for user control of the resolution/sensitivity trade-off
- SpaceTime control: up to 5 settings, for direct optimization of beamformer and imageformer parameters to achieve desired spatial and temporal resolution for each study
- Persistence: up to 6 levels, for proprietary time-based color temporal averaging, allowing smoothing of flow information over time, without tissue motion artifacts
- Edge: up to 4 levels, for smoothing flow information in two spatial dimensions
- Filter: 3 application-specific motion discrimination settings
- Postprocessing: optimizes real time or frozen CDV image:
  - 4 velocity maps
  - 3 velocity variance maps (for cardiac option)
  - Mix function for combining 2D and CDV information
  - 2 levels of accent function for high velocity jets (for cardiac option)

  - Velocity tag function to emphasize an adjustable range of velocities within the CDV display

Scale
- Adjustable baseline
- CDV scale inverts
- Maximum and minimum scale settings depend on transducer type, CDV mode frequency and color Doppler RES box settings. For central baseline position: Max: 1.4 m/s; Min: 0.005 m/s

Calipers and Generic Measurements
- 6 pairs of color calipers available
- Display:
  - Mean velocity for single calipers
  - Doppler angle correction with adjusted color Doppler scale and mean velocity readings
  - Distance between color calipers for each pair
  - Velocity difference between calipers for each pair

High Resolution Color Flow (HRCF)
HRCF is a new color mode that combines the resolution of B-mode with increased color Doppler sensitivity. HRCF works by applying chirp coded-excitation to color Doppler velocity. HRCF benefits include improved spatial resolution, less color bleeding, better slow flow sensitivity, improved penetration, improved representation of vascular

hemodynamics, and enhanced small vessel visualization. HRCF is available on the 4C1, 6C2 and 15L8w transducers.

Displays
High resolution color flow display in any of the following combinations:
- 2D/HRCF
- 2D/HRCF/PW or HPRF

Image Processing Parameters
- CD level: independent signal threshold adjustment
- Gate: up to 3 transducer dependent settings for user control of the resolution/sensitivity trade-off
- SpaceTime control: up to 4 settings, for direct optimization of beamformer and imageformer parameters to achieve desired spatial and temporal resolution for each study
- Persistence: up to 6 levels, for proprietary time-based color temporal averaging, allowing smoothing of flow information over time, without tissue motion artifacts
- Edge: up to 4 levels, for smoothing flow information in two spatial dimensions
- Filter: up to 4 application-specific motion discrimination settings
- Postprocessing: optimizes real time or frozen HRCF image:
  - 4 velocity maps
  - 3 velocity variance maps (for cardiac option)
  - Mix function for combining 2D and HRCF information
  - 2 levels of accent function for high velocity jets (for cardiac option)
  - Velocity tag function to emphasize an adjustable range of velocities within the CDV display

Scale
- Adjustable baseline
- CDV scale inverts
- Maximum and minimum scale settings depend on transducer type, CDV mode frequency and color Doppler RES box settings. For central baseline position: Max: 0.79 m/s; Min: 0.008 m/s

Calipers and Generic Measurements
- 6 pairs of color calipers available
- Display:
  - Mean velocity for single calipers
  - Doppler angle correction with adjusted color Doppler scale and mean velocity readings
  - Distance between color calipers for each pair
  - Velocity difference between calipers for each pair

CDE Color Doppler Energy Capability*
CDE Color Doppler Energy capability displays the intensity of the Doppler signal providing:
- Independence from velocity and angle to flow
- Higher sensitivity to low velocity and low intensity flow, including flow in small vessels
- Ability to display flows in the areas where velocities are perpendicular to the color Doppler beams (Doppler signal intensity information)
- Demonstration of flow without exhibiting aliasing effect

** Not available on the cardiac transducer image specs*

Displays
Color Doppler Energy display in any of the following combinations:
- 2D/CDE
- 2D/CDE/PW or HPRF

Image Processing Parameters
- CD Level: independent signal threshold adjustment
- Display dynamic range: 10 dB to 70 dB; 1 dB increments
- Gate: 3 transducer dependent settings for user control of the resolution/sensitivity trade-off
- Scale: range of settings available for selecting better sensitivity to low flow or high flow signals. Color bar labels correspond in general

to CDV Scale settings. Range is transducer and scanning parameter dependent
- SpaceTime control: up to 5 settings, for direct optimization of beamformer and imageformer parameters to achieve desired spatial and temporal resolution for each study
- Persistence: up to 6 levels for temporal smoothing
- Edge: up to 3 levels for smoothing in two spatial dimensions
- Filter: 3 application-specific motion discrimination settings
- Postprocessing: optimizes real time or frozen CDE image:
  - 5 CDE maps
  - 5 levels of CDE transparency (mixing with grayscale information). Includes one setting for a complete suppression of 2D imaging information within color Doppler RES box

Convergent Color Doppler (CCD Color)*

Convergent™ Color Doppler provides the combination of mean velocity, flow direction, and the energy (intensity) of Doppler signal on one display. It is characterized by:

- Increased sensitivity to low velocity and low intensity flow states, including flow in small vessels, while preserving direction information
- Ability to display flows in the areas where velocities are perpendicular to the color Doppler beams (Doppler signal intensity information) while displaying flow velocity and direction in other areas
- Superior color flow fill with reduced tissue motion artifact

** Available only for cardiac imaging*

Displays

Display in any of the following combinations:

- 2D/CCD Color
- 2D/CCD Color/PW or HPRF
- 2D/CCD Color/CW

Image Processing Parameters*

- CD Gain: independent signal gain adjustment
- Gate: transducer dependent range of settings for the color Doppler gate size
- Display Dynamic Range: 20 dB to 40 dB, 1dB increments
- Scale: range of settings available for optimal display of low flow or high flow signals
- Persistence: up to 5 levels for smoothing over time
- Edge: up to 4 levels for smoothing in two spatial dimensions
- Filter: 3 application-specific motion discrimination settings
- Space/Time: up to 4 levels, for optimizing frame rate and color Doppler line density
- Postprocessing: optimizes real time or frozen CCD Color image
  - 3 Velocity/Energy maps
- Balance: range of settings available for modifying the amount of energy and velocity information in CCD Color postprocessing maps

** Available only for cardiac imaging*

Solo Spectral Doppler

In Solo spectral Doppler mode, the Sequoia 512 system uses a dedicated beamformer optimized for spectral Doppler signal processing in the audio frequency domain.

- High signal-to-noise ratio
- Digital audio signal processing
- Increased penetration for detection of deep flow dynamics
- Enhanced detection of flows with low volume of blood
- Sensitive HPRF Doppler for measuring high velocity flows with reduced aliasing
- Clear spectral waveform with crisp envelope
- Simultaneous steerable PW Doppler on all transducers and scan formats
- Simultaneous, steerable CW Doppler on all

cardiac transducers and scan formats
- Update capability for frozen 2D image. User-selectable update rates: every 1, 3, 5 or Infinite number of seconds or R-R intervals
- In PW Doppler mode, all parameter changes affect only spectral image processing
- 2D, RES imaging and color Doppler processing can be independently and easily optimized during spectral Doppler operation

Operating Modes
- PW
- CW
- HPRF
- Non-imaging auxiliary CW
- Simultaneous or update duplex
- Update triplex

Auto Doppler

Provides an automatic, quick, consistent and efficient spectral Doppler calculation capability.
- Automatic tracing of the spectral envelope
- Operates on real-time, strip cine or frozen PW/CW spectral Doppler information
- Adjustable tracing sensitivity; default sensitivity setting available
- Automatic background noise analysis for reliable tracing even with a noisy spectral Doppler signal
- Automatic marking of the end systolic and end diastolic traced velocities for visual feedback and increased confidence
- User-selectable trace component (above, below, both sides of the base line)
- Adjustable time interval for automatic measurements on a frozen spectral Doppler display
- Automatic delimiter positioning. Time interval includes up to 5 cardiac cycles for measurement averaging
- Customizable configuration of automatic measurements for each application. Up to 8 types of automatic measurements configured from a selection of 10:
  - Velocity time integral
  - Heart rate
  - Minimum traced velocity
  - Maximum traced velocity
  - Maximum flow acceleration
  - Acceleration time
  - Resistive index
  - Pulsatility index
  - Systolic/diastolic ratio
  - Time average maximum velocity
- Doppler flow angle display
- Selectable ranges of the heart rate for valid automatic measurements
- Selectable type of flow for more reliable automatic measurements
- Selection of automatic measurements and calculations for each configuration

Displays
- Selectable 1/3, 1/2, 2/3 combined 2D/spectral Doppler display or full screen spectral Doppler display
- Adjustable sweep speed: 25, 50, 100, 150, 200 mm/s
- Spectral Doppler invert
- Adjustable Doppler angle correction
- Temporal expansion: ability to redisplay spectral Doppler strip after acquisition in different time base (full resolution)
- Strip size expansion: ability to redisplay spectral Doppler strip after acquisition in different size (full resolution)

Spectrum Processing Parameters
- D Gain: -40 to +40 dB
- Display dynamic range: 10 dB to 70 dB; 1 dB increments
- Edge: 2 levels for optimizing spectral clarity and envelope definition
- Persistence: up to 5 levels for temporal smoothing of the spectrum
- Depth: 0.1 cm to 36 cm
- Sample gate length: 1.0 mm to 30.0 mm
- Filter:
  - Up to 5 settings of wall motion filter
  - Each filter level is dependent on transducer

type, scale, gain, dynamic range, signal strength, etc.
  - Low velocity filter levels (0° Doppler angle): max: 0.5 m/s; min: 0.0001 m/s
- Postprocessing: optimizes a real time or frozen spectrum:
  - Up to 6 preset spectral Doppler postprocessing curves
  - 8 spectral Doppler B-color maps

Pulse Repetition Rate

- PRF depends on the velocity scale setting
- HPRF mode is entered automatically when PW spectral Doppler settings exceed Nyquist limit

Calipers and Generic Measurements

- 6 pairs of spectral Doppler calipers:
  - Velocity for individual calipers
  - Mean velocity in the spectrum
  - Pressure gradient for individual calipers
  - Velocity difference between calipers for each pair
  - Time difference between calipers
  - Derived heart rate when ECG is off
  - Acceleration (slope) between calipers
  - Velocity ratio
  - Resistivity Index
  - Pressure half time, calculated from the slope
- Trace measurements:
  - Velocity time integral
  - Mean pressure gradient
  - Time-average traced velocity
  - Maximum traced velocity
  - Minimum traced velocity
  - Pulsatility index
  - Resistivity index
  - Systolic/diastolic ratio

Measurement Ranges

- Scales:
  - User selectable, transducer dependent, scanning parameters dependent
  - PW Doppler (central baseline, 0° Doppler angle) Max: 4.80 m/s; Min: 0.0375 m/s
  - CW Doppler (central baseline, 0° Doppler angle) Max: 9.60 m/s; Min: 0.171 m/s
- Minimum distance between calipers:
  - Transducer type, velocity scale, strip size and sweep speed dependent
  - Down to 0.0002 m/s in velocity dimension
  - Down to 0.002 s in time dimension

Audio

- Provides digital high-quality audio signal rendering of flow information
- Stereo presentation for bi-directional flow
- Choice of 5 filter settings for audio signal
- Audio signal available while playing back the strip cine

Cine Capability

- Available in all modes
- Imaging cine, for real-time acquisition and review of 2D and color Doppler images
- Strip cine, for real-time acquisition and review of spectral Doppler or M-mode strips in full strip or combined mode screens
- Continuous acquisition
- Dedicated "push-rotate" wheel control for freezing and immediate scrolling through cine memory
- Adjustable memory allocated for cine (from 20 to 80% of available RAM)
- Number of frames or seconds of information in cine memory depends on:
  - Mode in use
  - Image adjustment
  - Amount of information displayed (2D, color Doppler, image size, image texture, etc.)
  - Adjustable memory allocated for cine
- Measurement and calculation capability

Imaging Cine

Real-time acquisition and review of 2D and color Doppler image at the push of a button

- Variable memory
- Immediate access to scrolling and browsing imaging cine memory with adjustable speed and direction using dedicated wheel control

- Continuous wrap around review with adjustable speed
- User-selectable margins for continuous review
- Frame counter display
- Color Doppler and 2D imaging enhancement functions capability
- Clip and static captures from Imaging Cine to DIMAQ™ integrated ultrasound workstation

Strip Cine

Real-time acquisition and review of spectral Doppler or M-mode strip recordings and physio traces in full screen strip or combined modes at the push of a button.

- Variable memory
- Immediate access to scrolling and browsing strip cine memory with adjustable speed and direction using dedicated wheel control
- Temporal expansion of the strip. Ability to redisplay spectral Doppler or M-mode strip after acquisition in different time base
- Strip size expansion. Ability to redisplay spectral Doppler or M-mode strip after acquisition in different size
- Continuous wraparound review with adjustable speed and direction
- Loop length displayed in seconds
- Stores updated 2D reference image, when in duplex display
- Audio signal available while playing back the spectral Doppler strip cine
- Static frame captures from Strip Cine to DIMAQ workstation memory

ADVANCED IMAGING TECHNOLOGIES

Native™ Tissue Harmonic Imaging Option (NTHI)

The NTHI capability minimizes acoustic artifacts related to tissue aberrations by receiving and processing the second harmonic signals that are generated within insonified tissue. NTHI offers a selection of proprietary technologies for optimal tissue harmonic imaging:

- Single pulse cancellation technology allows for NTHI without loss of frame rate
- Coherent phase inversion technology specifically tuned for high resolution MultiHertz imaging settings
- Significant improvements to image clarity and tissue contrast resolution in a variety of high-frequency and low-frequency applications
- Diagnostic information not previously visualized on difficult-to-image patients
- Significant reduction of ultrasound beam distortions and artifacts typically presented by the body wall
- Excellent detection, separation and display of the second harmonic signals, generated in native tissue
- Suppression of the fundamental frequency range from the echo signal, typically containing artifacts in difficult-to-image patients
- Preservation of high spatial resolution of the second harmonic image, due to the full control of the ultrasound pulse shape, bandwidth and spectrum envelope on transmit combined with an excellent matched filtering of the fundamental frequencies on receive
- Coherent phase inversion technology for excellent high-frequency second harmonic imaging
- Excellent contrast resolution and penetration due to the high system dynamic range and excellent signal-to-noise ratio
- NTHI functionality available on selected transducers
- Instant access to NTHI capability using MultiHertz imaging toggle switch

Native TEQ™ Dynamic Ultrasound Technology Option (NTEQ)

Control-free image optimization through Native patient specific imaging. NTEQ ultrasound technology automatically and intuitively responds to patient specific information with continuous, hands-free, voice-free adjustment of the overall gain and brightness, as well as regional gain compensation in both, axial and lateral dimensions.

- NTEQ technology is based on two automated, synergistic processes:

- A real-time monitoring function that continuously checks the image for subtle tissue and interface changes distinguishing between soft tissue, artifacts, noise and specular reflectors
- An overall and depth-related gain optimization function that is instantly triggered when a change is detected in the image plane

- NTEQ technology optimizes system performance by modifying patient specific data before the image is formed, not a post-processing technique
- NTEQ technology uses returned echo information to adjust patient specific gain over the entire image, independent of any region of interest
- Overcomes limitations of the conventional DGC adjustments for non-uniform tissue structures
- Provides consistent, reproducible image quality, independent of the "starting point" for TEQ control, including serial patient studies
- Provides easy and fast balance of grayscale image while in color Doppler mode
- Assures optimal gain settings under sub-optimal ambient lighting conditions for stored images
- Works with all transducers

Native TEQ dynamic ultrasound technology

- Frees the clinician to concentrate on the clinical question
- Significantly improves user ergonomics with dramatically reduced hand motion
- Reduces the human interface interaction necessary to optimize the image
- Accelerates workflow and shortens study time
- Enables more consistent exams
- Provides optimized results independent of user experience level
- Consistently and reliably delivers acoustically balanced images
- Allows automatic image optimization on every patient, from every view, in every application, with every transducer

The NTEQ option also includes TEQ™ ultrasound technology for on-demand 2D and spectral Doppler image optimization at the push of the TEQ button.

TEQ™ Ultrasound Technology

- TEQ ultrasound technology for 2D is a sophisticated signal-processing technology that automatically equalizes tissue gain and brightness in two dimensions providing consistent, reproducible image quality in 2D and M-mode at the push of a button
  - Assists in image brightness settings during contrast agent imaging studies
- TEQ ultrasound technology for spectral Doppler adapts to individual patient hemodynamics and instantly optimizes for PW and CW Doppler information, saving time and maximizing workflow
  - Automatically optimizes scale, baseline, gain and dynamic range at the push of a button
- Pre-processing technology applied to RF echo data before image is formed
- Affords increased productivity and reduced inter-operator variability
- Overcomes limitations of conventional DGC adjustments for non-uniform tissue structures
- Assures optimal gain settings under sub-optimal ambient lighting conditions for stored images
- Assists in image brightness settings during contrast agent imaging studies
- Frees operator to focus on imaging – not on image quality adjustments
- Available on all transducers

Clarify™ Vascular Enhancement Technology Option (Clarify VE)

Clarify vascular enhancement technology is based on a highly sophisticated algorithm that uses power Doppler flow information to enhance B-mode tissue resolution, reducing partial volume averaging artifacts and acoustic clutter throughout a region of interest. Clarify VE technology provides:

- A reduction in noise within macro- and microvascular structures

- Clearer vessel wall definition
- Improved tissue boundary detection
- Enhanced tissue contrast resolution
- Preservation of excellent spatial resolution

Clarify VE technology

- Real-time, adaptive, pixel-by-pixel analysis implemented through a simple, time-saving user interface
- Provides multiple levels of clarification to optimize tissue contrast resolution and definition of both tissue and vessel walls according to user preference
- Image optimization in reduced keystrokes, for enhanced workflow efficiencies
- Imaging parameters can be saved within user-defined customized presets
- Clarify VE technology can be seamlessly used in a variety of applications including peripheral vascular and abdominal vascular exams, or any vasculature in any organ accessible with ultrasound
  - Available on 4C1 transducer

Cadence Contrast Agent Imaging Technology*

Cadence™ contrast agent imaging technology provides innovative methods for contrast agent detection, including extremely effective bubble preservation and emission technologies for both Cardiology and General Imaging investigations.

** At the time of publication, the U.S. Food and Drug Administration has cleared ultrasound contrast agents only for use in LVO. Check current regulations for the country in which you are using this system for contrast agent clearance.*

Cadence Contrast Pulse Sequencing Technology (CPS) for General Imaging and Cardiology

- Provides proprietary detection of the nonlinear fundamental signals that return from contrast agents
- Optimized for low MI imaging in abdominal, cardiovascular, small parts, gynecology and small animal applications
- Utilizing low MI, allows the clinician to view "tissue only, contrast only, or both together" – all from the same dataset
- Offers unique Convergent™ CPS enhancement technology, an integration of Cadence CPS technology with Color Doppler Energy information (15L8 and 15L8w transducers)
- Available with 15L8, 15L8w, 6C2, 4C1, 4V1, EV8C4, 4V1c and 3V2c transducers

Cadence Agent Detection Imaging (ADI) for General Imaging

- Provides optimal detection of contrast agent emission
- Optimized for high MI imaging in abdominal applications
- Utilizing high MI, allows the clinician to view "tissue, contrast, or both together" – all from the same dataset
- Available with 6C2, 4C1 and 4V1 transducers

Cadence Coherent Contrast Imaging for General Imaging

- Proprietary Single Pulse Cancellation technology for second harmonic contrast agent imaging
- Optimized for low MI second harmonic imaging
- Available with the 4C1 and 6C2 transducers using NTHI

Cadence Coherent Contrast Imaging (CCI) for Cardiology

- Proprietary Single Pulse Cancellation technology for second harmonic contrast agent imaging
- Optimized for low MI second harmonic imaging in cardiology applications
- Available with the 3V2c transducer

Cadence Power Contrast Imaging (PCI) for Cardiology

- Provides triggered detection of contrast agent emission
- Optimized for high MI imaging in cardiology applications
- Available with the 5V2c, 4V1c, and 3V2c transducers

Color Harmonic Imaging for Cardiology

- Color Doppler velocity display of the second harmonic signal from contrast agents
- Improves signal-to-noise ratio for better discrimination and delineation of intra-cavity flow patterns
- Available with 5V2c, 4V1c, and 3V2c transducers

The Cadence family of contrast technologies selectively leverage other features of the Sequoia ultrasound system, including:

- TEQ Technology optimized specifically for Cadence CPS and CCI
- Live dual image display for simultaneous visualization of tissue image and contrast agent image
- Extended Trigger functionality, both ECG-gated and time-based
- PrecisionBurst programmable burst – reperfusion controls
- MBD Micro-Bubble Destruction capability
- Image Control simplicity with pre-programmed Contrast Exam presets
- Frame Rate control for reducing exposure of the contrast agent to ultrasound
- Teaching File edit and compile facility
- Stopwatch timer with injection timestamp
- Multi-stage, user configurable Digital Dynamic Clip function, allowing from 1 Hz to 60 Hz (50 Hz PAL) clip capture rate
- Axius™ ACQ auto-tracking contrast quantification technology

The DIMAQ Integrated Ultrasound Workstation

Integral to Sequoia 512 system architecture is a special purpose DIMAQ workstation. The DIMAQ workstation offers advanced digital image and data processing and management in real time. It has direct access to all information in the ultrasound system for the current and previous exams.

- Real-time digital image processing, such as DELTA differential echo amplification
- Exam categories, exam presets, image presets configurations
- Digital image and data management system
- Hard drive: 36 GB
- RAM size: 64 MB
- 640 Mb magneto-optical disc drive compatible with 3-1/2" MO discs of 128, 230 and 540 Mb capacity
- Integrated CD/DVD burning capability for storage of DICOM images (optional feature)
  - Supports standard CD/DVD media capability for reading/writing study data to & from CD/DVD to hard drive
  - Supports DICOM CD-R/DVD-R Interchange Media (DICOM DVD/CD as an FSC = File Set Creator)
  - DICOM data format
  - DICOM images stored on disc can be recalled on the Sequoia ultrasound system, KinetDx™ solutions or computer with DICOM reader
  - DICOM reader included on each CD/DVD disc recorded on Sequoia for study review on a standard PC
  - Image calibration data is available to allow measurements
  - Supports standard Sequoia system compression ratio options
- Digital capture, storage and retrieval of images and data:
  - Review capability of stored examination from MO, CD/DVD
  - Capability of erasing exams from the hard disc and MO disc
  - MO disc formatting capability
  - User adjustable RAM size allocated for examination captures (from 20% to 80% of available RAM)
  - Flexible virtual memory on the hard drive for continuous automatic storing of current examination data
  - Static image and strip captures
  - Dynamic clip captures

- Full screen or selectable ROI captures for dynamic clips
- User-configurable clip capture structure (clip size, compression level, frame rate, etc.)
- Configurable clip capture frame rate: selectable from 1 Hz up to 60 Hz (for NTSC), up to 50 Hz (for PAL)
- Lossless compression for static images
- High speed JPEG lossy compression for clip captures with user-selectable compression level
- The number of static images, or total duration of dynamic clips, that can be stored on a single MO disc, single CD/DVD disc or the hard drive is dependent on the following: Clip structure, frame rate of imaging and capturing, ROI setting, compression level and informational content of the image (2D, color Doppler, image size, image texture, etc.)
- Full screen or quad screen display of captured information
- Adjustable speed for playback of captured clips
- User selectable playback mode on a quad screen display: same-start, loop-aligned, free-running
- Live imaging in one quadrant of the quad screen display (ROI or full)
- Configurable examination stages for captures
- Single key access to different examination stages during acquisition
- Storage and retrieval of the original set of examination captures or the user-selected subset of the captures
- Clip and static captures from VCR tape to DIMAQ workstation memory

• Stopwatch timer (for monitoring elapsed time in a variety of applications)
• Extended Image Trigger functionality (both ECG-gated and Time-based)
• Manual user calibration on VCR playback for off-line measurements and calculations, including tapes recorded on other ultrasound systems
• Examination utility for copying an examination from the internal hard disk to an MO disk, or CD/DVD disc for back-up, as well as from an MO disk, or CD/DVD disc to the hard disk
• 24 hour restart capability of a stored examination from the hard disk for review, continuing image acquisition, measurements and calculations
• Capability of erasing exams from the hard disk and MO disk
• "Teaching File" edit and compile capability
  - Generate an exam file with customizable collection of images from different patient studies

For more details on the DICOM 3.0 compliance and digital connectivity implementation, please refer to ACUSON Sequoia echocardiography system DICOM Conformance Statement (for Sequoia 5.0, 6.0, 7.0 and 8.0 releases).

Obstetrical Calculation Package

• Single key access to OB calculation package
• Customization capabilities to support needed measurements and calculations
• Worksheet for measurements and calculations with editing capabilities. Up to 5 measurements per parameter
• Support for up to six fetuses; switching back and forth between fetuses. Simultaneous display of twin data
• Gestational parameter entry on the patient demographic page
• LMP or EDD entry with automatic calculation of menstrual age and/or EDD
• Pop-up menu selection of measurements: BPD, HC, AC, FL, CRL and up to 4 optional measurements
• Type of measurements: length, circumference, area
• Automatic activation of the proper measurement tools
• Menstrual Age calculations from BPD, HC, AC, FL, CRL and up to 4 optional parameters
• Composite menstrual age calculation
• Amniotic fluid index

- Commonly used biometric tables pre-loaded. 3 choices of tables (different authors) per each biometric parameter
- Customization capabilities to support user defined biometric equations
- Customer entry of user-defined regression equations and tables
- Automatic calculation of EFW, LMP%, EFW%, cephalic index, HC/AC ratio, FL/BPD% ratio, FL/AC% ratio and one optional ratio
- Automatic report generation with patient information and summary of measurements and calculations. Single key report access
- Customizable report pages for: 2D report data, pre-defined comments, free-form comments and biophysical profile

Gynecologic Calculation Package

- Supports 2D calculations of: uterine volume, left and right ovarian volume, left and right follicular volumes
- Measurements of up to 15 follicles on each side
- Other 2D measurements supported include: endometrial thickness, cervix length, width, and height; uterine length, width, and height; ovarian length, width, and height; follicular length, width, and height
- PW Doppler measurements: mean velocity (TAMX), maximum velocity, minimum velocity
- PW Doppler calculations: Resistive Index, Minimum and Maximum Velocity ratio (S/D ratio) for the uterus and ovaries

Vascular Calculations Package

- Single key access to calculation packages
- Flexible, user-customizable site labeling and report contents
- Available categories
  - Resistive Indices – up to 4 sites
  - MAX (m/s)
  - MIN (m/s)
  - TAMX (m/s)
  - Angle (°)
  - Pulsatility Index (PI)

  - Resistive Index (RI)
  - S/D ratio
  - Velocities – up to 6 sites
  - Acceleration – up to 4 sites
  - Ratio – up to 4 sites
  - % stenosis, Diameter – up to 4 sites
  - % stenosis, Area – up to 4 sites
  - Carotid Study
  - CCA Peak Systilic Velocity
  - CCA End Diastolic Velocity
  - ICA Prox PSV and EDV
  - ICA Mid PSV and EDV
  - ICA Dist PSV and EDV
  - ECA
  - Vertebrals
  - Subclavian
- Easy access to calculation Worksheet and Report with summary areas and comment page

Perspective™ Advanced Display Option

A forward-looking, comprehensive solution providing imaging display capabilities. Based on the ACUSON Sequoia System's Digital Lab System Architecture.

  - High Speed Internal Transfer (HSIX) enables high speed processing on advanced imaging applications for enhanced workflow

FreeStyle™ Extended Imaging

- Provides expansive anatomical views
- Enabled on all General Imaging transducers

- Standard caliper measurement function is available
- Display tools include zoom, pan and rotate
- Capable of field-of-view of up to 70 cm in length

FreeStyle™ Compounding

- Forms a compound image utilizing multiple lines of sight
- Increases contrast resolution, reduces speckle artifact and preserves detail resolution
- Functions with all transducers in all imaging formats

FreeStyle™ Dynamic Color Doppler Imaging*

- Provides panoramic, wide field-of-view dynamic or static color Doppler images for easier orientation of anatomy and pathology
- Includes 2D measurement, pan, zoom and rotate capabilities

** Available with all General Imaging transducers*

TCE™ Tissue Contrast Enhancement Technology

TCE technology is an intelligent, patient specific processing technology utilizing Native™ patient-specific imaging to adapt to each image and each portion of the image to improve contrast resolution.

- A sophisticated non-linear processing technology that adapts according to the tissue signature
- Characterizes echo information and applies most appropriate processing
- Available on all transducers

3D Surface Rendering

- Provides qualitative 3D assessment
- An intuitive user interface includes:
  - Existing dynamic clip capture capability
  - Tool kit: 'Scalpel', 'Region-of-interest' and 'Bookends'
  - Pan, Zoom, Rotate and Animate functions
  - 'Redo', 'Undo' and 'Erase' available on rendered images
- Rendered image and original dynamic clip can be stored
- Archived dynamic clip can be reconstructed any time in the future
- Potential applications include:
  - Fetal face and spine
  - Gallbladder and urinary bladder
  - Any anatomy surrounded by fluid

3D MultiPlanar Reconstruction

- Qualitative reconstruction tool for all clinical ultrasound specialties
- Provides 2D and color Doppler image planes not achievable with normal scanning techniques
- Provides four-quadrant display with three orthogonal views and reference cube

Axius Velocity Vector Imaging™ Technology Option (VVI)*

A dynamic 2D method to visualize, measure, and display global and regional myocardial motion and mechanics.

- Uses grayscale images and a sophisticated tracking algorithm to determine the velocity and direction of myocardical tissue motion and displays it in a dynamic vector presentation overlapping the 2D clip
- Base of vectors tract tissue motion
- Length of vector indicates how fast the tissue at the base of the vector is moving
- Direction of vectors point in the direction of tissue motion
- Algorithm allows for processing ultrasound clips obtained in all views of the heart, as well as for generic moving tissue (e.g., vessel wall)
- Not limited by color Doppler dependencies of frame rate, angle or mean velocities
- Compatible with all Sequoia platform transducers
- VVI's tracking algorithm incorporates multiple sources of information, including speckle tracking:
  - Manual tracing of the myocardial boarder on any single frame of a clip
  - Mitral plane motion tracking
  - Tracking of the inward and outward motion of the tissue border
  - Tissue motion along the border trace using sophisticated speckle tracking

- Periodic motion of the heart
- Spatial coherence of tissue motion

• Parameters and parametric displays supported by VVI include:
- Visual assessment of wall tracking
- Visual assessment of vector dynamics
- Display of time curves of the selected velocity vector components
- ECG display
- Individual heart beat, or average of multiple heart beats analysis
- Parametric color M-mode display of a selected component of Tissue Velocity along the dynamic tissue border trace over time
- Parametric color M-mode display of Tissue Strain along the dynamic tissue border trace over time
- Parametric color M-mode display of Tissue Strain Rate along the dynamic tissue border trace over time
- Up to 20 different points can be selected on the 2D image along the trace for graphic displays of Velocity, Strain and Strain Rate. Combined display or full-screen magnification
- 3D representations of parametric color M-mode displays along the trace over time for:
  ❍ Selected components of Tissue Velocity
  ❍Tissue Strain
  ❍ Tissue Strain Rate
  ❍ Pan, Zoom, Rotate of the 3D parametric display
- Time curves of global and segmental (6-segment model) LV volumes automatically calculated by Simpson method
- Parametric color display of automatically calculated global and segmental Ejection Fraction
- Time curves and measurements of Dmin (transverse diameter) and Dmax (longitudinal diameter)
- Simultaneous display of volume time curves and measurements for current and previous cases
- Synchrony analysis
  ❍ 6-segment chamber model
  ❍Time curve display and measurements for segmental tissue motion parameters: Velocity (Tangential or Radial), Strain (Tangential), Strain Rate (Tangential) and Displacement (Tangential or Radial)
  ❍ Automatic time-to-peak and phase analysis of all motion parameter curves
  ❍Parametric color 6-segment model display of Time-to-Peak and phase information for Velocity (Tangential or Radial), Strain (Tangential), Strain Rate (Tangential) and Displacement (Tangential or Radial)
- An arbitrary, multi-segment M-line can be selected on a 2D clip display to obtain a virtual M-mode information derived form a 2D clip. Virtual M-mode can be used as a background for time curves providing reference on cardiac cycle phase Compatible with standard acquisition frame rate clips, and acoustic clip capture (e.g., isovolumetric contraction and relaxation events)

** Available only for cardiac imaging*

_four_Sight™ TEE view option*

An integrated method which provides acquisition, review, manipulation and dynamic display capabilities of gated 3D datasets using the V5M transesophageal transducer.

- 3D surface (volume) rendering for detailed anatomical display
  - DART navigation tool with adjustable indicator for line of sight direction for intuitive navigation
- Dynamic MultiPlanar Reconstruction
- Viewing presentation enhanced by zoom, pan and rotate functions
- Easy to use, rapid acquisition, enhanced workflow

** Available only for cardiac imaging*

Axius Quantitative Synch Tool™ Technology Option (QST)*

An integrated advanced quantitative tool for assessment of cardiac synchronization based

on processing of tissue Doppler information. Includes a Red/Green color map for quick visual assessment of cardiac timing and detailed strain and strain rate quantification capabilities for in-depth analysis.

- Visual tool to display early and late systolic cardiac motion for each heartbeat
- Supports DTI™ Doppler tissue imaging HTD and DTV capabilities, including tissue Doppler harmonic imaging
- Provides parametric color display of time-to-peak velocities derived from dynamic clips acquired in tissue color Doppler mode
  - Axius QST algorithm extracts DTI velocity data at each pixel location
  - Time-to-peak velocities color display is updated each heart beat
  - Adjustable red/green color map for time-to-peak velocity parametric display
  - Adjustable time range for peak velocity search aligned with the ECG trace
  - Selectable static 2D frame provides a reference background for the QST color information
  - Selectable settings for velocity peak search: Positive, Negative and Magnitude (absolute peak)
- Allows deriving velocity time curves from the user selectable ROIs on DTI dynamic clip display
  - Up to 6 user-adjustable callipers (ROIs) with corresponding color- coded velocity curves displayed
  - Automatic detection and display of time-to-peak and peak velocities on the curves
  - Curve annotations
  - 4 settings for ROI (caliper) size
  - 5 settings for velocity time curve smoothing using Gaussian filter
  - Time-to-peak-velocity measurements are transferred to the Sequoia Calc package
- Includes quantitative strain rate imaging capabilies –for quantitative assessment of tissue Doppler Imaging. Calculates Velocity, Strain (Str), Strain Rate (SR), and Displacement in the functional assessment of wall motion
  - Multiple user-definable regions of interest with tissue motion auto-tracking
  - Data export for further advanced computation
    - Available on the 4V1c, 3V2c and 8V3 transducers

** Available only for cardiac imaging*

Axius™ ACQ Auto-tracking Contrast Quantification Option

An integrated advanced quantitative research technique tool for the assessment of contrast agent images. Axius ACQ can be applied to a broad range of contrast applications and contrast agent imaging methods.

- Qualitative and Time Intensity Curve Wash-in/Wash-out image analysis methods
- Motion tracking and image alignment
- Multiple user-adjustable regions of interest
- Data export for further advanced computation

Axius Auto Ejection Fraction™ Technology Option*

A computer-aided diagnostic tool that utilitizes progressive learned pattern recognition technology for automatic calculation of Ejection Fraction in typical adult transthoracic exams. Available online and offline.

- Utilizes Siemens proprietary information fusion approach based on learning from a comprehensive database of cases representing typical adult transthoracic exams manually traced and processed by the clinical experts
- Utilizes a sophisticated learned algorithm for automatic tracing of endocardial borders on each frame of the acquired dynamic clip in 2D mode, identifying end-diastolic and end-systolic frames
- Calculates bi-plane or single plane EF measurements
- Trained for apical 4CH and apical 2CH adult transthoracic views
- Requires no user interaction
- Greater than 90% EF calculation accuracy as compared to manual tracing in 75% of patients

- Uses Simpson method for automatic LV volume calculations based on automatically generated LV boarder trace on each frame of the dynamic clip
  - Automatically calculates EF, EDV, ESV, HR and volume time curve
  - Confirmed results of auto measurements and calculations are transferred into Calculation Report Package
  - Supports manual editing with automatic recalculation of results
  - Supports clip playback display, zoom, and brightness adjustments
  - Supports analysis ofsingle or multiple heart cycles in one clip
  - Option to cancel automatic tracing results and perform calculation manually
- Includes edge-assisted EF capabilities of semi-automated method to generate left ventricular border traces and measurement of Ejection Fraction
  - Compatible with Left Ventricular Opacification (LVO) applications using an ultrasound contrast agent
  - Compatible with Cadence CPS technology, Cadence CCI technology, Native tissue harmonics, and fundamental images
  - Requires marking 3 points on the endocardial borders on ES and ED frames (both sides of the mitral annulus and apex)
  - Automatically displays endocardial borders for end-diastole and end-systole based on indicated points
  - Utilizes the Simpson method for LV volume calculations based on LV endocardial border trace
  - Automatically calculates EF, EDV, ESV and HR
  - Supports manual editing

** Available only for cardiac imaging*

WebPro™ Web Server Application

Provides web access from a remote computer location to the exams with static images stored on a Sequoia system hard disk.

- Sequoia 512 ultrasound system with the WebPro application installed acts as a web site that can be remotely accessed over the network using a standard computer with a network connection and a standard web browser
- Uses standard web technologies with TCP/IP and HTTP transmission protocols
- Can turn any networked computer into a remote ultrasound review station
  - Intra-hospital access (e.g. Intensive Care Unit/Operating Room – Doctor Office links)
  - Web access for referring physicians
  - Remote consultations with experts
  - Access for teaching hospital
  - Physician can access patient study while traveling (using laptop computer)
- Patient study transmission over Internet, hospital intranet, or a direct point-to-point dial-up connection
- Network security achieved by HTTP user authentication (different login names and passwords assigned by administrator to different users)
- Sequoia system hard drive patient database search capabilities by Name, ID number and Date
- Allows the download of an entire study or a select set of images (access to key images saves time when downloading from remote location and "slow" network)
- Transfers a complete study with quarter-size B&W and color static images and the first frames of the dynamic clips. Allows image-scrolling review. Any selected image can then be additionally transferred at the full resolution and size for confident diagnosis
- Web access to "in-progress" and previously stored studies

- Special lossless image compression provides ultra-fast transmission rate and access to images while maintaining diagnostic level of original digital image quality
- The speed of transition is dependent upon the connection type, as estimated below:
  - ISDN 128 K modem and ISDN line (e.g. Internet or point-to-point): 40 static images in 4 min
  - Ethernet 10BaseT (e.g. Hospital Local Area Network, Intranet): 40 images in 3 sec
  - T1 Wide Area Network (WAN): 40 images in 20 sec.
  - POTL – Plain Old Telephone Line, 28.8 K modem (e.g., Internet or point-to-point): 40 images in 16 minutes
  - Multiple user access can heavily impact the transfer rates. One user connection at a time is strongly recommended
- No interruption of the scanning process while remotely reviewing the study
- For patient information security reasons no remote image storage capabilities available
- Comprehensive on-screen user help facility
- Personal computer requirements:
  - 64 MB RAM minimum
  - Color Monitor 1024 x 768 resolution, 24-bit color video card
  - Web browser that supports and enables Java and JavaScript (Netscape Communicator 4.0 or Internet Explorer 4.0 or higher recommended)
- Network connection requirements:
  - Sequoia ultrasound system on site
  - Unshielded twisted pair cable connection from the back of the system
  - An IP address should be assigned to the ultrasound system on the network and configured onboard the system
  - ISDN line and ISDN 128 K modem network connections are recommended for the Wide Area Network (WAN) part of network connections using local telecom company services for personal Computer Sites
  - Regular Local Area Network (LAN) connection

DICOM Storage SCU to PACS

Provides digital network connectivity of the Sequoia 512 ultrasound DICOM 3.0 - compliant Picture Archival and Communication Systems (PACS) qualified by Siemens.

- Uses DICOM 3.0 (Digital Imaging and Communication in Medicine) - an open international standard and network communication protocol - for digital network connectivity with the hospital PACS server(s) which support the Service Class Provider (SCP) role of the Storage service class
- Exports exams with static images and dynamic clips using DICOM 3.0 Storage service class in a role of Service Class User - SCU (client)

Includes implementation of the following Application Entities (AE) of the DICOM 3.0 standard on the DIMAQ Integrated Ultrasound Workstation of the Sequoia 512 ultrasound system:

- Verification AE:
  - Part of the DICOM configuration tool that issues verification request to a remote server, receives a response and reports the result ("Success", "Rejected' or "Time-out") Service Object Pair (SOP) Class Name: Verification SOP Class Role: SCU
- Image Export AE:
  - Uses DICOM 3.0. Storage service class as SCU to export Sequoia system single frame and multi-frame ultrasound images to a host (server) which supports the SCP role of the Storage Service class
  - Foreground store
  - Manual selection and export of a completed and closed study. No other functions of the system are possible until the exporting process is finished
  - Background store
  - Lets the system automatically export images as soon as they are captured, while the study is still "in-progress"
  - Lets the system automatically export all the images belonging to the study as soon as the study is closed

- RLE (Run Length Encoding) lossless image compression for single-frame images (static images)
- JPEG baseline lossy compression for multi-frame images (dynamic clips)
- Support for uncompressed images (Implicit VR Little Endian)
- Configurable destination for image exporting
- Images can be copied to the two network destinations simultaneously
- SOP Classes: Ultrasound Image, Multi-frame Ultrasound Image, Secondary Capture
- Role: SCU

• DICOM Storage Commitment AE:
- Provides dynamic negotiations with the server on successful storage of all images on a DICOM Store SCP (server)
- Uses DICOM Storage Commitment Push model to inform the server when all stores for a study have been completed
- SOP Class Name: Storage Commitment Push
- Role: SCU

For more details on the DICOM 3.0 compliance and digital connectivity implementation, please refer to Sequoia Ultrasound System DICOM Conformance Statement (for Sequoia 5.0, 6.0, 7.0 and 8.0)

DICOM Print Management SCU

Provides digital network connectivity of the Sequoia 512 ultrasound system for printing ultrasound images on a remote DICOM-compliant remote printer qualified by Siemens. Includes implementation of the following Application Entities (AE) of the DICOM 3.0 standard on the DIMAQ integrated ultrasound workstation of the Sequoia 512 ultrasound system.

• Verification AE:
- Part of the DICOM configuration tool that issues verification request to a remote print server, receives a response and reports the result ("Success", "Rejected" or "Time-out")
- Service Object Pair (SOP) Class Name: Verification SOP Class
- Role: Service Class User (SCU)

• Image Print AE:
- Uses DICOM 3.0. Print Management service class as SCU to print Sequoia system single frame ultrasound images through a print server which supports the SCP (Service Class Provider) role (host) of the Storage/Service class
- Foreground Print. No other functions of the system are possible until the printing process is finished
- Manual selection and print of a completed and closed study
- Manual selection and print of a select image while study is still open
- Background Print. Allows the user to continue scanning while printing
- Lets the system automatically print images as soon as they are captured, while the study is still "in-progress"
- Lets the system automatically print all the images belonging to the study as soon as the study is closed
- Configurable destination for printing images
- User-selectable print formats
- Multiple printer support (back-up printers on the network, etc.)
- Images can be printed on the two remote printers simultaneously
- SOP class names: basic grayscale print management meta, basic color print management meta
- Role: SCU

For more details on the DICOM 3.0 compliance and digital connectivity implementation, please refer to Sequoia Ultrasound System DICOM Conformance Statement (for Sequoia 5.0, 6.0, 7.0 and 8.0)

DICOM Modality Worklist SCU*

Provides Digital network connectivity of the Sequoia 512 ultrasound system Hospital/ Cardiology/Radiology Information System (HIS/CIS/RIS) via DICOM to HIS/CIS/RIS network protocol gateway qualified by Siemens. Includes implementation of the following Application Entities (AE) of the DICOM 3.0 standard on the DIMAQ Integrated Ultrasound Workstation of the Sequoia 512 ultrasound system.

• DICOM Modality Worklist AE:

- Embedded in the Begin page of the Sequoia system
- Operates as DICOM modality worklist service class user to query HIS/CIS/RIS (often via a DICOM to HL7 network protocol gateway) to obtain patient demographic and study scheduling information (to automatically populate the begin page of the Sequoia 512 ultrasound system including:
- Imaging modality, scheduled station AE title and name, scheduled procedure step sequence, start date and time, description, ID, comments, scheduled performing physician name
- Requested procedure ID and description, accession number of the imaging service, referring physician's name, patient's name, ID, comments, birth date, sex, size, eight, last menstrual date
- Filtering query elements include: modality name, scheduled procedure step start date and time, description (study type), accession number, patient's name and ID
- Service Object Pair (SOP) class name: modality worklist information model FIND
- Role: Service Class User (SCU)
- The Sequoia system can serve to itself as a virtual HIS/CIS/RIS if the scheduled study list is downloaded and saved before the system is unhooked from the network and made portable

• DICOM Modality Performed Procedure Step (MPPS) AE:
- Embedded in the begin page of the Sequoia system
- The Sequoia system informs the HIS/CIS/RIS on the status of a particular exam step (e.g., the start or the end of the study).The communicated information could be utilized by the HIS/CIS/RIS for managing the modality worklist
- Supports the N-CREATE and N-SET DICOM message service elements for the modality performed procedure step class of the Service Object Pair (SOP) in the role of the Service Class User (SCU)
- The Sequoia system uses N-CREATE elements for constructing MPPS service object pair when a study is started
- Upon ending the study, the Sequoia system uses N-SET service request for setting values, contained in MPPS SOP. The "Performed Procedure Status" will be set to either "COMPLETED" or "DISCONTINUED." The content of the "Performed Series Sequence" will be updated, supplying all mandatory attributes
- SOP Class Name: Modality Procedure Step
- Role: SCU

** Requires HIS/CIS/RIS Mitra™ PACS Broker DICOM gateway or equivalent*

CARDIAC IMAGING AND QUANTIFICATION PACKAGE

M-Mode

- Simultaneous 2D imaging and M-mode with all transducers
- Selectable 1/3, 1/2, 2/3 combined 2D/M-mode display or full screen M-mode display
- Adjustable sweep speed: 25, 50, 100, 150, 200 mm/s
- Independent M-mode adjustments:
  - Display dynamic range: 20 to 100 dB, 1 dB increments
  - M Gain: -20 to +20 dB
  - Edge: 3 settings
  - Postprocessing: up to 5 settings
  - B-color: 8 settings

Calipers and Generic Measurements

- 6 pairs of M-mode calipers available
  - Depth for single calipers
  - Difference in depth between calipers for each pair
  - Difference in time between calipers
  - Derived heart rate
  - Slope between calipers
- Minimum distance between calipers:

- Transducer type, image depth, RES enhanced resolution setting, strip size and sweep speed dependent
- 0.003 cm in depth dimension
- 0.002 s in time dimension

ProtoCALL™ Cardiac Calculations Package

The Sequoia system ProtoCALL cardiac calculations package is a diagnosis-driven, goal-directed tool. Measurements are grouped together along physiologically related concepts.

- Single key access to calculation package
- Easy-to-learn and easy-to-use
- Comprehensive customization capabilities to support needed measurements and calculations
- Measurements can be performed during patient examination, from Cine and AEGIS system DIMAQ workstation memory or from videotape
- Diagnosis driven, goal directed structure of measurement menu
- Automatic activation of the proper measurement tools
- Types of measurements: distance, 2D area and volume, velocity, Velocity Time Integral (VTI), color Doppler velocity for PISA, acceleration, coronary artery flow reserve calculation
- Basic measurements: M-mode, 2D dimensions, 2D volume/mass, basic Doppler survey
  - Pressure predictions: RVSP, PADP, LVSP, LVEDP, LASP, simplified and expanded bernoulli
  - Valve stenosis: aortic valve, mitral valve, pulmonary valve, tricuspid valve, generic site
  - Valve regurgitation: aortic, mitral, pulmonary, tricuspid, generic PISA
  - Volume flow and shunts: SV aortic valve, SV mitral valve, SV pulmonary valve, SV tricuspid valve, shunts
  - Ventricular function: LV systolic, LV diastolic, RV systolic, RV diastolic, respiratory trends wall motion scoring: 4 standard views (PLAX, PSAX, A4C, A2C); scoring and calculations for different stages of the stress echo examinations
- Coronary Flow Reserve (CFR) application. Dedicated package for spectral Doppler trace measurements, calculations and report of the ratio of coronary blood flow before and after hyperaemia.
  - Maximum diastolic velocity ratio
  - Average diastolic velocity ratio
  - Average systolic-diastolic velocity ratio
  - Peak-to-peak velocity ratio
  - Velocity Time Integral (VTI) ratio
  - Full cycle R-R assessment
- Up to 522 comprehensive measurements and up to 469 comprehensive calculations, for a fully configurable selection to meet particular echocardiography laboratory requirements
- Up to 10 individual measurements can be averaged
- Single key access to report for measurement and calculation values
- Editing capabilities for individual measurements in the report
- Saving pictures of report pages to DIMAQ workstation memory, recording to VCR or printing to a local video printer or to a remote DICOM compliant printer

Integrated Stress Echo Capability

- User-configurable stress echo protocol
- Internal or external ECG signal for clip capture triggering
- Presorted stress echo exam presets and protocols for exercise stress or pharmacological stress echo
- Full screen or ROI clip captures
- Capability of capturing a full heart beat or selectable parts of the heart beat
- User-configurable number of clips per capture
- User-configurable capture frame rate: Up to 60 Hz (NTSC); 50 Hz (PAL)
- User-configurable on-screen timer capability for selected stages (e.g., at peak stress)
- Immediate review and select capabilities during image acquisition stage
- Review by stage or view
- Wall motion scoring

Color Doppler M-mode for the CDV Capability
Color Doppler M-mode for the CDV capability displays information on velocity, direction and velocity variance of blood flow along an adjustable M-line, in a strip time recording format. Allows for an additional significant increase of temporal resolution for CDV information.

- Frozen (updated) 2D/CDV display combined with the real time color Doppler M-mode
- Selectable 1/3, 1/2, 2/3 combined CDV/CD M-mode display or full screen color Doppler M-mode display
- Adjustable sweep speeds: 25, 50, 100, 150, 200 mm/s
- Color Doppler M-mode adjustments:
  - CD level: independent signal gain adjustment
  - Gate: 3 transducer dependent settings, for user control of the resolution/sensitivity trade-off
  - Filter: 3 application-specific motion discrimination settings
  - Edge: 4 levels, for smoothing flow information along Color Doppler M-mode line
  - Postprocessing: optimizes a real time or frozen color Doppler image:
    - 6 velocity maps (5 directional and 1 non-directional)
    - 3 velocity/variance maps
    - Mix function for combining grayscale M-mode and color Doppler M-mode information
    - 2 levels of accent function for high velocity jets velocity tag function to emphasize an adjustable range of velocities within the Color Doppler M-mode display

DTI Doppler Tissue Imaging Capability
DTI™ Doppler Tissue Imaging capability uses the proprietary multivariate motion discrimination technology for processing Doppler frequency shift information from moving tissue (e.g., myocardium, heart valves, etc.) and displays physiologic data on velocity, acceleration and scattering capabilities of moving tissues in several imaging and strip display capabilities. It provides additional clinical and investigational information on myocardial function during transthoracic and transesophageal echocardiography studies, including stress echo:

- Allows real-time imaging presentation of tissue motion abnormalities – useful in myocardial function and tissue viability analysis at rest and during stress echo studies
- Useful in the analysis of motion parameter gradients across myocardium for tissue viability studies
- Useful in stress echo studies, supported by the integrated stress echo functionality of the DIMAQ integrated ultrasound workstation and by the high frame rate performance of DTI capabilities
- Useful in echocardiography studies of conduction abnormalities (investigational)
- DTI Doppler Tissue Imaging Option includes the following color Doppler capabilities and features:
  - DTI Velocity (DTV) capability
  - DTI Acceleration (DTA) capability
  - DTI Energy (DTE) capability
  - DTI capability in color Doppler M-mode (available in DTV and DTE capability)
- Color Doppler harmonic capability in Doppler tissue imaging (requires Native tissue harmonic imaging option)

DTI Velocity (DTV) Capability
Provides real time imaging display of tissue mean velocities in the sampling area within the user-selected region of interest using various, user-selectable color-coding maps.

Displays
Display in any of the following combinations:

- 2D/DTV
- 2D/DTV/DTI PW or HPRF
- 2D/DTV/CW
- 2D/DTV/DTV Color M-mode

Image Processing Parameters

- Level: independent signal gain adjustment

- Gate: 3 transducer dependent settings, for user control of the resolution/sensitivity trade-off
- SpaceTime control: 5 settings, for direct optimization of beamformer and imageformer parameters to achieve desired spatial and temporal resolution for each study
- Persistence: 4 levels, for color frame temporal averaging, allowing smoothing of tissue motion information over time
- Edge: 4 levels, for smoothing tissue motion information in two spatial dimensions
- Filter: 2 application-specific motion discrimination settings
- Postprocessing: optimizes a real time or frozen DTV image:
  - 5 Velocity maps (3 directional and 2 non-directional)
  - 3 levels of Mix function for combining 2D and color information
  - Accent function to emphasize high tissue velocities
  - Velocity Tag function to emphasize an adjustable range of velocities within the DTV display

Scale

- Adjustable baseline
- Color Doppler scale invert
- Maximum and minimum scale settings depend on transducer type, DTV imaging frequency and color Doppler RES box settings. For central baseline position:
  - Maximum: 0.4 m/s
  - Minimum: 0.009 m/s

Calipers and Generic Measurements

- 6 pairs of DTI color Doppler calipers available
- Display:
  - Mean tissue velocity for single calipers
  - Doppler angle correction with adjusted DTV scale and mean tissue velocity readings
  - Distance between color Doppler calipers for each pair
  - Tissue velocity difference between calipers for each pair

Color Doppler M-mode for the DTV Capability

Color Doppler M-mode for the DTI Velocity capability displays information on tissue velocity along an adjustable M-mode line, in a strip time recording format.

- Frozen (updated) 2D/DTV display combined with the real time color Doppler M-mode
- Selectable 1/3, 1/2, 2/3 combined DTV/CD M-mode display or full screen Color Doppler M-mode display
- Adjustable sweep speeds: 25, 50, 100, 150, 200 mm/s
- Color Doppler M-mode adjustments:
  - CD Level: independent signal gain adjustment
  - Gate: 3 transducer dependent settings for user control of the resolution/sensitivity trade-off
  - Filter: 2 application-specific motion discrimination settings
  - Edge: up to 4 levels for smoothing tissue motion information along the M-mode line
  - Postprocessing: optimizes real time or frozen DTV Color M-mode image:
    - 5 Velocity maps (3 directional and 2 non-directional)
    - 3 levels of mix function for combining grayscale
    - M-mode and color Doppler M-mode information
    - Accent function to emphasize high tissue velocities

- Velocity tag function to emphasize an adjustable range of velocities within the color M-mode display:

High Frame Rate Tissue Doppler (HTD) Capability
Provides real-time imaging display of tissue mean velocities in the sampling area within a user-selected region of interest using various, user-selectable color-coding maps. The HTD capability provides a selection of harmonic or fundamental frequency settings using MultiHertz control. HTD provides significant increase in temporal resolution over other Doppler tissue imaging capabilities. The HTD capability could be useful in quantitative strain rate imaging (optional), stress echo, and other DTI applications that could benefit from significantly increased temporal resolution. HTD capability is available on selected transducers.

Displays
Display in any of the following combinations:
- HTD
- HTD /DTI PW or HPRF
- HTD /CW

Image Processing Parameters
- MultiHertz multiple frequency imaging provides selection of up to 3 harmonic and fundamental frequencies in HTD capability (transducer dependent). HTD harmonic imaging provides reduction of tissue Doppler signal artifacts and enhanced signal clarity
- CD Gain: independent signal gain adjustment
- Gate: 3 transducer dependent settings, for user control of the resolution/sensitivity trade-off
- SpaceTime: 5 settings, for direct optimization of beamformer and imageformer parameters to achieve desired spatial and temporal resolution for each study
- Edge: 4 levels, for smoothing tissue motion information in two spatial dimensions
- Postprocessing: optimizes a real-time or frozen HTD image:
  - Velocity Tag function to emphasize an adjustable range of velocities within the HTD display
- Balance:
  - 3 settings including directional Velocity HTD map, Power HTD map, and Mix directional Velocity/Power HTD map.
    - Adjustable in the real-time or frozen display
  - 3 settings for CPS including tissue only display, mix – tissue plus contrast display, contrast only display
    - Adjustable in the real-time or cine
- Dynamic Range: Range 20 dB to 100 dB, user-adjustable in 1dB increments

Scale
- Adjustable baseline on the real-time or frozen display
- Color scale invert on the real-time or frozen display
- Maximum and minimum scale settings depend on transducer type and HTD mode frequency settings. For central baseline position:
  - Maximum: 0.32 m/s
  - Minimum: 0.024 m/s

Frame Rates
- Maximum frame rates in HTD capability exceeding 320 F/sec (transducer and system settings dependent)

DTI Acceleration (DTA) Capability
Provides real time imaging display of the rate of change of tissue velocity in the sampling area (tissue velocity difference between consecutive ultrasound frames) within the user-selected region of interest using various, user-selectable color-coding maps.

Displays
Display in any of the following combinations:
- 2D/DTA
- 2D/DTA/DTI PW or HPRF
- 2D/DTA/CW

Image Processing Parameters
- CD Level: independent signal gain adjustment
- Gate: 3 transducer dependent settings, for user control of the resolution/sensitivity trade-off

- SpaceTime control: 5 settings, for direct optimization of beamformer and imageformer parameters to achieve desired spatial and temporal resolution for each study
- Persistence: 4 levels for color frame temporal averaging, allowing smoothing of tissue motion information over time
- Edge: 4 levels, for smoothing tissue motion information in two spatial dimensions
- Filter: 2 application-specific motion discrimination settings
- Postprocessing: optimizes a real time or frozen DTA image:
  - 5 Tissue Acceleration (velocity difference) maps, including 3 directional (acceleration vs. deceleration) and 2 non-directional
  - 3 levels of mix function for combining 2D and color information
  - Accent function to emphasize high tissue accelerations
  - Velocity tag function to emphasize an adjustable range of accelerations within the DTA display

Scale

- Adjustable baseline
- Color scale invert
- Maximum and minimum acceleration (velocity difference) scale settings depend on transducer type, color Doppler mode frequency and color Doppler RES box settings. For central baseline position:
  - Maximum: 0.4 m/s
  - Minimum: 0.009 m/s

Calipers and Generic Measurements

- 6 pairs of DTI color Doppler calipers available
- Display:
  - Mean tissue acceleration (mean velocity difference between frames) for single calipers
  - Doppler angle correction with adjusted color Doppler scale and acceleration readings
  - Distance between color Doppler calipers for each pair
  - Tissue acceleration difference between calipers for each pair

DTI Energy (DTE) Capability

Provides real time imaging display of the intensity of Doppler signals returning from tissue within the user-selected region of interest using various, user-selectable color-coding maps.

Displays

Display in any of the following combinations:

- 2D/DTE
- 2D/DTE/DTI PW or HPRF
- 2D/DTE/CW
- 2D/DTE/DTE Color M-mode

Image Processing Parameters

- CD level: independent signal gain adjustment
- Display dynamic range: independent adjustment of displayed intensity range of DTE signals, by changing the low intensity threshold. Range: 20 dB to 100 dB; 1 dB increments
- Scale: range of settings available for selecting better sensitivity to low or high tissue velocity signals. Adjusts pulse repetition frequency for DTE capability. Color bar labels correspond in general to DTV Scale settings. Range is transducer and scanning parameter dependent
- Gate: 3 transducer dependent settings for user control of the resolution/sensitivity trade-off
- SpaceTime control: 5 settings for direct optimization of beamformer and imageformer parameters to achieve desired spatial and temporal resolution for each study
- Persistence: 5 levels for color frame temporal averaging, allowing smoothing of tissue motion information over time
- Edge: 4 levels for smoothing tissue motion information in two spatial dimensions
- Filter: 2 application-specific motion discrimination settings
- Postprocessing: optimizes a real time or frozen DTE image:
  - 6 DTE maps (5 color maps, 1 grayscale map)
  - 5 levels of DTE transparency (mixing with grayscale information). Includes one setting for a complete suppression of 2D imaging information within Color Doppler RES box

Color Doppler M-mode for the DTE Capability
Color Doppler M-mode for the DTI Energy capability displays intensity of tissue Doppler signals along an adjustable M-mode line, in a strip time recording format.

- Frozen (updated) 2D/DTE display combined with the real time color Doppler M-mode
- Selectable 1/3, 1/2, 2/3 combined DTV/CD M-mode display or full screen color Doppler M-mode display
- Adjustable sweep speeds: 25, 50, 100, 150, 200 mm/s
- Color Doppler M-mode adjustments:
  - CD level: independent signal gain adjustment
  - Gate: 3 transducer dependent settings, for user control of the resolution/sensitivity trade-off
  - Filter: 2 application-specific motion discrimination settings
  - Edge: 4 levels for smoothing tissue motion information along the M-mode line
  - Display dynamic range: independent adjustment of displayed intensity range of DTE signals, by changing the intensity threshold. Range: 20 dB to 100 dB; 1 dB increments
  - Scale: range of settings available for selecting better sensitivity to low or high tissue velocity signals. Adjusts pulse repetition frequency for DTE capability. Color bar labels correspond in general to DTV Scale settings. Range is transducer and scanning parameter dependent
- Postprocessing: optimizes real time or frozen DTE color M-mode information:
  - 6 DTE maps (5 color maps, 1 grayscale map)
  - 5 levels of DTE transparency (mixing with grayscale information). Includes one setting for a complete suppression of 2D imaging information within Color Doppler RES box

ECG and Physiologic Module

- Built-in ECG and physiologic signal module providing:
  - ECG signal for triggering
  - Auxiliary trace of the conditioned signal from any compatible accessories or monitors
- Optional physiology evaluation transducer set including:
  - Phonocardiography transducer
  - Pulse tracing transducer
  - Respiration trace transducer
- Detected and displayed heart rate, averaged over three R-R intervals, updated every R-R interval. Standard range: 30 to 300 beats per minute
- Small animal physio capability
  - Provides accurate processing and display of small animal ECG waveforms
  - 3 system settings for the heart rate range selection:
    - Standard (30 to 300 bpm)
    - QRS1 (> 300 bpm)
    - QRS2 (> 800 bpm)
  - Supports R-wave triggering
    - Single trigger
    - Dual trigger
    - Multi trigger
    - Timed triggers
- Position and Gain adjustment for a selected trace
- Selectable QRS complex source

Transducer Technology

- New generation transducer design utilizes proprietary miniaturization technology:
  - Advanced ergonomics and human factors
  - Lighter and easier to handle for reduced operator fatigue and enhanced patient comfort
  - Provides access to tight anatomical areas
  - Lighter cables for better manageability
- Patented micro pinless MP transducer connector utilizes proprietary technology:
  - 612 pinless connections
  - Preservation of signal integrity
  - Dramatic reduction of noise (compared to conventional pin connectors)
- Variety of MultiHertz multi-frequency transducers with different range of frequencies and footprint size:
  - Transducer footprint size: 7 to 66 mm

Transducer versatility across all applications, including:

- Abdominal
- Endocavity
- Vascular
- Cardiac (adult, pediatric and neonatal)
- Transesophageal
- Neonatal head
- Transcranial
- OB/GYN
- Small parts
- Superficial imaging
- Pediatric
- Intraoperative
- Intracardiac

Hanafy Lens Technology

- Patented transducer technology for controlling slice thickness without increased size or weight
- Provides continuous focusing and image uniformity
- Designed into the 6C2, 4C1, 4V1, 4V1c, 15L8, and 15L8w transducers
- Delivers consistent narrow slice thickness focusing and extremely broad bandwidth
- Provides advantages in both transmit and receive with a clear well-controlled, uniform signal path

Interventional Imaging Option

Adult intracardiac echocardiography (ICE) using the ACUSON AcuNav™ ultrasound catheter family.

- Disposable ACUSON AcuNav™ 8F ultrasound catheter
  - 8 Fr. catheter (cross-sectional diameter 3.3 mm), 110 cm insertable length
- Disposable ACUSON AcuNav™ 10F ultrasound catheter
  - 10 Fr. catheter (cross-sectional diameter 2.7 mm), 90 cm insertable length
- Ultrasound catheters must be purchased separately
- Reuseable SwiftLink™ catheter connector (MP type)(additional SwiftLink connector is optional)
- 10 sterile covers
- Optional AcuNav Interchangeability for using AcuNav catheters on additional systems
- Complete echocardiography exam capabilities during intracardiac minimally invasive procedures, such as atrial fibrillation ablation, transcatheter septal closure device placement, pacemaker lead placement, transseptal catheterization, and balloon valvuloplasty or septostomy
- Visualization of cardiac anatomy and regional myocardial tissue motion, great vessels and vascular anatomy, blood flow direction and velocity, other devices located within the heart
- Sterile, steerable, single-use catheter
- SwiftLink catheter connector provides one-step system-to-catheter set-up
- High resolution, high frame rate imaging in multiple modes, including: 2-D, M-mode, PW spectral Doppler, CW spectral Doppler, color Doppler velocity and Doppler tissue imaging (optional)
- Digital phased array technology – not mechanical scanning
- Imaging penetration up to 15 cm allows for visualization of left sided cardiac anatomy from within the right atrium or right ventricle
- Two planes of bi-directional steering of the catheter tip (160 degrees in each direction: anterior-posterior/left right) for maneuverability, rapid anatomic orientation and micro-positioning
- Longitudinal side-fire imaging provides standard echocardiographic views, similar to TEE, for easier orientation
- User-changeable imaging presets provide instant image optimization
- Leverages Siemens' gold-standard, proprietary Coherent Imageformer Technology for excellent image quality
- Tension control knob for holding the desired catheter curvature
- 64-element digital phased array with simultaneous processing for the highest imaging resolution in all modes
- Vector wide-view array imaging format for increased anatomic information

- Access to advanced imaging modes provides full echocardiography capabilities, including:
  - 2D imaging
  - M-mode
  - Pulsed Wave (PW) spectral Doppler mode
  - Continuous Wave (CW) spectral Doppler mode
  - Color Doppler velocity capability
  - DTI Doppler Tissue Imaging Capability (optional)
  - RES Enhanced Resolution Capability with user selectable magnification
  - Comprehensive Measurements and Calculation, including volume, function and hemodynamics
- MultiHertz Multiple-Frequency Imaging
  - 2D and M-mode imaging frequencies: 5.5, 7.5, 8.5, 10.0 MHz
  - Color Doppler imaging frequencies: 4.0, 5.0, 6.0, 7.0 MHz
  - CW Doppler frequency: 5.0 MHz
  - PW Doppler frequencies: 4.0, 5.0 MHz

Documenting Capabilities

- On-board VCR controls
- On-screen VCR counter
- VCR status screen messages
- On-board printing device control
- Printing status screen messages
- Selective printing on two connected printers
- Capability to review images stored in the printer's memory on the system monitor
- On-board CD/DVD (optional, included in progressive media and display option)
  - Supports 12 cm single-layer disc formats: 8X DVD-R and CD-R by TDK, JVC, VERBATIM, IMATION
  - Includes embedded DICOM viewer for easy offline review of CD/DVD
    - Auto run functionality when CD/DVD is inserted into a Windows computer
  - Viewer includes Stress echo review format
- Report printing to PostScript printer

Recording Devices Supported

- Sony® SVO-9500MD (NTSC) or SVO-9500MDP (PAL) Super-VHS video cassette recorder
- Sony UP-960 B/W video page printer (NTSC only)
  - 5.5" x 7.5" single print capability; print time 22 sec
- Sony UP-895 B/W video page printer
  - High-density B/W prints; multiple print modes for both, standard and side prints; print time 4 sec
- Sony 51-MDU/A color video page printer
  - High quality color dye sublimation thermal printing; resolution 300 dots per inch; 16.7 million colors. 5.8" x 8.2" (147 x 208 mm) print size; 8 frame memory;
  - 1, 2, 4, 8 or 16 images per print; print time 20 sec
- Mitsubishi CP-800UM color page video printer
  - NTSC video input; 222 dpi high resolution color; dye sublimation or monochrome thermal printing with 16.7 million colors; 1, 2, 4 or 6 images per print; selectable print sizes 5" x 7.4" (117 x 159 mm) or 4.6" x 5" (88 x 117 mm); print time 24 sec per 4.6" x 5" print or 36 sec per 5" x 7.4" print; 8 frame memory; printer can be located on top of system cart
- Mitsubishi CP-800E color page video printer
  - PAL video input; 264 dpi high resolution color; dye sublimation or monochrome thermal printing with 16.7 million colors; 1, 2, 4 or 6 images per print; selectable print sizes 5" x 7.4" (117 x 159 mm) or 4.6" x 5" (88 x 117 mm); print time 26 sec per 4.6" x 5" print or 42 sec per 5" x 7.4" print; 8 frame memory; printer can be located on top of system cart
- Sony external monitor
  - Screen size 14"
- Peripheral devices can be installed on board of the Sequoia system or on optional external peripherals cart with optional quick disconnect cable kit

Inputs and Outputs

- RS-170 video format or CCIR format
- Cable assemblies to control standard hard copy devices include:
  - Super VHS VCR in/out with serial control
  - Interlaced RGB image in/out with serial control
- Interlaced RGB video (in/out)
- Interlaced composite color outputs, BNC connectors (e.g. for VHS video)
- 2 interlaced Y (B/W) outputs, BNC connectors
- Computer video output (non-interlaced progressive RGB)
- Remote exposure capabilities with TTL signal output for B/W image, BNC connectors
- RS232 serial in/out port
- Ethernet 100BaseT and 10BaseT for DICOM 3.0 standard network connectivity
  - Same port can be used for service system diagnostics
  - Dedicated analog phone line is required for service
- Diagnostics USB data port on systems with certain perspective advance display option
- PAL or NTSC video standards
- Quick disconnect capabilities from external set of peripherals

Power and Physical Specifications

- Dedicated, hospital-grade, interference-free, well-grounded wall outlet is required to plug in the Sequoia 512 system
- The Sequoia 512 system features low noise power supplies
- 4 isolated on-board receptacles available to provide power to peripheral devices

U.S.A.

- 115 VAC ± 10%, 50/60 Hz
- Nominal input power: 1500 VA continuous, 1725 VA intermittent
- Sequoia system power usage: 1250 VA
- Isolated accessory power available: 250 VA continuous, 400 VA intermittent
- UL2601-1

Canada

- 115 VAC ± 10%, 50/60 Hz
- Nominal input power: 1500 VA
- Sequoia system power usage: 1250 VA
- Isolated accessory power available: 250 VA
- CSA C22.2 No. 601.

Japan

- 100 VAC ± 10%, 50/60 Hz
- Nominal input power: 1500 VA
- Sequoia system power usage: 1250 VA
- Isolated accessory power available: 250 VA
- IEC 60601-1

International

- 230 VAC ± 10%, 50/60 Hz
- Nominal input power: 1650 VA
- Acuson system power usage: 1250 VA
- Isolated accessory power available: 400 VA
- IEC 60601-1

Electromagnetic Compatibility

The Sequoia 512 ultrasound system conforms to the EMC requirements of the Medical Device Directive define in IEC 60601-1-2:1993 (1st edition), Emissions and Immunity.

Medical Device Directive

- 93/42/EEC and amendments 98/79/EC and 2000/70/EC

Operating Environment

- Ambient temperature: 15°C–33°C (59°F–90°F)
- Relative humidity: Up to 90% non-condensing
- Height with CRT monitor and keyboard in lowest position: 133 cm/53 inches
- Height with CRT monitor and keyboard in fully extended position: 148 cm/58 inches
- Height at lowest folded down position of FPD: 117 cm/46 inches
- Ground clearance: 6.35 cm/2.5 inches
- Depth: 123 cm/48 inches
- Width: 66 cm/26 inches
- Weight:
  - System with CRT: 184 kg/406 pounds
  - System with flat panel display: 180 kg/397 pounds
- Heat dissipation: 5000 BTU/hour

CE Declaration

CE 0123

This product is provided with a CE marking in accordance with the regulations stated in Council Directive 93/42/EEC of June 14, 1993 concerning Medical Devices. Siemens Medical Solutions USA, Inc., is certified by notified body 0123 to Annex II.3 – Full Quality System.

All features listed are available on Sequoia 512 ultrasound system, as either standard or optional features. Please see your Quotation for a list of capabilities and features supported on your system. All specifications are subject to change without notice.

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