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SIGNA™ Voyager

G2 Data sheet

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SIGNA™ Voyager

Enter a whole new realm of possibility in MR with the new SIGNA Voyager. This system is designed to maximize productivity and workflow while delivering extraordinary clinical potential and exceptional patient comfort. And it has one of the smallest footprints and one of the lowest power consumptions in the industry for a 1.5T wide bore system.

Get ready to experience MR excellence!

SIGNA Voyager: Redefine the limits of what's possible.

Through enhanced technology, we've advanced the capabilities of wide-bore MR by delivering 1.5T image quality with both high productivity and an extraordinary patient experience.

Building on the solid foundation of proven 1.5T LCC magnet technology SIGNA Voyager includes the next generation in RF technology and gradient technology.

Built on the latest GE MR platform, the SIGNA Voyager offers a wide range of advanced clinical functionality, making it a workhorse 1.5T system for practices of various sizes and specialties.

Magnet

The foundation for quality and flexibility

When it comes to delivering on the promise of 3.0T image quality When it comes to improving the patient experience and providing high image quality no other component of an MRI system has greater impact than the magnet. The SIGNA Voyager features a wide bore magnet that delivers a large field of view. The magnet geometry has been optimized to reduce patient anxiety by providing more space in the bore. The 50cm field of view provides uniform image quality and could reduce exam times since fewer acquisitions may be necessary to cover large anatomy.

Easy siting and affordable operation:

Complemented by GE's active shielding technology, the SIGNA Voyager has very flexible installation specification for easy siting. And with zero-boil-off technology helium refills are effectively eliminated, thus reducing operating costs and maximizing uptime.

Magnet Enclosure

This magnet enclosure system is designed to provide several benefits for the patient and technologist:

- Patient anxiety is eased, resulting in reduced exam time for uncooperative patients
- Technologists have easy access to the patient

Magnet shim

High homogeneity is assured – our SIGNA Voyager magnet provides excellent results for:

- Large FOV imaging up to 50 cm
- Off-center FOV imaging such as elbow, shoulder and wrist imaging
- Robust fat saturation required for abdominal, breast and musculoskeletal imaging
- High-performance applications, such as cardiac, diffusion tensor and spectroscopy

Magnet Specifications	
Magnet Length	173 cm
Operating field strength	1.5T (63.86 MHz)
Magnet shielding	Active
EMI shielding factor Size (W x L x H) Magnet weight	"99% 2.07 m x 1.73 m x 2.36 m 3900 kg"
Magnet cooling	Cryogenic (liquid helium)
Long-term stability	< 0.1 ppm/hour

Magnet Specifications	
Cryogen refill period	Zero boil off*
Fringe field – (axial x radial)	5 Gauss = 4.0 m x 2.5 m 1 Gauss = 5.7 m x 3.4 m
Manufacturer	GE Healthcare

*Under normal operating conditions

Patient Focused Design	
Patient Bore (L x W x H)	163 cm x 70 cm x 70 cm
Patient Aperture	74 cm
Patient comfort module	Head or feet first entry Dual-flaired patient bore 2 way in-bore intercom system Adjustable in-bore lighting system Adjustable in-bore patient ventilation system

Diameter Volume (x, y, z)	Typical ppm	Guaranteed ppm
10cm DSV	0.007	0.02
20cm DSV	0.035	0.06
30cm DSV	0.1	0.15
40cm DSV	0.40	0.5
45cm DSV	1.04	1.25
50cm DSV	3.1	4

Volume Root-Mean-Square (V–RMS) values are computed from 24 measurements on each of 32 planes with linear terms set to zero.

Gradients

The gradients of an MR system play a crucial role when it comes to imaging performance, throughput, and consistency during clinical practice. Gradient speed, accuracy, and reproducibility often determine the success of demanding acquisitions like DTI and Fiesta. SIGNA Voyager introduces Ultra High Efficiency (UHE) gradient system that includes Intelligent Gradient Control technology. This novel technology enables the SIGNA Voyager to deliver excellent TR and TE values that enable a superior clinical performance.

Gradient Performance	
Peak amplitude	36 mT/m (45 mT/m performance*)
Peak Slew-rate	150 T/m/s (200 T/m/s performance*)
Maximum FOV (x,y,z)	50 cm x 50 cm x 48 cm
Duty Cycle	100%

*SIGNA Voyager's UHE gradient technology delivers minimal TE and TR values that are equivalent and comparable with other gradient technologies running at 45 mT/m peak amplitude & 200 T/m/s peak slew-rate.

Ultra High Efficiency (UHE) Gradient System

The SIGNA Voyager gradient coil is 2x more efficient than previous generation of products (i.e. the Voyager gradient coil requires half the amount of current required by previous designs to generate the same gradient field). This eco-friendly design enables the gradients to deliver superior performance while significantly reducing power consumption. The gradient is non-resonant and actively shielded to minimize eddy currents and mechanical forces within the system. The gradient coil and the RF body coil are integrated into a single module, which is water and air-cooled for optimum duty-cycle performance and patient comfort.

Further, the SIGNA Voyager gradient driver includes Intelligent Gradient Control (IGC) technology which employs a digital control system that utilizes predictive models of the electrical and thermal characteristics of the gradient coil to maximize the performance of the gradient system to deliver exceptional clinical performance.

Quiet Technology (ART - Acoustic Reduction Technology)

State-of-the-art clinical imaging demands the routine use of ultra-fast imaging techniques. The strong gradients interact with the magnetic field to create mechanical forces resulting in acoustic noise. GE has implemented Quiet Technology that significantly reduces acoustic noise and improves the patient environment. Acoustic reduction is achieved through a combination of careful system design choices and novel pulse sequence software that reduces the sharp transitions in gradient waveform that are known to generate high levels of acoustic noise.

Gradient Coil Isolation and Acoustic Damping

The full performance of the High Efficiency Gradient System is used while helping to maintain a safe environment for the patient. Clear separation between the gradient coil, RF body coil, and patient support structures ensures minimal component interactions.

RF Coil Isolation

During gradient pulses, the RF body coil acts as secondary source of noise. To further reduce vibration to the patient, the RF body coil mounting has been optimally designed.

Vibro-Acoustic Isolation

To isolate the magnet from the building and reduce the transmission of acoustic noise in the structure, GE has designed a vibroacoustic-dampening pad that sits under the feet of the magnet. The dampening characteristics of the pad are optimized based on the magnet geometry and weight. This kit is not required for the mobile MR configurations.

Fidelity, accuracy, and reproducibility

Gradient systems have historically been defined in terms of peak amplitude (mT/m) and slew rate of the generated field (T/m/s). While these parameters are important in achieving high temporal resolution parameters, such as TRs and TEs, applications such as PROPELLER MB, TRICKS, and spectroscopy rely more heavily on gradient fidelity, accuracy and reproducibility.

Fidelity is defined as the degree to which an electronics system accurately and reproducibly amplifies an input signal. Applied to MR gradient systems, gradient fidelity refers to the system's ability to generate requested waveforms. The high fidelity of the SIGNA Voyager gradients is achieved through the use of innovative design of the digital control architecture within the gradient amplifier. This architecture has two digital control paths.

- Dedicated active feedback loop to regulate current errors
- Unique feed-forward model to match amplifier output to gradient coil response

Gradient Amplifier & Coil (water-cooled)	
Control	Optimized digital control system that utilizes Intelligent Gradient Control (IGC) with frequency dependent feed-forward and feed-back model to deliver accurate output with optimized performance
Gradient current accuracy	300 uAs
Shot-to-Shot repeatability ‡	150 uAs
Symmetry ‡	100 uAs

‡ Typical gradient fidelity expressed in terms of the absolute integrated errors in micro-Amperes-second (μAs). Gradient integral precision is the maximum integrated current error over a full-scale, echo-planar gradient waveform. Shot-to-shot repeatability is the largest difference between integrated errors across waveforms.

RF Architecture Total Digital Imaging

The SIGNA Voyager offers startling advances in imaging, starting with pioneering technology called TDI. It stands for Total Digital Imaging, and it means greater clarity and increased SNR by up to 25%. TDI is built on three fundamental components:

GE's Direct Digital Interface (DDI) employs an independent analog-to-digital converter to digitize inputs from each RF channel. Every input is captured and every signal digitized, literally redefining the concept of an RF channel. The result? Not only does DDI technology improve SNR of our images, but it also works with legacy GE coils for unmatched flexibility.

TDI RF architecture introduces Digital Surround Technology (DST) with delivers the capability to simultaneously acquire MR signal from the integrated body coil and the surface coil. By combining the digital signal from surface coil elements with the signal from the integrated RF body coil, the superior SNR and sensitivity of the high-density surface coils are combined with the superior homogeneity and deeper signal penetration of the integrated RF Body Coil. The result? Richer, higher quality spine images.

Digital Micro Switching (DMS) technology represents a revolutionary advance in RF coil design by replacing analog blocking circuits with advanced Micro Electro-Mechanical System (MEMS) based blocking circuits. The result? Coil design that supports ultrafast coil switching times, enabling a platform for further expansion of "zero-TE" imaging capabilities.

SIGNA Voyager's novel RF architecture enables superior image quality, which enhances quantitative imaging capabilities. This unique architecture strengthens applications like 3D ASL, for high SNR quantitative perfusion maps useful in many neurological diagnoses, and IDEAL IQ, for quantitative fat fraction maps of the liver to aid in diagnosis. And neither application requires contrast injections, eliminating both the cost of contrast and the pain of needles.

TDI Receive RF Architecture	
Number of available RF Channels	65/49/33
Number of available Digitizers (A/D converters)	65/49/33
Receiver sampling rate per channel	80 MHz
Maximum Samples per second (65ch/49ch/33ch)	5200 Mega Samples/ 3920 Mega Samples/ 2640 Mega samples
Quadrature demodulation Receiver	Digital
Dynamic range at 1 Hz BW Receiver	> 165 dB
Resolution	Up to 32 bits

Transmit RF

Recieve RF Architecture	
RF amplifier	Water cooled, small footprint
Maximum output power	16 kW Body 2 kW Head
Maximum RF field with integrated body coil	>20 uT
Transmit gain	>100 dB (40 dB coarse/ >84 dB instantaneous)
RF exciter frequency range	63.86 ± 0.650 MHz
Frequency resolution	<0.6 Hz/step
Frequency stability	14 part per billion (0 to 50C)
Phase resolution	0.005 degree/step
Amplitude control	16 bit with 12.5 ns resolution
Amplitude stability	<0.1 dB over one min. at rated power
Digital RF pulse control	2 amplitude modulators, 2 frequency/phase modulators

Volume Reconstruction Engine

Reconstruction performance today is challenged by explosive growth in data, and increased computational complexity. The amount of data to be stored and processed continues to increase with the advances in MR system technology. The SIGNA Voyager meets that challenge head-on with innovations in reconstruction to take full advantage of computing power by leveraging both software and hardware technology.

The SIGNA Voyager features a powerful volume reconstruction engine (VRE 6.0) that enables real-time image generation, even when massive parallel-imaging datasets are involved. The reconstruction engine features onboard memory and local raw data storage to support and maintain simultaneous data acquisition and reconstruction under the most demanding applications.

With acquisition-to-disk capability, applications demanding more memory capacity than locally available can stream raw data to the hard disk to permit reconstruction of extremely large datasets.

VRE 6.0 delivers needed performance for today's challenging applications based on high channel counts and reconstruction needs. The performance enhancement allows for much faster speed compared to previous generation solutions due to core performance gains.

Reconstruction System Gen 6	
Hardware	Dell R630XL (Intel)
Cores	Dual Intel® Xeon® E5-2680v3 (12 Cores 2.6G) 30MB Intel® Smart Cache DDR4 Memory Controller with Turbo-Boost
Operating system	Scientific Linux (T)
RAM	128GB DDR4 2400 RDIMM
Ethernet	4x Gigabit (10/100/1000)
Acquisition Disk	2 x 400GB Solid State Drive SATA
Reconstruction performance	63,796 2D FFT / sec

TDI Coil Suite

Description

The TDI Coil Suite consists of a set of receive-only RF arrays designed for use with the SIGNA Voyager 1.5T MR system. TDI stands for Total Digital Imaging.

The superior flexibility of the TDI RF architecture allows not only newly designed TDI RF Coils, but also existing coils with proven clinical performance, such as the Flex Coil Suite and the 1.5T Anterior Array. The TDI Coil Suite includes the TDI Head Neck Array, a TDI Posterior Array embedded in the Comfort Plus patient table, 1.5T Anterior Array and the Flex coils. The Suite is indicated for use for: head, neck, brachial-plexus, spine, pelvis, hips, prostate, abdominal, cardiac, lower extremities, blood vessels, and long bone imaging. The combined use of the entire TDI Coil Suite will facilitate high-resolution, high-SNR whole-body imaging from the top of the head down to the feet.

The TDI Coil Suite introduces Digital Micro Switching (DMS) technology that is included in the design of the posterior array coil. DMS technology represents the future of RF coil technology by replacing wasteful power consuming RF coil components with sophisticated MEMS components that operate efficiently, precisely and reliably.

Coil Mode Configuration

The 1.5T TDI Coil Suite was designed to reduce multiple physical coil changes within a single exam and between different exams, and to improve patient comfort. The system will automatically select the coil mode configuration that best fits the selected region of interest. The combined effect is to help reduce the total duration of an exam and improve workflow.

TDI Posterior Array (PA)

The TDI Posterior Array is the first coil to include the Digital Micro Switch (DMS) which enables it to achieve ultra-fast coil switching to enable a platform for “zero-TE” imaging capability and further expansion of SilentScan capability.

To simplify the workflow for the technologist and increase efficiency, the system will automatically select the appropriate subset of coil elements based upon the prescribed field-of-view.

Whole body imaging is supported..

TDI Posterior Array Specifications	
Length	120.5 cm (47.4 in)
Width	48.6 cm (19.1 in)
S/I Coverage	113 cm (44.4 in)
Head-fi or feet-fi t imaging Elements	32

PA Transparency

The TDI Posterior Array is designed to be used in conjunction with the TDI Head Neck Array, the 1.5T Anterior Array, and the Flex Coils. When needed, the TDI Posterior Array has also been designed to become transparent when additional surface coils are placed directly on top of the table. With DMS technology, we have changed the paradigm when it comes to coil switching. With conventional design, receive only surface coils require a positive bias to decouple during transmit and become transparent. With DMS technology the posterior array is always transparent (it does not require a positive bias during transmit) and becomes visible only when needed. This provides a very robust decoupling mechanism and the Posterior Array can support additional coils directly on top of its surface with no impact to image quality. This feature is critically important for technologist workflow, especially for breast and musculoskeletal exams.

Patient Comfort Pads

To improve patient comfort, the TDI Coil Suite includes an innovative set of Patient Comfort pads. The pads are designed with highly reliable uniform density foam that is designed to support a wide range of patient sizes and weights.

The pad coating is strong, easily cleanable, and processed with an Ultra-Fresh treatment. An anti-skid undersurface reduces pad movement and thus may simplify setup and egress.

TDI Coil Suite (continued)

TDI Head Neck Array (HNA)

The TDI HNA is a standard component of the TDI Coil Suite. The HNA consists of 3 imaging components: a head base-plate, an anterior neuro-vascular face-array, and the open face adapter.

The open-face design provides a patient-friendly feel. The base plate may be used with the open face adapter to accommodate cervical spine exams in large or claustrophobic patients or for patients with intubation. Improved access and patient comfort may be achieved through elevation of the superior end of the coil. The HNA with anterior NV Face-Array consists of 21 elements arranged to provide parallel imaging support in all 3 planes.

The HNA also includes a flexible bill for coverage of aortic arch while also delivering high patient comfort.

TDI Head Neck Array Specifications	
Length	53 cm
Width	35 cm
Height	35 cm
Weight of HNU base and Anterior Adapter	6.5 kg
R/L Coverage in brain mode	24 cm
S/I Coverage in NV mode	45 cm, when combined with TDI PA
R/L Coverage in brain mode	24 cm
R/L Coverage in NV mode	32 cm
Acceleration factors	1D R=3, 2D R=6
Number of elements	Up to 29 elements in the FOV, when combined with TDI PA and AA

TDI Head Neck Array with Open Face Anterior Adapter Specifications	
Length	53 cm
Width	35 cm
Height	21 cm
Weight	5 kg
S/I Coverage	45 cm, when combined with TDI PA
R/L Coverage	24 cm
Number of elements	Up to 14 elements in the FOV, when combined with TDI PA

1.5T Anterior Array (AA)

The 1.5T Anterior Array is a standard component of the TDI Coil Suite that facilitates chest, abdomen, pelvis, and cardiac imaging with the TDI RF coil suite. The Anterior Array is lightweight, flexible, thin and pre-formed to conform to the patient's size and shape. With 54 cm of S/I coverage, the coil permits upper abdominal and pelvic imaging without repositioning the patient. The 16 element electrical design supports parallel imaging in all 3 planes.

Two Anterior Arrays can be combined to deliver extended coverage with abdomen imaging and for run-off studies.

Anterior Array

Anterior Array Specifications	
Length	55.6 cm (21.9 in)
Width	67.4 cm (26.5 in)
Height	3.3 cm (1.3 in)
Weight	2.8 kgs (6.16 lb) resting on patient 3.9 kgs (8.6 lb) with cable
S/I Coverage	54 cm (21.3 in)
R/L Coverage	to the full 50 cm (19.7 in) FOV of the system
Number of elements	Up to 28 elements in the FOV, when combined with the PA
Acceleration factors (with PA):	1D R=3, 2D R=9

TDI Coil Suite (continued)

Peripheral Vascular / Lower Extremity Array - optional

The PVA is an optional component of the TDI Coil Suite that facilitates imaging of the thighs and lower legs. The high-density layout supports parallel imaging in all 3 planes. The coil incorporates an innovative hinge design between the upper & lower elements to simplify patient setup. In addition, to improve patient comfort, the lower leg section of the coil is fully supported by the Comfort Plus table and not the patient.

PVA in un-folded position

Optional Peripheral Vascular/Lower Extremity Array Specifi ations	
Length	105 cm (41.3 in)
Width	2nd station: 64.2 cm (25.3 in) 3rd station: 51.6 cm (20.3 in)
Height	24.8 cm (9.8 in)
Weight	9.1 kg (20.0 lbs)
S/I Coverage	104 cm (49.9 in) overall 2nd station: 52 cm (20.5 in) 3rd station: 52 cm (20.5 in)
R/L Coverage	to the full 50 cm (19.7 in) FOV of the system
Feet-first imaging	
Number of elements	Up to 35 elements in the FOV, when combined with the PA
Acceleration factors	1D R=3, 2D R=6

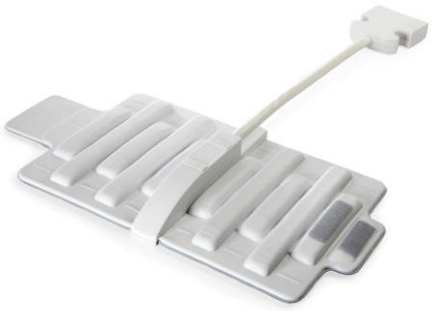
Flex Coil Suite

The Flex Coil Suite is a versatile set of high density 16ch coils designed to give high quality images in a wide range of applications. The high degree of flexibility is particularly advantageous when imaging patients that do not fit the constraints of rigid coils, improving the patient and technologist experience, and enabling most exams to be completed with the same level of image quality expected from dedicated coils.

The coils are available in Small, Medium, and Large. The full Flex Suite is intended to cover a broad range of muscular skeletal applications, including upper and lower extremities of hand, wrist, elbow, shoulder, knee, ankle, and foot.

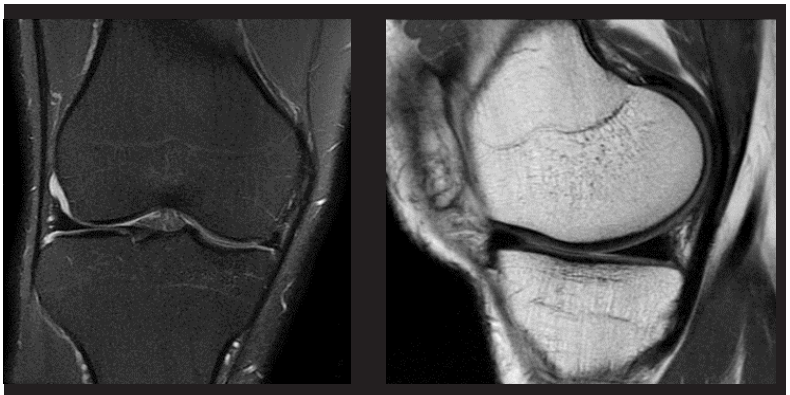
Flex Coil Suite Specifications

Component	Coverage (WxL)	Wrap Diameter	Elements	Weight
Flex Coil, Large	23 cm x 71 cm	15.5 cm – 21.5 cm	16	1.2 kg
Flex Coil, Medium	23 cm x 57 cm	11.5 cm – 15.5 cm	16	0.9 kg
Flex Coil, Small	23 cm x 44 cm	9.0 cm – 12.5 cm	16	0.9 kg



16ch Flex Coil (M)

Interface and Knee Base



High resolution knee imaging with Flex Suite

RF Coils and Arrays

There are also optional coils available to configure a SIGNA Voyager system to meet specific applications requirements. The coils listed below are commercially available at the time of printing and are optional with the system. Please contact your local GE sales representative for the most current list.

HD Breast Array

- 8-channel phased-array design
- Optimized for uniformity, parallel imaging and VIBRANT
- Bilateral and unilateral breast imaging
- Biopsy plates available
- Coil dimensions: 50 x 54 x 25 cm

Shoulder Phased Array

- 3-channel phased-array coil
- Sleeve design. Comprehensive shoulder imaging

Homogeneous penetration of humeral head and neck, rotator cuff, glenoid labrum, acromium process and glenohumeral articular surfaces

8ch Foot Ankle Coil

- 8 channel phased array design
- Chimney design adds versatility for high SNR foot and ankle imaging
- Coil dimensions: 53 x 36 x 38 cm

16ch T/R Knee Array

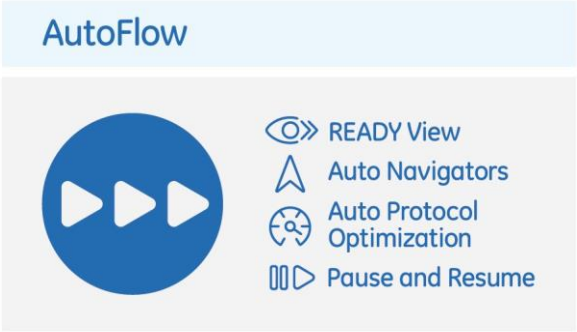
- 16 channel phased array coil Local transmit coil
- Parallel imaging in all 3 directions
- Coil dimensions: 51 x 29 x 55 cm

16ch T/R Hand Wrist Coil

- 16-channel phased array coil, local transmit coil
- Prone or Supine positioning
- Optimized design for Fingers through wrist
- High SNR to enable high resolution images
- Parallel imaging compatible for speed
- Coil dimensions: 46 x 14 x 20 cm

Autoflow Workflow

SIGNA Voyager's AutoFlow suite of features makes workflow easier and more efficient than ever:



READYView

READYView is a visualization platform that enables access to advanced post processing tools that enable both speed and advanced capabilities. It helps the user get the most from multi-parametric exams by enabling analysis of MR data sets with multiple images for each scan location. The user experience driven framework offers a combination of protocols and tools that enables quantified analyses of multiple data sets quickly and easily. Some of the key capabilities of READYView are

Analyze the following type of MR data sets:

- Time series
- Diffusion weighted scan
- Diffusion tensor scan
- Variable echo imaging
- Blood oxygen level dependent imaging
- Spectroscopy (single voxel and 2D or 3D CSI)
- Elastography1 imaging
  - Simple workflow to process and fuse functional data.
  - Select and process functional data with One Touch single click capability.
  - READY View automatically selects the most relevant protocol for you.
  - Efficient multi-contrast exam reading using MR General Review based on smart layout technology.
  - Adaptive multi-parametric protocols as guided workflow to streamline processing and analysis of multi-parametric studies.
  - Display all multi-parametric images and get all related functional values from a single ROI deposition.
  - Fully customizable workflows with adjustable layouts, personalized parameter and settings, custom review steps.
  - Easy-to-use slide bars let you segment parametric images in real time.
  - Display and export ROI statistics from the Summary table
  - Export graph values as csv file
  - Save State let you save and restore the state of the processed images at any stage.
  - Contextual help pages that give general assistance about the image processing algorithms.
  - Save all generated parametric images in one click.

Auto Protocol Optimization (APx)

Auto protocol Optimization enables a simple and automated workflow for breath-hold imaging. Technologists are liberated from troublesome parameter adjustments to optimize scan time and image quality by selecting among protocol parameters automatically calculated by the MR system. Auto Protocol Optimization enables breath-hold exams with more reliable image quality and more predictable exam duration, regardless of patient profile (breath hold capability and physical characteristics) or operator skill level.

Auto Navigators:

Delivers real-time robust free breathing respiratory motion compensation tostreamline routine and advanced body imaging. They are compatible with DISCO, Turbo LAVA,Turbo LAVA Flex and GE's body imaging suite.

Pause and Resume:

Eliminates the need to redoscans or retrace your steps, giving you greater flexibility to respond to patient needs mid-scan.

eXpress PreScan 2.0

Optimized PreScan step leading to an increase in efficiency of the calibration process enabled by the new eXpress algorithm 2.0 FSE phase correction algorithms. This leads to as much as a 40% reduction in pre-scan time, translating to a time savings per exam of up to 6 minutes* (Based on a routine MSK protocol containing conventional FSE based sequences).

Streamlined workflow

The TDI Coil Suite, Comfort Plus Patient Table, IntelliTouch technology and dual in-room displays (IRD) streamline the SIGNA Voyager workflow and help you improve patient care by letting you keep your focus where it's needed most – on your patient. With autoflow, entire exams are completed in just a few mouse-clicks due to the automated acquisition, processing, and networking capabilities of the patient setup and work-flow features of the SIGNA Voyager.

Autoflow Workflow (continued)

TDI Coil Suite

The TDI Coil Suite helps dramatically improve patient setup and workflow. Because the posterior array is embedded in the table and because the coils are significantly lighter than previous generations, MR technologists are required to lift and handle less weight. Also, the posterior array becomes transparent to the system when other surface coils are deployed, so that special handling and configuration steps are not required to scan with options such as the Flex coils or the breast array. Finally, to help reduce anxiety and improve compliance, the TDI Coil Suite enables patients to be scanned feet-first as well.

Comfort Plus patient table

The SIGNA Voyager offers a fully integrated Comfort Plus patient table (also known as TDI patient table), which features the embedded TDI Posterior Array, helps improve exam efficiency, and patient comfort. The Comfort Plus patient table can be lowered to very low heights for easy and fast transfer of wheelchair patients. The cradle width has also been increased by 30% from previous generations to enable a more comfortable experience for patients.

High-density coil interface

SIGNA Voyager with TDI technology takes the guess-work out of coil plug-in and identification by automatically identifying the coil that is connected. Prominent visual indicators near the coil connection port allow the technologist to ensure a secure coil connection, every time.

Comfort Plus Patient Table	
Min/max table height	52 to 93 cm, continuous
Patient table drive	Automated, power driven vertical and longitudinal
Longitudinal speed	25 cm/sec (fast) and 1.9 cm/sec (slow) 15 cm/sec for patient positioning
Total cradle length	244cm
Total cradle travel	264 cm
Scannable range	181 cm
Peripherals connector	on cradle
Maximum patient weight for scanning	250 kgs (550 lbs)
Maximum lift capacity	250 kgs (550 lbs)
Patient transport accessories	Drawers
Landmarking	• Laser alignment with S/I and R/L alignment • IntelliTouch Landmarking Capability
Coil connection ports	Four ports. Three high density auto-coil sensing connection ports, fourth port for embedded PA coil

IntelliTouch patient positioning workflow

IntelliTouch technology can enhance exam productivity by eliminating the need for laser alignment and reduces the number of steps for patient preparation.

For those patients where more precise alignment is desired, lasers may be used for either the selection or confirmation of landmark positioning.

The SIGNA Voyager has automated many routine tasks to both simplify patient preparation and reduce errors. With IntelliTouch technology, the following tasks can be completed by simply touching the side of the table and pressing the advance to scan button.

- Landmark the patient
- Activate the surface coil
- Center the patient in the bore
- Start scanning
- Acquire, process and network images

Dual system control panels

For operation on either side of the scanner, two ergonomically designed control panels are integrated into the front of the system enclosures. These panels incorporate backlit buttons to guide the user to the next logical step in exam setup.

From the system control panels you can:

- Position the table
- Home position
- Stop table

Dual In-room display monitors (IRD)

Simplify exam preparation and reduce the time between patients with the dual high-resolution, touch-screen in-room operator consoles. With an in-room display monitor available at either side of the magnet, the technologist always has all the control he needs at his fingertips, irrespective of which side he is operating from. Further touch-screen capability makes the controls even more intuitive and easy to use.

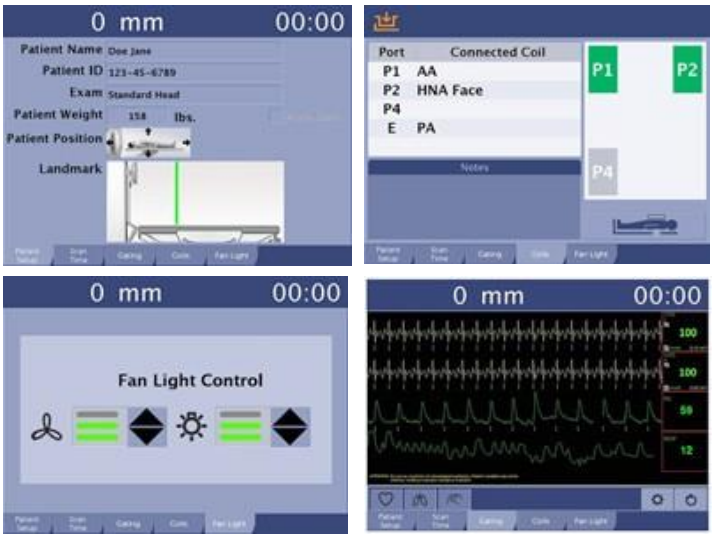
By consolidating all controls into one place, the IRD provides real-time feedback to the user to help ensure that any necessary changes in patient setup are quickly and clearly related back to the user. The IRD enables the user to visualize cardiac and respiratory waveforms directly in the exam room – eliminating the need for the technologist to leave the room and improving the patient experience. The IRD also allows for the integration of third-party interfaces and tools.

Autoflow Workflow (continued)

The SIGNA Voyager includes two touch-screen In Room Display monitors, one on each side of the system to improve ergonomics for the technologist, the display provides realtime interaction with the scanner and the host computer. The user has direct control or selection of the following:

- Display of patient name, ID, study description
- Display and entry of patient weight
- Display and entry of patient orientation and patient position
- Cardiac waveform display and ECG/EKG lead confirmation with gating control: trigger select, invert and reset
- Respiratory waveform display
- IntelliTouch technology landmarking
- AutoStart – initiate the scanner to automatically acquire, process, and network images
- Display connected coils and coil status
- Display of table location and scan time remaining
- Screen saver
- Control multiple levels of in-bore ventilation and lighting

Together, the significant advances of the SIGNA Voyager are designed to help improve care by enabling technologists to help maintain their focus where it is needed the most – on the patient.



SIGNA Voyager with AutoFlow

Autoflow

The SIGNA Voyager with autoflow scan interface incorporates many features designed to lighten the workload by automating many routine steps.

The SIGNA Voyager includes an automated protocol-driven user interface designed for consistency in generating high-quality imaging for all patients and from all technologists. Designed for efficiency, the SIGNA Voyager computer platform is built upon a parallel, multi-processor design that delivers the simultaneity and speed needed for advanced clinical operation. Productivity, efficiency and streamlined data management are achieved through simultaneous scanning, reconstruction, filming, archiving, networking and post-processing.

Though the protocol-driven workflow can dramatically simplify and automate image acquisition and processing, the flexibility that is synonymous with GE systems is maintained. If desired, the user can have complete control of exact sequence parameters for site optimization and patient specific situations.

Modality worklist

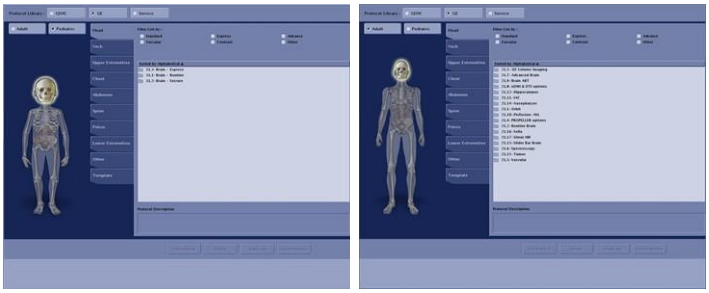
The modality worklist (MWL) provides an automated method of obtaining exam and protocol information for a patient directly from a DICOM Worklist server. For sites with full DICOM connectivity, once a patient has been selected from the MWL, a new session can be opened on the host interface and the IRD will highlight the relevant exam details. For sites that do not have full connectivity, minimal data entry (patient number and weight) is necessary prior to starting a new session. Additional data fields for patien -sensitive information such as allergies, premedication, pregnancy status, and history are provided.

MWL provides complete control of the MRI protocol prescription. The protocol may be selected well in advance of the patient's arrival at the MR suite, thereby simplifying exam preparation and reducing necessary work by the technologist during the time-critical procedure.

The ConnectPro software enables the DICOM worklist server class for the SIGNA Voyager Operator's Console. This software may require separate gateway hardware to connect non-DICOMcompatible HIS/RIS systems to the MR system.

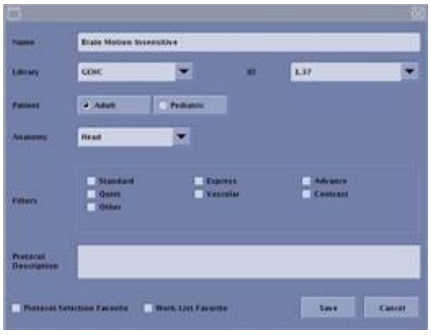
Protocol libraries and properties

The SIGNA Voyager system provides the user with complete control of protocols for simple prescription, archiving, searching, and sharing. The protocols are organized into two main libraries, GE Optimized and Site Authored. For quick search and selection, each protocol may be archived with independent properties based on patient demographics, anatomy, type of acquisition, or identification number. For commonly used protocols, a favorites flag may be used for quick selection from the Modality Worklist or for sharing across other libraries.



Adult and Pediatric Protocol libraries for simple management of exams

SIGNA Voyager with AutoFlow (continued)



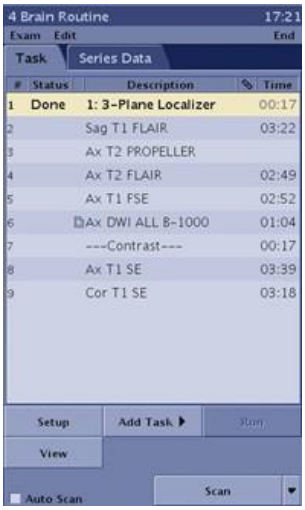
Each protocol or series can be saved with user-defined properties to simplify search and selection for future use. Favorite protocols can be highlighted for quick selection from the Modality Worklist or other libraries.

ProtoCopy

Standard on every SIGNA Voyager system, the ProtoCopy feature enables a complete exam protocol to be shared with the click of a mouse. The exam protocol can originate from either a library or previously acquired exam. This enables routine archive of protocols for emergency backup and simple management of libraries across multiple systems.

Workflow manager

Once a protocol has been selected for an exam, it is automatically loaded into the Workflow Manager. The Workflow Manager controls image prescription, acquisition, processing, visualization, and networking and may fully automate these steps if requested.



The Workflow Manager automatically loads the protocol and controls image prescription, acquisition, processing, and visualization

AutoStart*

If AutoStart is selected, once the landmark position has been set and the technologist exits the scan room, the Workflow Manager will automatically start the acquisition.

AutoScan*

With AutoScan enabled, the Workflow Manager will sequentially go through the list of prescribed series without any user interaction. Once a series has been completed, the next series will be scanned automatically. For series requiring contrast, the system will await user interaction.

Automatic Calibration screen

Auto calibration

A calibration scan is necessary for any acquisition that uses either ASSET parallel imaging or PURE surface coil intensity correction. A system preference can be selected to automatically acquire calibration data if desired. When needed, a calibration scan is automatically prescribed and acquired based on the clinical imaging volumes saved by the user. The reduced time lapse between the calibration and clinical scan minimizes possibility of patient movement and this may help improve image quality.

1.5T PURE

1.5T B1 uniformity correction for Neuroimaging includes an algorithm that considers both transmit and multichannel receive effects, allowing for a corrected image with improved image uniformity.

Auto coil prescription

Once the patient has been landmarked on the Comfort Plus patient table with the appropriate components of the TDI Coil Suite, the system will automatically determine the optimum subset of elements to enable for scanning. The optimization of the elements is based upon the prescribed FOV and will automatically adjust if the FOV changes in either size or position over the anatomy. The user has the option to view and edit the physical coil extents and the optimally selected element coverage.

SIGNA Voyager with AutoFlow (continued)

Ready Brain Application

An MRI examination of the brain consists of a number of connected steps. Ready Brain provides the flexibility to automate a number of these connected steps ranging from acquiring a localizer image, prescribing acquisition planes, scanning relevant series, performing post-processing up to transferring the final image data to a reading station. By standardizing the steps of an exam and the location of the scan planes, such automation could result in greater consistency, especially in longitudinal follow-up.

Ready Brain features an automatic localizer, automatic calculation of the mid-sagittal plane for 2D/3D prescription and determination of the AC-PC line/OM line and correction for extreme (>45 degree) rotation.

Linking

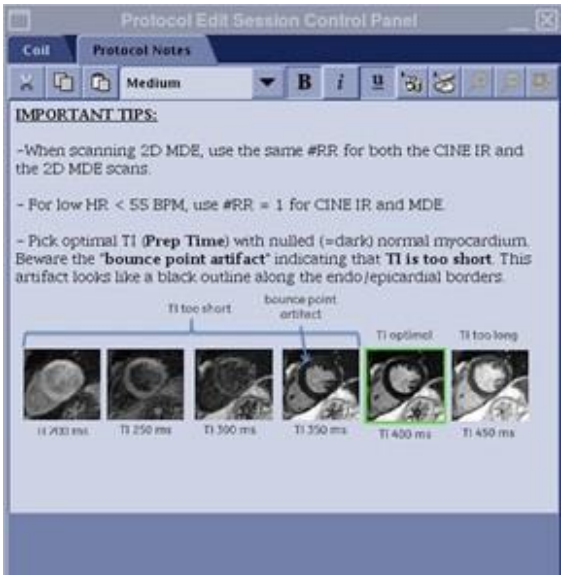
Linking automates the prescription of images for each series in an exam. Once the targeted anatomical region has been located the Linking feature combines information from a prescribed imaging series to all subsequent series in the Workflow Manager. All series that have been linked may automatically be prescribed (Rx) and no further interaction will be needed by the technologist to initiate the scan. The user has control over which specific parameters can be linked together. Series can have common fields of view, obliquity, slice thickness, anatomical coverage, saturation bands, or shim volumes. Multiple series can be linked together and saved in the Protocol Library or edited in real time. Linking may be used with any anatomy and with any acquisition. Once the first volume is prescribed, all other subsequent series with the same planes can be automatically prescribed and acquired.

Linking

Protocol notes and Video Guides

GE Protocols that are included in the system contain Protocol Notes that provide guidance and tips that are very pertinent to the procedure being performed. For specific applications, protocol notes also include Video Guides that provide step-by-step video instructions that guide the user to perform relevant tasks.

Protocol Notes are also editable by the user as each protocol defined by the MR staff includes Protocol Notes. The content the MR staff adds to the Protocol Notes, on a series-by-series, basis can include text and images. Protocol Notes allow the MR staff to communicate protocol parameters, graphic prescription locations, etc. that are specific to your site. Protocol Notes appear below AutoView. Protocol Notes and Video Guides provide valuable point of use training.



AutoVoice

The AutoVoice feature will ensure that consistent and repeatable instructions are presented to the patient for each and every exam. User selectable, pre-recorded instructions are presented at defined points in the acquisition. This helps ensure that the patient is in the right position and is fully aware of the next step in the acquisition process. AutoVoice is particularly helpful during breath-hold exams. The AutoVoice feature includes instructions in over 14 languages and the user can create and include their own unique voice instructions for local needs.

Inline viewing

Inline viewing allows the user to conveniently view, compare, and analyze images without having to switch to the Browser.

Simply select the series to view from the Workflow Manager and the images are displayed along with standard image display tools. Image comparisons can be easily done by selecting multiple series at a time. The integrated viewer allows the user to seamlessly move between scanning and image viewing.

SIGNA Voyager with AutoFlow (continued)

Inline processing

The SIGNA Voyager workflow automates many of the routine tasks that previously required user interaction. This dramatically reduces the workload for the user and helps ensure that consistent and repeatable images are presented for review. Processing steps are automatically completed immediately after the data has been reconstructed and the images saved into the database. These automated processing steps can be saved in the Protocol Library to ensure consistent exam workflow for each type of patient.

For certain tasks, such as vascular segmentation, the user must accept the results, or complete additional steps prior to saving the images to the database. In these cases the data is automatically loaded into the appropriate tool, then the system will await further instruction by the user. Examples of fully automated and partially automated inline processing include:

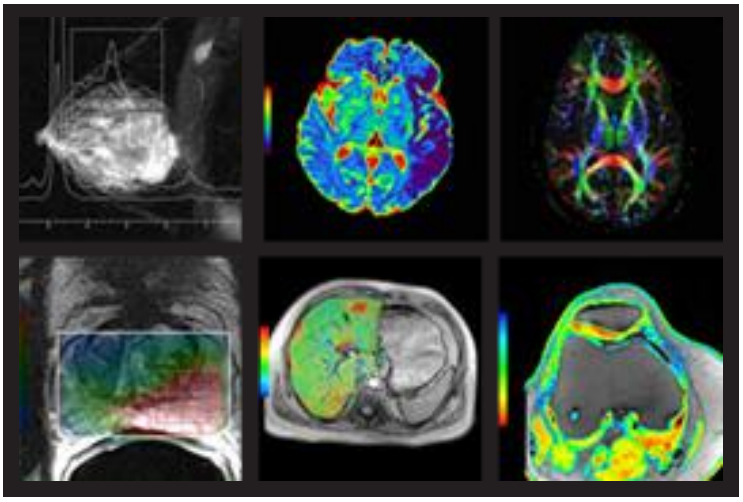
Inline processing capabilities	
Diffusion Weighted Images ADC/ eADC Maps	Automatic compute and save
Diffusion Tensor Images FA/ADC Maps	Automatic compute and save
Image Filtering: A-F, SCIC, PURE	Automatic compute and save
Maximum/Minimum Intensity Projection	Automatic compute and save
Reformat to orthogonal planes	Automatic compute and save
T2 Map for cartilage evaluation	Automatic compute and save
FiberTrak	Automatic load
Spectroscopy – Single voxel brain and breast metabolite	Automatic load
3D Volume Viewer	Automatic load
Spectroscopy – 2D/3D Chemical Shift Imaging	Automatic load
BrainStat (Readyview)	Automatic load
Image Fusion	Automatic load
Pasting	Automatic compute and save
SER (Readyview)	Automatic load
eDWI	Automatic compute and save
3D ASL	Automatic compute and save

Image fusion

To better visualize tissue and contrast, multiple images from separate acquisitions can be overlaid on one another. With the SIGNA Voyager high-resolution 2D and 3D anatomical images can be fused with functional data or parametric maps for improved visualization for the user. The data is registered using translation and rotation to ensure accurate fusion.

The automated workflow features of the system can be used for any anatomy and for any sequence. When combining the technology of AutoStart,* Linking, Inline Processing, AutoVoice,* and the AutoScan* features, an entire exam can be completed with just a few actions. The flexibility of the SIGNA Voyager user interface and acquisition parameters helps ensure that each acquisition is tailored for every patient. However, the technologist steps are kept consistent

Image fusion	
MR Standard	3D Registration
ADC/eADC	3D Registration
Diffusion Tensor	3D Registration
BrainSTAT	3D Registration
SER (Signal Enhancement Ratio)	Reformat
T2 Mapping	Reformat
Spectroscopy (Brain and Breast)	Automatic load



Computing platform

Operator console

The SIGNA Voyager system comes equipped with a scan control keyboard assembly that contains intercom speaker, microphone and volume controls, and an emergency stop switch. Start-scan, pause-scan, stop-scan, and table advance to isocenter hot keys are also included.

DICOM

The SIGNA Voyager system generates MR Image, Secondary Capture, and Gray Scale Softcopy Presentation State (GSPS) DICOM objects. The DICOM networking supports both send and query retrieve as well as send with storage commit to integrate with the site's PACS archive. DICOM filming support includes both Basic Grayscale and Basic Color Print Service Classes. Additionally, the SIGNA Voyager system supports the CT and PET image objects for display allowing the user to refer to cross-modality studies.

Computing Platform	
Main CPU	Intel® Xeon® E5-1620v3 (Quad-Core 3.5Ghz) 10MB Intel® Smart Cache DDR4 Memory Controller with Turbo-Boost
Host Memory	32GB DDR4-2133 RDIMM ECC
Graphics Subsystem	NVidia®Quadro K620 2GB DDR3 Memory
Cabinets	Single, tower configuration
System Disk	2 x 512GB Solid State Drive SATA
Network	2 x Gigabit (10/100/1000) Ethernet Ports

Data Storage	
DVD Interchange	8x DVD-RW SATA Average 35,000 images per 4.7GB DVD

Filming	
Filming	Drag and Drop filming One-button Print Series One-button Print Page Multi-image formats – from 1 to 42 images displayed simultaneously in various layouts DICOM Basic Grayscale Print Service Class DICOM Basic Color Print Service Class

Wide-screen display monitor	
Display Monitor	24.1" Widescreen LCD Flat Panel 1920 x 1200 dot resolution Non-interlaced, flicker-free presentation Contrast ratio 1000:1 Digital DVI Interface

Display	
AutoView	432 x 432 Image Window (standard)
Window /Level (W/L)	6 user-programmable keys on scan control keyboard 6 user-programmable options in image viewer Inbuilt video button to flip contrast Arrow keys on scan control keyboard On-image through middle mouse button Save State stores user-selected image orientation, user annotation and window level
Image display	Zoom/Roam/Flip/Rotate/Scroll Explicit Magnify and Magnifying Glass Image Measurement Tools Grid On/Off Cross Reference/User Annotation Exam/Series Page Hide Graphics/Erase Annotation/Screen Save Accelerator Command Bar Compare Mode/Reference Image/Image Enhance ClariView Image Filtering Smooth and Sharpen Edge Filters Minified Reference Scoutview Cine Paging Add/Subtract/Edit Patient Data
Image display performance	256 Image buffer (256 x 256)at 30 fps
Image annotation	Shadowed to permit ease in reading Two graphic/text planes overlay the entire screen Grid placement with anatomical reference on an image Drawing and annotation may be added to and removed from images

Image Acquisition

Pulse Sequences

Computing Platform	
Spin Echo	A technique for generating T1, proton density and T2 images.
Fast-Spin Echo (FSE) Fast-Spin Echo XL (FSE XL)	These techniques utilize a short echo-train technology to reduce the time for image acquisition while minimizing image blurring from T2 decay.
Fast-Recovery Fast-Spin Echo (FRFSE-XL)	The sequence of choice for high-quality, high-speed, and high-contrast T2-weighted imaging in neurological, body, orthopedic, and pediatric applications. Compared to FSE, FRFSE allows shorter acquisition times or increased slice coverage.
3DFRFSE	A sequence for creating high-resolution, three-dimensional T2-weighted images of all anatomies and is especially useful for MR cholangiopancreatography (MRCP) studies.
Single-Shot Fast-Spin Echo (SSFSE)	An ultra-fast technique that permits complete image acquisition following a single RF excitation. It can acquire slices in less than one second, making it an excellent complement to T2-weighted brain and abdominal imaging and MRCP studies.
GRE FGRE SPGR FSPGR	This suite of gradient-echo techniques uses short TR and TE to generate T1- or T2-weighted images in far less time than conventional SE. The ultra-short TR and TE possible with these sequences also ensure the performance needed for high-resolution MRA studies.
2D and 3D Dual Echo Gradient Echo	A vital tool for abdominal imaging. This variation on conventional gradient echo provides a pair of images for which the signals from water and fat either are in-phase or out-of-phase. By design, all of the images acquired within a single breath-hold are in perfect registration.
SPECIAL	Spectral Inversion at Lipids (SPECIAL) is a spectral spatial inversion technique for fat saturation.
T1 FLAIR T2 FLAIR	T1 and T2 Fluid Attenuated Inversion Recovery (FLAIR) pulse sequences have been designed expressly for neuro applications. FLAIR allows suppression of signal from cerebrospinal fluid (CSF). In addition to this capability, T1 and T2 FLAIR add extraordinary contrast between white and gray matter to T1- and T2-weighted brain and spine imaging.
Echo Planar Imaging (EPI) FLAIR Echo Planar Imaging	Essential tools for any high-throughput site employing advanced techniques. Echo planar imaging is what enables rapid imaging. And both echo planar and FLAIR echo planar techniques make it easier to generate neuro studies from uncooperative patients who simply refuse to stay still long enough for conventional techniques.
2D and 3D Time of Flight (TOF) Imaging 2D-Gated TOF Imaging	2D TOF Imaging, 2D Gated TOF Imaging, 3D TOF Imaging and Enhanced 3D TOF Imaging are all ideal for MR angiography. Based on conventional gradient echo scanning, TOF imaging techniques rely primarily on flow-related enhancements to distinguish moving from stationary spins.
2D Phase Contrast (2DPC) 3D Phase Contrast (3DPC)	These techniques demonstrate flow velocities and directional properties in vessels and other moving fluids such as CSF and aortic flow.
3D Gradwarp	3D Gradwarp is a technique integrated into image reconstruction that helps reduce image distortion by compensating for gradient non-linearities in all three dimensions. This correction differs from the default 2D correction that is conventionally performed by incorporating the slice direction into the processing. SIGNA Voyager uses higher order gradwarp as part of both 3D Gradwarp and 2D Gradwarp algorithms.
SmartPrep™	SmartPrep uses a special tracking pulse sequence to monitor the MR signal through a user-prescribed volume to detect the arrival of an strong signal change and to trigger the acquisition.
Double/Triple IR	These pulse sequences are included to allow black-blood imaging for studies of cardiac morphology. Triple IR adds fat suppression to black-blood imaging.
FastCINE	This pulse sequence is included specifically for studies of cardiac function. Through the use of retrospective gating, it allows full R-R coverage.
iDrive Pro	iDrive Pro brings real-time interactive imaging to the MR system, making it easier to generate detailed diagnostic information on just about any anatomy. This includes organs that are subject to motion artifacts, such as spine, heart, diaphragm and GI tract. The iDrive Pro technique allows the user to change scan parameters on the fly, during scanning, to evaluate the results immediately.

Image Acquisition (continued)

Reformat	An online tool that allows the operator to convert image data sets from the acquired plane into orthogonal or oblique views. The reformat tool is easy to use and particularly useful for the interrogation of 3D datasets with complex anatomy. Reformatted images can be saved into the database for further review or filming.
Readyview Performance	Readyview Performance enables advanced MR-image post-processing using a wide range of sophisticated algorithms, including: ADC maps and eADC maps Correlation Coefficients for mapping of motor strip and visual/auditory stimuli NEI (Negative Enhancement Integral) Positive Enhancement Integral Signal Enhancement Ratio
Auto TR	Auto TR dropdown menu replaces the TR dropdown menu located on the Graphic Rx desktop. Displays lowest TR value of each series.
EPI and DW-EPI	Standard on all systems are gradient echo, spin echo, flair, and diffusion-weighted echo planar imaging. The standard EPI sequence supports single and multi-shot imaging, multi-phase imaging, as well as cardiac gating. Diffusion EPI produces images that can detect acute and hyper-acute stroke with b-value up to 10,000 s/mm2, multi-NEX compatibility and the ability to generate ADC and T2-weighted TRACE images. The FLAIR option suppresses the CSF signal component to ease interpretation.
LAVA – Liver Acquisition with Volume Acceleration	LAVA is a three-dimensional (3D) spoiled gradient echo technique designed specifically to image the liver with unprecedented definition, coverage, and speed. Excellent fat suppression, through a version of the SPECIAL technique customized for the liver, is one of the reasons for the high definition of anatomical structures. The coverage and speed of LAVA are the result of short TR, innovative use of partial k-space acquisition, and advanced parallel imaging. What is the clinical benefit of LAVA? It enables the high-quality 3D MR imaging of the liver during short breath-holding periods.
BRAVO	Brain Volume imaging is a high-resolution 3D imaging technique designed to produce heavily T1-weighted isotropic images of the brain. BRAVO uses ARC to reduce scan time and minimize parallel imaging artifacts.
2D and 3D MERGE	Multiple Echo Recombined Gradient Echo (MERGE) uses multiple echoes to generate high-resolution images of the C-spine with excellent gray-white matter differentiation. By combining early echoes with high SNR and late echoes with imrproved T2* contrast, the result is improved cord constrast within the spinal column.
Turbo LAVA	LAVA Turbo provides a reduction of breath-hold timing for both LAVA and LAVA FLEX acquisitions by up to 47% compared to conventional LAVA / LAVA FLEX acquisitions.

Imaging Options and Parallel Imaging Support

Imaging options			
Pulse sequence imaging options	• 3 D Slice Zip x 2 (Z2)/ • Zip x 4 (Z4) • ARC* • ART • ASSET • Blood Suppression • Cardiac Compensation • Cardiac Gating/ Triggering • Classic • DE Prepared • EDR • Flow Compensation • Fluoro Trigger • Full Echo Train • IDEAL • IR Preparation	• Magnetization Transfer • MRCP • Multi-Phase/Dynaplan • Multi-Station • Navigator • No Phase Wrap • Real Time • Respiratory Compensation • Respiratory Gating/Triggering • Sequential • SmartPrep* • Spectral Spatial RF • Square Pixel • T2 Prep • Tailored RF • Zip 512/Zip 1024	
Parallel Imaging Array Spatial Sensitivity Encoding Technique (ASSET) imaging option is a 1D image-based parallel imaging technique used to speed data acquisition. For temporally sensitive acquisitions, ASSET reduces image blurring and motion, enables greater anatomical coverage, and reduces SAR. Parallel imaging acceleration factors ranging from 1-3.0 are supported depending on the coil selected. **ASSET 3.0** Next generation reference scan algorithm which provides improved control over motion related artifacts and dephasing which can occur during the reference scan step. The new ASSET 3.0 reference algorithm leads to a reduction in artifacts caused by motion or dephasing in clinical results. The improvement is also utilized in the PURE image uniformity correction. **ARC Parallel Imaging** Auto-Calibrating Reconstruction (ARC) parallel imaging eliminates breath-hold mismatch errors by imbedding the calibration data within the scan data. In addition, this innovative reconstruction permits small FOV imaging by minimizing focal parallel imaging artifacts from the exam. Supporting both 1D and 2D acceleration, net acceleration factors of up to 4 can be achieved. ARC together with CUBE can be used in all anatomies. With the SIGNA Voyager, the following applications are parallel imaging enabled:	• 2D DT-EPI • 2D DW-EPI • 2D FGRE • 2D FIESTA • 2D FIESTA FastCARD • 2D FIESTA FastCINE • 2D FIESTA Fat Sat • 2D FRFSE • 2D FRFSE-XL IDEAL • 2D FSE IDEAL • 2D FSE • 2D FSE Double IR • 2D FSE-IR • 2D FSE Triple IR • 2D FSE-XL IDEAL • 2D FSPGR • 2D GRE-EPI • 2D MDE • 2D MFGRE • 2D SE-EPI • 2D SSFSE • 2D SSFSE 3-Plane • 2D SSFSE-IR • 2D SSFSE MRCP • 2D T1FLAIR • 2D T2MAP	• 3D BRAVO • 3D COSMIC • 3D Cube T1 • 3D Cube T2 • 3D Cube T2FLAIR • 3D Cube DIR • 3D Cube PD • 3D Delta Flow • 3D Dual Echo • 3D Fast TOF GRE • 3D Fast TOF SPGR • 3D FGRE • 3D FGRE IDEAL • 3D FIESTA • 3D FIESTA-C • 3D FRFSE • 3D FRFSE MRCP • 3D FSPGR • 3D FSPGR IDEAL • 3D Heart • 3D LAVA • 3D LAVA FLEX • 3D MDE • 3D MERGE • 3D QuickSTEP • 3D SWAN • 3D TOF GRE • 3D TOF SPGR • 3D TRICKS • 3D Velocity Inflow • 3D VIBRANT • 3D VIBRANT FLEX	• Cine IR • eDWI • Fast 2D Phase Contrast • FGRE Timecourse • IFIR • Inhance Inflow • M R Echo Fast GRE Timecourse • M R Echo FIESTA Timecourse • MR Echo Function • MR Echo MDE • MR Echo Realtime • PROPELLER MB • SWAN 2.0 • PS-MDE • BB SSFSE • 3D PROMO • DISCO • DW Duo (LX DWI Propeller) • Flex • HyperBand • HyperSense • IR & SR Prepared • PROMO

SIGNA™Works Features

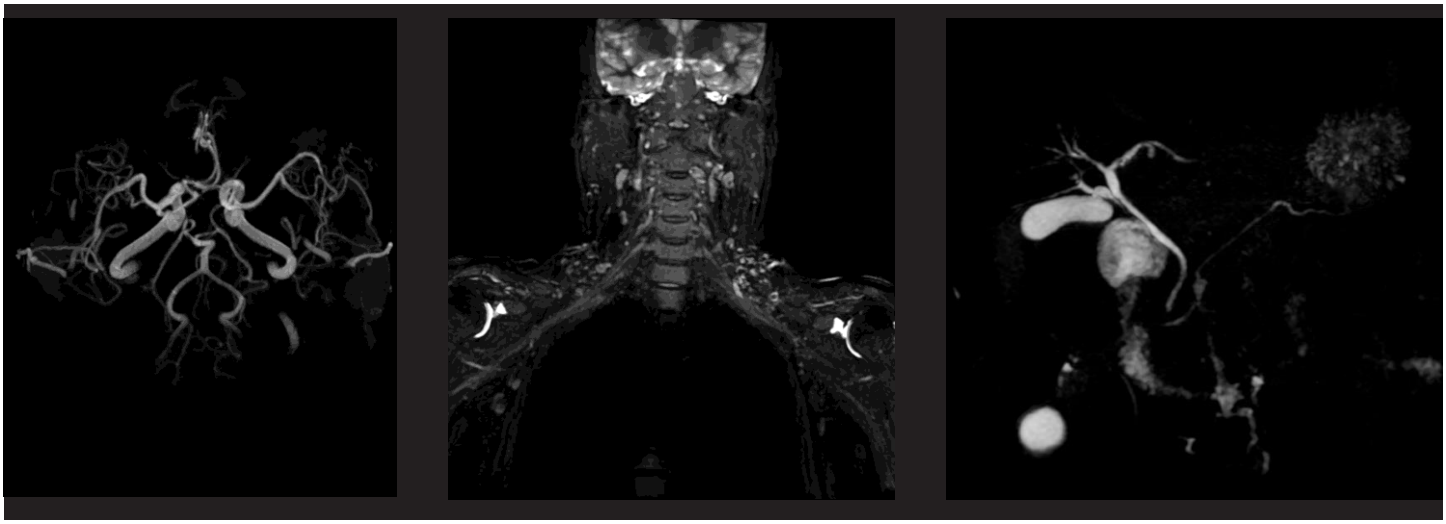
HyperSense

HyperSense is an acceleration technique based on sparse data sampling enabling faster imaging without the penalties commonly found with conventional parallel imaging.

HyperSense is intended to be used with volumetric acquisitions, it is combined with (ARC) parallel imaging delivering optimal signal to noise ratio with shorter acquisition times.

Benefits

- Increase productivity by reduced scan times
- Faster 3D imaging acquisitions
- Combined with ARC for higher acceleration factors

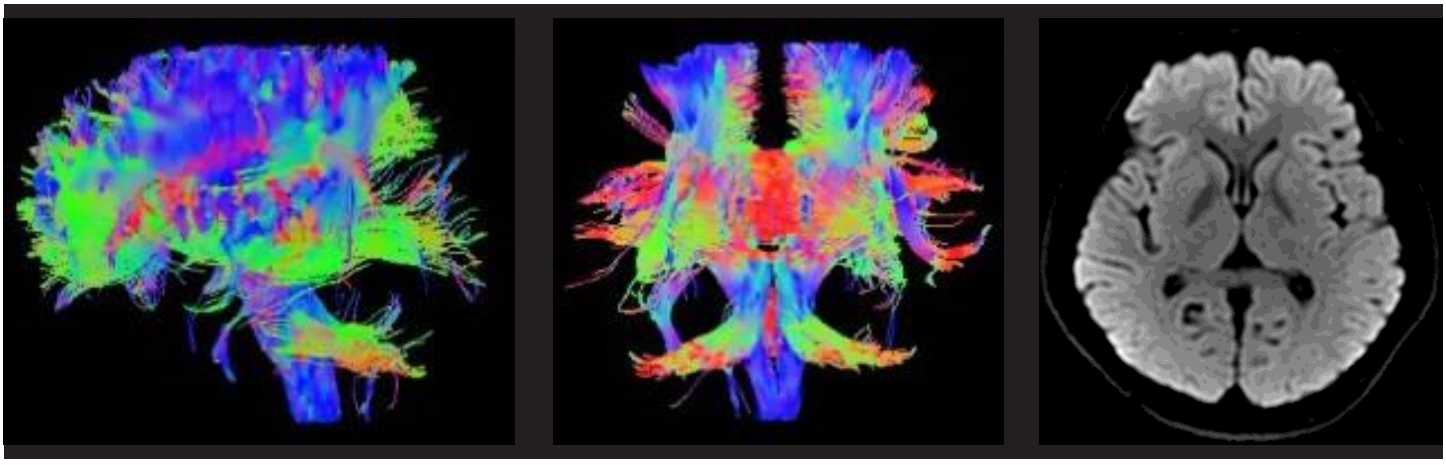


HyperBand

HyperBand provides a reduction in scan time by simultaneously exciting multiple slices at multiple locations. It can lead to higher acceleration reduction factors when combined to other methods of parallel imaging. The benefits of HyperBand acceleration include enhancements on productivity and patient experience, increased anatomy coverage and higher resolution image acquisition.

Benefits

- Simultaneous excitation: multiple slices at multiple locations
- Acquisition time reduction without compromising post processing metrics
- More diffusion directions, number of slices or higher temporal resolution without extra scan time
- Shorter breath holds
- Combine with ARC for higher acceleration factor



SIGNA™Works Features (continued)

HyperCube

Delivers small field-of-view organ-specific volumetric imaging acquisition that can reduce artifacts originating from outside of the prescribed FOV. HyperCube can be applied with or without fat suppression using Flex or chemical saturation methods. Provides significant savings of imaging time without sacrificing contrast quality and it can be used across the entire body.

Benefits

- Significant scan time reduction while maintaining SNR efficiency
- High resolution small FOV isotropic volumetric imaging
- FLEX for large FOV robust fat suppression

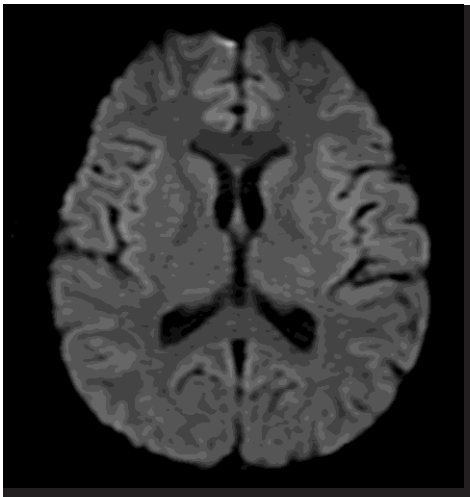
SIGNA™Works Features (continued)

MAGiC DWI

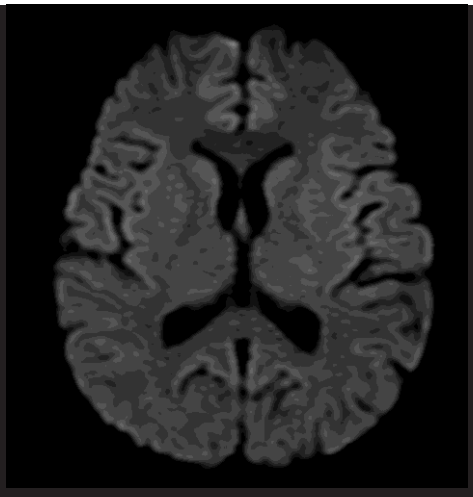
MAGiC DWI generates multiple synthetic b-values from a single DWI scanned series allowing the user to view diffusion contrasts changes in real time after the acquisition. It delivers high b-values without stressing protocol parameters and resulting in shorter scan times without sacrificing contrast or anatomy coverage. Synthetic Diffusion is not limited to diffusion directionality or coil type.

Benefits

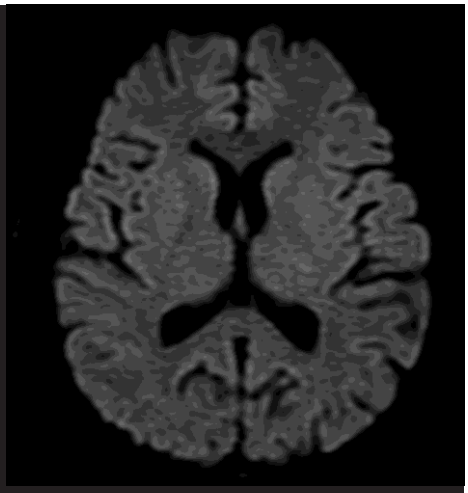
- Multiple synthetic b-values from a single DWI scan
- High b-values in shorter scan times
- Compatible with FOCUS Diffusion



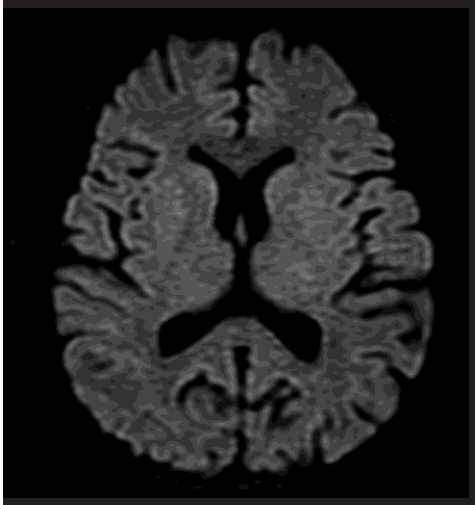
b750



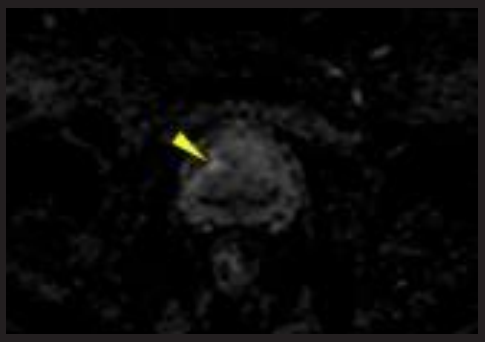
b1000



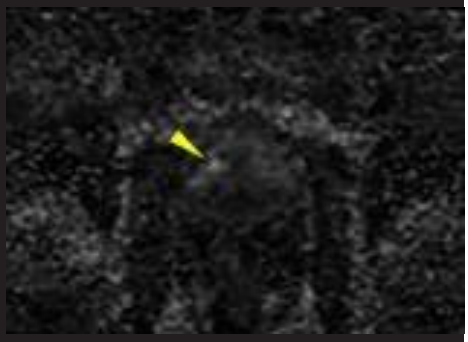
b1500



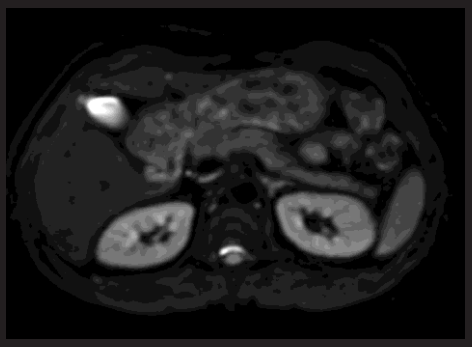
b2000



eDWI b800



MAGiC DWI b2000



eDWI b800

MAGiC DWI b1000

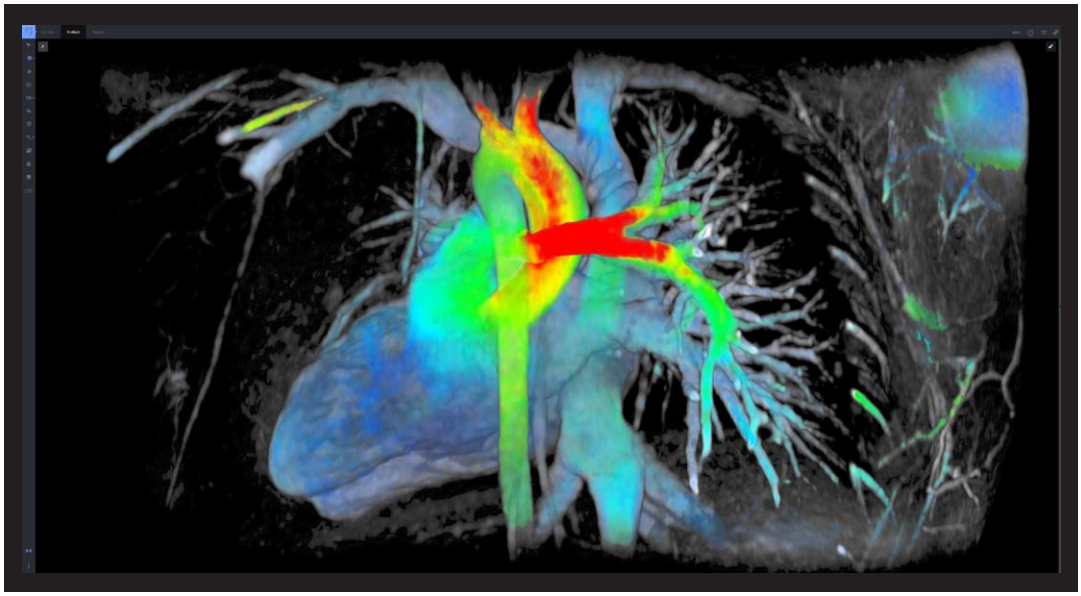
SIGNA™Works Features (continued)

ViosWorks

ViosWorks is a 3D cine-based acquisition that can be planned in any dimension and allows for velocity encoding in all directions to assess vascular flow. The acquisition delivers fast imaging with the use of Hyperkat acceleration including both, single and view sharing frames for higher temporal results. Provides high spatial resolution to enable visualization of flow through complex structures.

Benefits

- 3D cine acquisition in any dimension
- Free breathing whole chest coverage
- Allows velocity encoding in all directions
- Single and view sharing frames for higher temporal resolution
- Effortless workflow

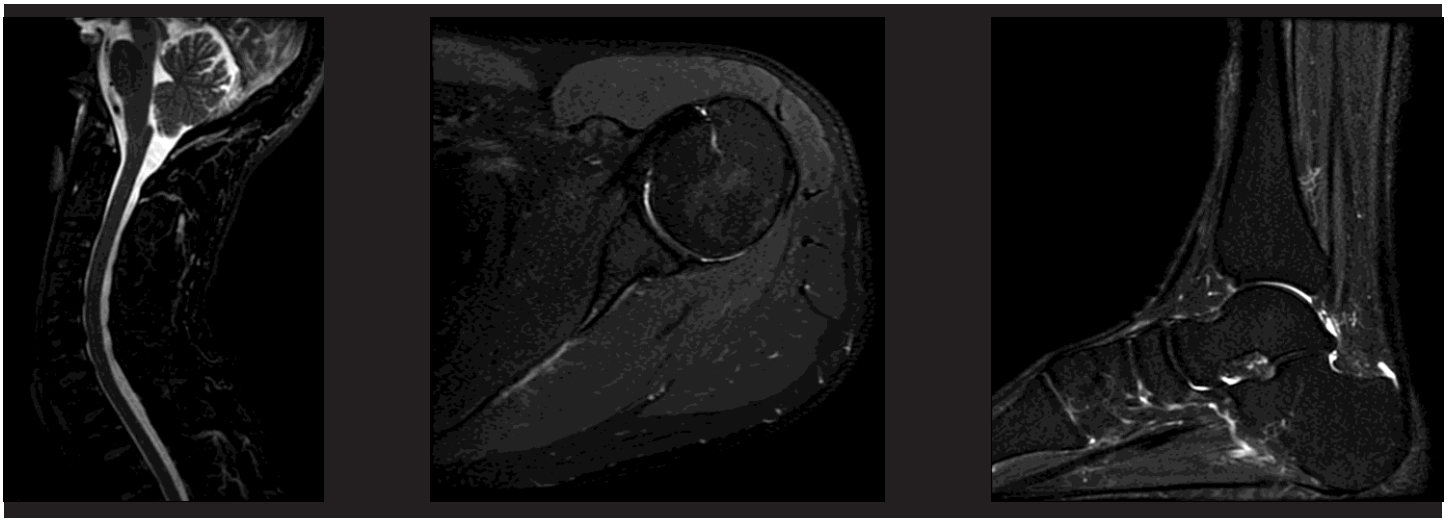


Flex for Cube and FSE

Flex uses a dual echo fat-water separation technology to provide robust and homogeneous fat suppressed images. Flex is compatible with ARC acceleration and can be used with a fast triple echo selection for significant scan time reduction. Enhanced uniformity and control of fat water swaps allow large field of view and off-center imaging where uniformity is a challenge. Delivering fast 2D and 3D acquisitions with reconstructed in-phase, out-of-phase, water and fat images, Flex represents productivity gains in all clinical areas.

Benefits

- 2D and 3D dual echo fat-water separation technique
- Uniform fat suppression for large FOV challenging offcenter anatomies
- Dixon-based, less sensitive to B0 inhomogeneity
- Choice of single pass acquisition for significant scan time reduction
- Water, Fat, in-phase and out-of-phase images



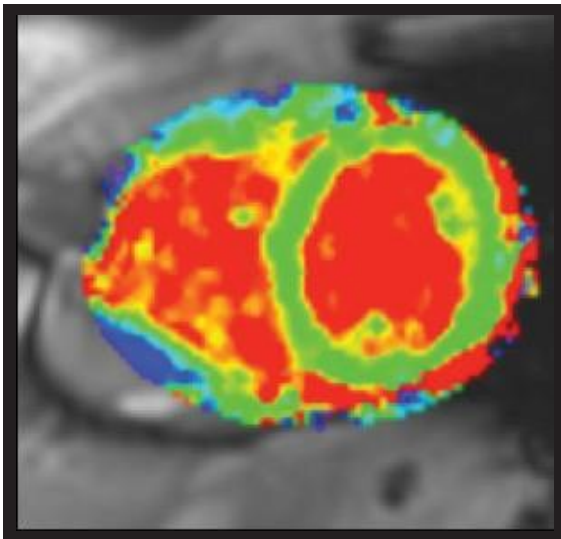
SIGNA™Works Features (continued)

CardioMaps

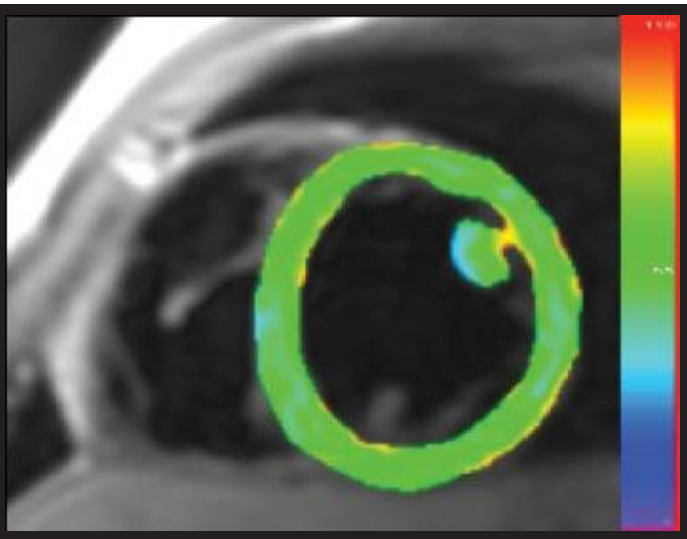
CardioMaps is a powerful diagnostic technique that supports detection of cardiac pathologies by quantitative measurement of T1 and T2 relaxation times. The T1 Mapping acquisition includes automatic motion correction that compensates for cardiac and/or respiratory motion, providing reliable results. T1 Mapping offers two methods of acquisition: Inversion-recovery Look-Locker with FIESTA readout (MOLLI) for apparent T1 (T1*) measurements or saturation-recovery SMART1 Map for true T1 measurements.

Benefits

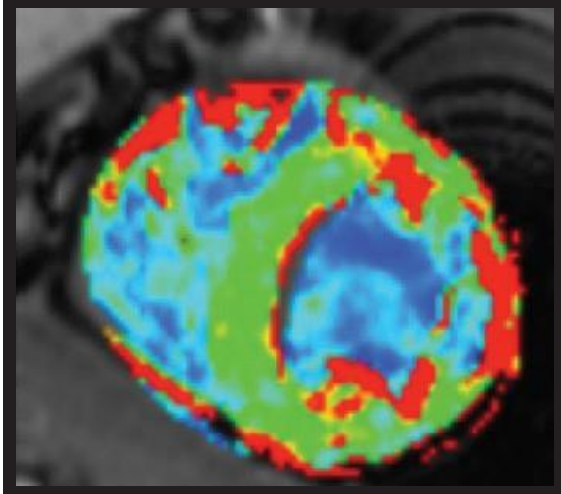
- Quantitative measurement of T1 and T2 relaxation times
- Automatic motion correction for T1 Mapping
- Two methods of acquisition for T1* or true T1 measurements



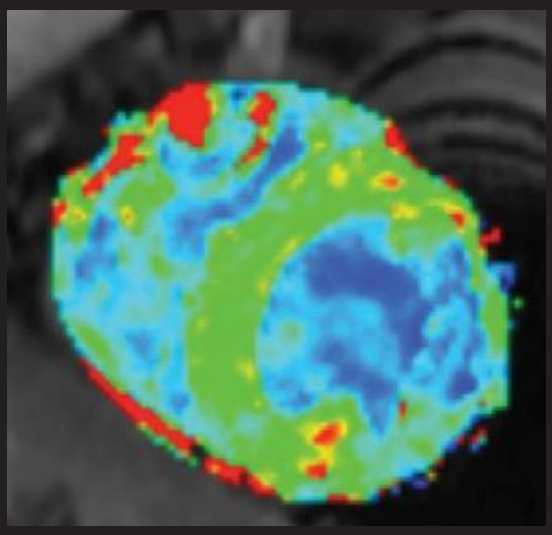
T1 CardioMap



T2 CardioMap



T1 CardioMap
Without Motion Correction



T1 CardioMap
With Motion Correction

Neuro Applications

MAGiC

MAGiC (MAGnetic resonance image Compilation), enables one and done imaging capability by delivering multiple contrasts in a single scan. MAGiC utilizes a multi-delay, multi-echo acquisition. The data acquired is processed using a technique to generate T1, T2, PD and Inversion Recovery (IR) weighted images (including: T1-FLAIR, T2-FLAIR, STIR, Dual IR and PSIR weighted images), all at once, reducing scan time by up to 50% compared to acquiring all contrasts separately.*

MAGiC generates all the different contrasts from the same acquisition, leading to enhanced image slice registration, owing to the absence of inter-acquisition patient movement. Because of the efficiency of MAGiC, the user has the flexibility to explore more advanced imaging, such as Spectroscopy**, Susceptibility Weighted Imaging** etc., in the same time required to perform the routine exam without MAGiC.

MAGiC provides the user the ability to change the contrast of the images after acquisition. This is performed by adjusting the TR, TE, and/or TI parameters post-acquisition, to generate the specific contrast desired.

MAGiC also enables users to generate parametric T1, T2, R1,R2, PD maps for further analysis of MRI scan data.

The Silent Neuro Exam Package

The Silent Neuro Exam Package includes a completed set of sequences designed to generate high-resolution images which delivers T1, T2, Flair, PD and Diffusion weighted contrasts. The new Silenz 2.0 imaging sequence delivers 3D isotropic and non-isotropic images with T1 and/or PD contrast with sound levels that are within 3dB(A) of the ambient conditions. Newly enhanced gradient waveforms have been employed to minimize the acoustic signature of FSE, Cube 2.0 and Propeller based acquisitions to generate T2 and T2 Flair weighted as well as Diffusion weighted images. In addition, the localizer and pre-scan sequences have been optimized as well to deliver a complete neuro exam at near fully silent levels.

Silent Suite

The Silent Suite includes a set of protocols including PROPELLER based acquisitions that provide high-resolution images with and without fat suppression based on optimized gradient waveforms to minimize the acoustic signature. This allows a full exam to be conducted with less than 11 dB(A) from the ambient room conditions. Additionally, acoustically reduced acquisitions can be run including multi-slice 2D FSE and Cube 2.0 acquisitions.

PROPELLER MB

PROPELLER MB uses innovative k space filling technique and post processing algorithms to help reduce and correct for motion and minimize magnetic susceptibility artifacts. Radial k space filling pattern causes oversampling of the k space center, generating more SNR and providing excellent tissue contrast. Radial k space filling is inherently less sensitive to motion compared to the Cartesian method. In addition, a sophisticated motion correction post-processing algorithm is deployed to reduce effects of motion originating from CSF flow, breathing, patient tremor or voluntary movements. PROPELLER MB has been enabled for high quality T1 FLAIR, T2, T2 FLAIR imaging in all planes, high quality axial diffusion weighted imaging for brain, high quality T2 weighted imaging for c-spine, excellent T2 weighted imaging for Body, and excellent T2/PD weighted imaging for MSK.

3D ASL (Arterial Spin Labeling)

3D ASL utilizes water in arterial blood as an endogenous contrast media to help visualize tissue perfusion and provide quantitative assessment of Cerebral Blood Flow (CBF) in ml/100 g/min. The quantitative CBF maps can be generated and stored in DICOM format.

3D ASL deploys stacked spiral FSE readout with modulated flip angle to acquire 3D volumetric data with increased SNR and minimal image distortion. The 3D data can be reformatted to axial, sagittal, coronal or oblique planes. A pulsed-continuous labeling is applied to label arterial blood close to the imaging volume thus improving conspicuity of flowing blood. Selective, interwoven pulses are then used to saturate and invert the imaging volume, in order to achieve better background suppression, and reduce sensitivity to motion.

3D ASL helps generate robust, reproducible images and perfusion maps with high SNR, reduced motion artifacts and less distortion in high magnetic susceptibility regions.

Cube 2.0

Cube 2.0 replaces several slice-by-slice, plane-after-plane 2D FSE acquisitions with a single 3D volume scan – providing you with T1, T2, T2 FLAIR, PD, and Dual inversion sequences. You can easily reformat sub-millimeter isotropic volume data from a single acquisition into any plane – without gaps, and with the same resolution as the original plane. Our self-calibrating parallel imaging engine ARC helps eliminate artifacts while accelerating image acquisition.

3D PROMO

3D PROMO provides a real time 3D navigator based motion correction algorithm correcting for the 6 rigid body terms where re-acquisition of severely corrupted data provides robust high quality motion reduced 3D outcomes. 3D PROMO is compatible with T2, and T2 FLAIR CUBE acquisitions.

3D BRAVO

BRAVO incorporates 1D ARC parallel imaging with 3D IR-prepared FSPGR acquisition to produce isotropic T1-weighted volumes. The center of k-space is over sampled and serves as the calibration data for the parallel imaging reconstruction.

**Based on MAGiC clinical study of 109 patients from 6 separate institutions.
**Optional package (MAGiC in itself does not deliver advanced imaging)

Neuro Applications (continued)

3D COSMIC

This is a 3D sequence used to image the axial c-spine. COSMIC (Coherent Oscillatory State Acquisition for the Manipulation of Imaging Contrast) uses a modified fast GRE pulse sequence with steady-state free precession segmented multi-shot centric k-space acquisition. This improves the CNR and SNR of c-spine tissue including the spinal cord, vertebral disks, nerve root canal and contrast between CSF and nerve roots.

2D and 3D MERGE

Multiple Echo Recombined Gradient Echo (MERGE) uses multiple echoes to generate high-resolution images of the C-spine with excellent gray-white matter differentiation. By combining early echoes with high SNR and late echoes with improved contrast, the result is improved cord contrast within the spinal column.

Enhanced SWAN 2.0

SWAN 2.0 is a high-resolution 3D multi-echo gradient echo sequence that produces weighted averaging across images with different TE's to achieve higher susceptibility weighting. It provides minimum intensity projections over neighboring slices, enhancing contrast for certain tissues containing iron, venous blood, and other substances with susceptibilities that are different than the background tissues. SWAN 2.0 outputs an unwrapped phase image leading to increased delineation between diamagnetic products and paramagnetic products (such as blood or iron). Due to the nature of the weighted averaging of the multi-echo sequence, the SNR of SWAN is higher than that of a single-echo acquisition. SWAN 2.0 helps visualize and delineate small vessels, as well as large vascular structures and iron or calcium deposits in the brain. Also provided with this feature is a user selectable option to view phase images in Haacke's convention (Normal) or Inverted. This makes SWAN phase images more flexible and users can select the contrast based on their preference. Enhanced Swan 2.0 also supports the function of auto removal of the background noise in phase images.

3D FIESTA

3D FIESTA (Fast Imaging Employing Steady-state Acquisition) is a technique that uses an extremely short repetition time (TR) between RF pulses such that high-resolution 3D volume images can be acquired rapidly. The 3D FIESTA technique is especially useful for the rapid acquisition of high-spatial-resolution images of static structures such as cochlea, internal auditory canal, or joints.

3D FIESTA-C

This phase-cycled FIESTA reduces sensitivity to susceptibilities that may be encountered when imaging in the posterior fossa. It provides exquisite contrast that is ideally equated for visualization of the internal auditory canal. It is also ideally suited for T1 imaging through the cervical spine.

IDEAL

This sequence and reconstruction package acquires multiple echoes at different echo times with a fast-spin echo readout to create water-only, fat-only, as well as in-phase and out-of-phase images. IDEAL is designed for imaging those difficult regions such as the neck and spine where inhomogeneous magnetic fields yield failures with traditional fat saturation techniques.

Diffusion Tensor Imaging with Fiber Tracking

This package expands EPI capability to include diffusion tensor imaging, a technique that acquires diffusion information in up to 150 different diffusion directions. It generates image contrast based on the degree of diffusion anisotropy in cerebral tissues such as white matter. Readyview capabilities on the console (included with ScanTools) create Fractional Anisotropy (FA), Apparent Diffusion Coefficient (ADC) and T2-Weighted ACE maps.

The FiberTrak post-processing utility generates eigenvector information from the diffusion tensor acquisition and processing. Using a robust and efficient seeding process, three-dimensional renderings of the diffusion along white matter tracts are generated.

BrainSTAT

BrainSTATBrainSTAT is a standard post processing application that automatically generates parametric maps for neuro Blood Flow, Blood Volume, Mean Transit Time, and Time to Peak signal intensity. A Gamma Variate fitting algorithm is deployed to automatically estimate the values for the four parametric maps.

An optional add-on to the Brain STAT package enables the user to automatically or manually specify the Arterial-Input Function (AIF) based on the temporal form of the signal, to normalized Blood Flow, Blood Volume, Mean Transit Time, and Time to Peak signal intensity maps based on the patients' vascular flow dynamics.

eDWI

The eDWI application includes the acquisition sequence and post-processing tools. It is designed to provide high signal-to-noise ratio diffusion images of the brain and liver with short acquisition time. Its multi-B feature is designed to provide measurement of apparent diffusion coefficient (ADC) map with reduced effect of perfusion. In addition, The "3 in 1" combining technique applies diffusion weighting to all three gradients simultaneously, helping improve sensitivity. Built in tetrahedral feature applies four different diffusion weighing combinations of x, y, and z gradients simultaneously to acquire isotropic diffusion weighted images with high signal-to-noise ratio and shorter TE. Its smart NEX feature helps to reduce acquisition time. Inversion recovery has been deployed to provide robust fat suppression.

Spectroscopy Applications

PROBE - PRESS single-voxel spectroscopy

PROBE - PRESS single-voxel spectroscopy allows you to noninvasively evaluate the relative concentrations of in-vivo metabolites and lets you acquire and display volume-localized, water-suppressed H1 spectra in single-voxel mode. The package includes automated recon, acquisition set-up and graphic prescription of spectroscopic volumes.

The standard sequence consists of three slice-selective RF pulses with crusher gradients. The PRESS sequence makes use of reduced flip angles to decrease minimum TE time of the sequence. The key advantage of PRESS (over STEAM) is that it provides up to twice the SNR and decreased exam time or voxel size. It is the sequence of choice for all hydrogen single-voxel spectroscopy data acquisitions with TE values ≥ 35 ms.

PROBE - STEAM single-voxel spectroscopy

STimulated Echo Acquisition Mode acquires a stimulated echo from the localized volume. The basic sequence consists of three slice-selective 90-degree RF pulses and a set of crusher gradients. Although STEAM provides more accurate voxel localization, it has inherently lower SNR compared to PRESS. Moreover, since echo times available with STEAM can be shorter, it is better suited than PRESS for chemical species that have shorter T2.

PROBE - 2D CSI

This extends the PROBE-PRESS capabilities with simultaneous multi-voxel in-plane acquisitions. Post-processing, including the generation of metabolite maps, is automatically generated with Readyview.

PROBE - 3D CSI

This extends the PROBE-2D CSI capabilities to add 3D multi-voxel acquisitions. (PROBE 2D CSI is mandatory).

BREASE

This is a TE-averaged PRESS spectroscopy acquisition that provides the necessary biochemical information to help characterize breast tissue.

Breast Applications

VIBRANT

VIBRANT is a technique for simultaneous, high-definition fat-suppressed bilateral breast imaging in both the axial and sagittal scan planes. With VIBRANT, imaging is performed without in-plane data interpolation for enhanced data integrity. VIBRANT allows acceleration in both the phase encoding as well as the slice-select direction. The result is high spatial and temporal resolution images that demonstrate exquisite contrast and high lesion conspicuity.

VIBRANT Flex

VIBRANT-Flex uses a time-efficient dual-echo acquisition with 2 ARC parallel imaging to produce water-only, fat-only, in-phase, and out-of-phase images of the breast in a single scan. This processing enables excellent fat saturation to provide a clear depiction of the underlying breast anatomy.

IDEAL

With FSE-IDEAL, water, fat, in phase, and out-of-phase images can be generated even in the presence of large static-field variations. This sequence and reconstruction package acquires multiple echoes at different echo times with a fast-spin echo readout to create water-only, fat-only, as well as in-phase and out-of-phase images.

IDEAL is designed for imaging those difficult regions such as the neck and spine where inhomogeneous magnetic fields yield failures with traditional fat saturation techniques. This sequence produces consistent and reliable images in challenging anatomical areas.

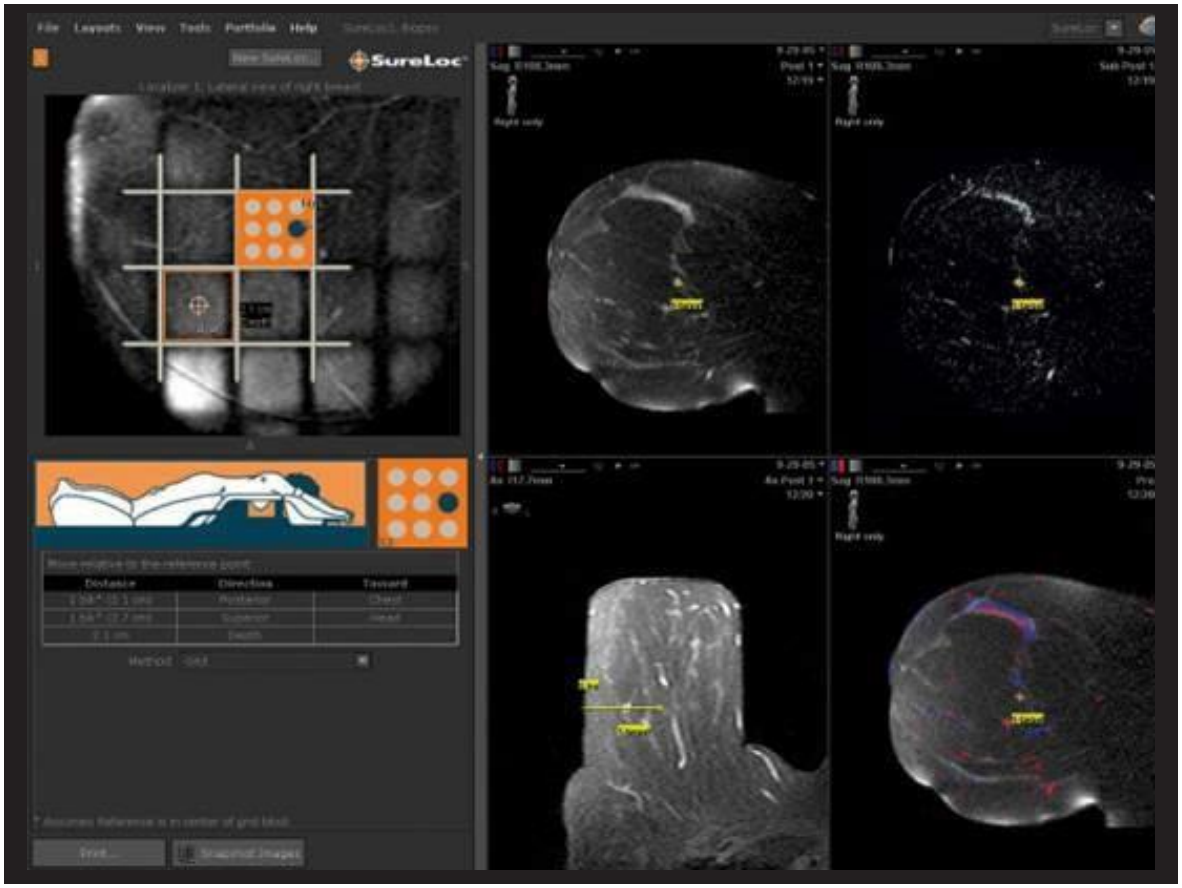
BREASE

BREASE is a TE-averaged PRESS spectroscopy acquisition that provides the necessary biochemical information to help characterize breast anatomy.

CadStream Breast Analysis

The CADStream package includes hardware and postprocessing software that facilitates analysis and management of breast image data. Image processing is performed automatically, using predefined templates for non-rigid image registration, subtraction, parametric maps, maximum intensity projection and multi-planar reformat. CADStream also generates reports that include images and graphs reports that can be exported in PDF or DICOM formats.

CADstream includes SureLoc – a tool that helps radiologists to more efficiently calculate coordinates for MR-guided interventions at the point of procedure. SureLoc reports needle position in real time and displays.



Cardiovascular Applications

iDrive Pro Plus

iDRIVE Pro Plus expands the capabilities of standard iDrive Pro with:

- Geometric changes to image plane location, obliquity, rotation, center FOV and FOV size
- Contrast parameters such as spatial pre-saturation on/off, special sat pulses, flow comp and RF spoiling
- Application of a non-selective IR pulse
- Swapping phase and frequency

It starts with an intuitive point-and-click user interface and live, on-image navigation icons. It continues with click-of-the-mouse image book-marking and a suite of localization and drawing tools, and includes capabilities from 10-level undo/redo, built-in time, autoNEX and click-of-the-mouse display/review/save, all to streamline even the most complex exams and manipulations.

ViosWorks

ViosWorks is a 3D cine-based acquisition that can be planned in any dimension and allows for velocity encoding in all directions to assess vascular flow. The acquisition delivers fast imaging with the use of Hyperkat acceleration including both, single and view sharing frames for higher temporal results. Provides high spatial resolution to enable visualization of flow through complex structures.

- 3D cine acquisition in any dimension
- Free-breathing whole chest coverage
- Allows velocity encoding in all directions
- Single and view sharing frames for higher temporal resolution
- Effortless workflow.

cmr^{42}

cmr^{42} Cardiac MR analysis software from Circle Cardiovascular Imaging Inc, available through GE Healthcare, is a cardiac analysis environment that improves efficacy and performance for all of your cardiac imaging needs. cmr^{42} delivers the latest in function, flow, tissue analysis and perfusion as a comprehensive base package. When properly equipped, the user can extend capabilities to T1, T2 Mapping and Tissue Tracking.

2D FIESTA Cine

Fast Imaging Employing STeady state Acquisition is a fully balanced steady-state coherent imaging pulse sequence that has been designed to produce high SNR images at very short TR. The pulse sequence uses fully balanced gradients to re-phase the transverse magnetization at the end of each TR interval. This sequence accentuates the contrast of anatomy with high T2/T1 ratios (such as the cardiac blood pool), while suppressing the signal from tissues with low T2/ T1 ratios (such as muscle and myocardium). This enhances the contrast between the myocardium and the blood pool.

3D FatSat FIESTA

3D FatSat FIESTA is software designed for imaging of the coronary arteries. The software acquires 3D images using FIESTA (Fast Imaging Employing STeady-state Acquisition). Fat suppression is applied to accentuate the coronary arteries. The use of VAST (Variable Sampling in Time) technology greatly shortens breathholding requirements or allows for higher spatial resolution.

2D IR Prepared Gated

FGRE Vital to MRI myocardial assessments, this technique can help distinguish between viable and necrotic tissue and therefore have a major impact on patient management. This pulse sequence uses an IR-prepared, cardiac-gated fast gradient echo sequence to acquire images whose appearance depends on the tissue's T1 relaxation time. The IR-preparation step allows various tissues to be suppressed or enhanced. The IR prep pulse in this sequence is non-selective; i.e., it excites the entire volume inside the body coil, rather than a specific slice. That means that it can suppress both the myocardium and the blood flowing into the slice.

3D IR Prepared Gated FGRE

3D IR Prepared Gated FGRE is an advanced tool for myocardial assessment. It acquires extensive volumes of data, rather than merely single slices, during breath-holds, with acquisitions gated to the cardiac cycle. The software applies a non-selective inversion-recovery magnetization preparation step to create T1-weighted tissue contrast and suppress the signal from certain tissues.

Navigators

This software package is designed for use in conjunction with 3D IR Prepared FGRE or 3D FatSat FIESTA for cardiac imaging. It consists of navigators that make it possible to track the diaphragm and use the information to acquire crisp 3D gradient echo images of the heart even while the patient breathes.

Cardiac tagging

Used to improve visualization of contractile function, this tagging application combines cardiac-gated FastCINE gradient-recalled echo to acquire data throughout the cardiac cycle, with spatial SAT pulses applied throughout the FOV. Using the operator's choice of diagonal stripes or a grid pattern, tagging is applied once per R-R interval immediately following the R-wave ECG trigger, just before the start of data acquisition.

Fast Gradient Echo using EPI Echo Train

This technique combines a short-TR FGRE (Fast GRadient Echo) pulse sequence with an EPI echo train to acquire multiple views, or phase-encoding steps, per TR. It features uniform RF excitation, centric phase encoding, segmented k-space filling, retrospective gating in FastCARD-ET, EPI-caliber interleaving, and EPI-like acquisition of multiple views in one TR. Multi-phase FGRET is useful for applications such as multi-slice, multi-phase imaging of myocardial function.

Cardiovascular Applications (continued)

Black Blood Single Shot Fast Spin Echo

Black Blood SSFSE is available for either dual or triple inversion pre-pulse single shot FSE based acquisition utilized for morphological imaging of the heart and vessels. The use of inversion pre-pulses allows for nulling of the blood pool for improved visualization of vessels and heart structures. Utilization of single shot acquisitions allows for single breath hold multi-slice coverage which leads to larger volume coverage in fewer breath holds for patient tolerance as well as reduction of overall exam times.

StarMap

StarMap is a technique that acquires multiple echoes at different TE times at each location resulting in images that represent variations of T2* weighting. Post-processing of the images is employed to generate gray scale and color maps of the T2* signal decay across the echoes, which can be useful in the assessment of the presence of iron.

Cine IR (Cine Inversion Recovery)

Cine IR is a conventional ECG-gated, gradient-recalled echo FASTCARD or FASTCINE acquisition sequence with an Inversion Recovery (IR) preparation. A single adiabatic inversion pulse is generated upon detection of the cardiac R-wave to trigger the multi-phase readout. Each image (i.e., cardiac phase) is at a progressively longer TI time. Cine IR can be used to approximate the myocardial null point for a subsequent delayed enhancement (MDE) study for myocardial viability.

PS-MDE

Phase Sensitive Inversion Recovery reduces the sensitivity of inversion delay times in the suppression of myocardial signal for MDE results by utilization of a phase-sensitive reconstruction of the resultant image. The use of the phase image provides a more robust outcome and image appearance.

MDE Plus

Provides a Single Shot Fiesta based MDE acquisitions used to suppress myocardial signal with the single shot fiesta based method a reduction of breath hold times allowing multi-slice coverage in minimal number of breath holds. Additionally, the new method provides an optimized fat suppression pulse to ensure uniform suppression of fat for better contrast visualization

FGRE Time Course

The FGRE TC PSD is a Fast Gradient-echo time-course imaging sequence that utilizes single-echo acquisition to help reduce sensitivity to echo misalignment or system calibrations variations, which can result in robust image quality with less ghosting and artifact reduction. ASSET parallel imaging and shortened RF pulse design are incorporated to help improve temporal resolution and reduce motion related artifacts. In addition to selective notch pulse, it also supports non-selective saturation pulse for excellent background suppression and multi-plane imaging capability.

Cardiac VX

GE's Advantage Workstation Cardiac VX cardiac reporting software provides a fast and easy way to simultaneously review and analyze cardiac MR images as well as to generate comprehensive reports for referring physicians. Its functionality includes the ability to:

Completely evaluate for patent foramen ovale by analyzing images acquired with a non-invasive, IR-prepared fast gradient echo-train sequence

Analyze and quantify flow measurements using cine phase contrast images of blood flow or CSF flow

Conduct quantitative time course imaging analysis

Perform myocardial scarring analysis

The added structured reprint and research database reduces the amount of time a clinician spends reporting on a cardiac MRI case

Cardiac VX makes it possible to quickly and accurately complete clinical reports on cardiac MR exams including reports tailored specifically to pediatrics and CSF flow. It automatically compares newly acquired measurements against a set of predetermined normal values and flags those that are outside this normal range. Pre-written, user-programmable macros interface to these measurements to generate a complete report in just minutes.

Flow Analysis

A subset of the Cardiac VX software, clinicians interested only in quantifying CSF or blood flow can access all of the Cardiac VX's flow features including: peak and average flow charts and graphs, automated contour detection and PACs compatibility.

Flow Analysis is available as an Advantage Workstation application or an MR operator console application.

Respiratory Triggering

For patients who cannot hold their breath, respiratory triggering provides the answer. By synchronizing the acquisition to the respiratory cycle, high-resolution images are obtained while mitigating breathing artifacts.

TRICKS

Time Resolved Imaging of Contrast KineticS (TRICKS) technology uses intricate temporal sampling with complex data recombination to accelerate the temporal resolution of 3D dynamic imaging – without compromising spatial resolution. This technology is integrated with elliptical-centric data sampling to create the ideal imaging technique for MRA in even the most challenging circumstances.

Cardiovascular Applications (continued)

Easy to set up, TRICKS rapidly generates time resolved 3D images of blood vessels to meet the challenge of capturing peak arterial phases with minimal venous contamination. With TRICKS, the different vascular phases can be extracted, quickly and easily, after image acquisition.

Fluoro-Triggered MRA

Fluoro-triggered MRA (FTMRA) is designed to capture angiographic images at the precise moment of peak opacification. Rather than automating the image-acquisition upon detection of the bolus arrival, FTMRA allows the operator to trigger each acquisition almost instantly (less than 1 second switch over), as soon as the operator is satisfied with the level of vessel enhancement. The result is an interactive, ASSET compatible, accurate approach to MRA.

Quickstep

QuickSTEP is an automated multi-station acquisition. This application automatically prescribes, acquires, and combines images from multiple stations for fast acquisition and exam completion. To complete the entire exam in as little as 7 minutes, the system will automatically acquire mask datasets from multiple stations without any user intervention. Secondary images are then acquired at the same independent table positions. The system will automatically subtract the mask images from the secondary dataset and combine the resulting images from the multiple stations into one series. The user only needs to complete a quick review of the data prior to insertion of images into the database.

Inhance Application Suite

The Inhance application suite consists of several sequences designed to provide high-resolution images of the vasculature with short-acquisition times and excellent vessel detail. These sequences include:

Inhance 3D Velocity

Inhance 3D Velocity is designed to acquire angiographic images in brain and renal arteries with excellent background suppression in a short scan time. By combining a volumetric 3D phase contrast acquisition with parallel imaging, efficient k-space sampling, and pulse sequence optimization, Inhance 3D Velocity is faster than previous generations and is capable of obtaining the whole neurovascular anatomy in approximately 5-6 minutes.

Furthermore, background suppression is improved by the optimized pulse sequence design, resulting in better visualization of small branches. Respiratory triggering is also compatible with Inhance 3D Velocity to enable abdominal angiography, specifically renal arteries. This can result in excellent productivity and image quality.

Inhance 3D Deltaflow

Inhance 3D DeltaFlow is a 3D non-contrast-enhanced MRA application for peripheral arterial imaging. Inhance 3D DeltaFlow is based on the 3D Fast Spin Echo technique and it utilizes the systolic and diastolic flow differences to help generate arterial signal contrast. A subtraction of the systolic phase from the diastolic phase images results in an arterial only image, with good venous and background suppression. Interleaved acquisition and parallel imaging (ASSET) with optimized k-space trajectory helps reduce motion misregistration and improve vessel visualization respectively. In addition, with the use of partial-Fourier and coronal plane acquisition, the scan time is considerably reduced. Inhance 3D DeltaFlow is a robust 3D NCE MRA technique that provides excellent, high SNR visualization of peripheral arteries.

Inhance Inflow IR

Inhance Inflow IR is an angiographic method, which has been developed to image renal arteries with ability to suppress static background tissue and venous flow. This sequence is based on 3D FIESTA, which improves SNR while producing bright blood images. A selective inversion pulse is applied over the region of interest, which inverts arterial, venous, and static tissue. At the null point of the venous blood, an excitation pulse is applied to generate signal. The net result is an angiographic image with excellent background suppression and virtually no venous contamination. Uniform fat suppression is achieved using a spectrally selective chemical saturation (SPECIAL) technique while respiratory gating compatibility reduces respiratory motion artifacts during free-breathing renal exams.

Inhance 2D Inflow

The Inhance 2D Inflow pulse sequence is designed to acquire angiographic images of arteries that follow almost a straight path (i.e. femoral, popliteal, and carotid arteries). Arterial blood flow is faster during the systolic phase and slows down during the diastolic phase. Therefore, Inhance 2D Inflow is designed to acquire data during the systolic phase:

- Optimized spatial saturation gap to improve fat suppression and background suppression. With this saturation gap optimization, higher views per segment (vps up to 48 for slow heart-rate) can be used, resulting in significant scan time reduction
- Peripheral Gating that minimizes the pulsatile artifacts
- Optimized view ordering to improve arterial signal
- ASSET acceleration compatibility to reduce scan time

Body Applications

Spiral Imaging

Developed to acquire high-resolution images in far less than one second, Spiral Imaging is ideally suited for imaging moving structures such as the coronary arteries. Instead of collecting data in the conventional rectilinear grid pattern, it simultaneously applies the x and y gradients in conjunction with a 2D GRE or SPGR pulse sequence, and then interpolates the data onto a rectilinear grid for image generation. Non-gated sequences can be used with one or more slice locations; gated acquisitions can be conducted in sequential or non-sequential mode. The advantages of Spiral Imaging include fast acquisition from the more efficient k-space data collection, high SNR from over-sampling of the center of k-space, and intrinsic flow- and motion-compensation from the short echo times."

DISCO

DISCO (Differential Sub-sampling with Cartesian Ordering) provides the capability to image the entire liver in less than 3 second intervals. It utilizes Time Resolved Imaging of Contrast KineticS (TRICKS) technology with intricate temporal sampling with complex data recombination to accelerate the temporal resolution of 3D dynamic imaging - without compromising spatial resolution. This technology is now integrated with elliptical-centric data sampling to create the ideal imaging technique with robust LAVA FLEX based fat suppression in the most challenging circumstances. Easy to set up and easy to use, DISCO rapidly generates time resolved 3D images to meet the challenge of capturing multiple dynamic phases over time. DISCO can also be utilized to image the prostate and breast.

IDEAL IQ

IDEAL IQ is a GE exclusive technique that builds upon the original IDEAL (Iterative Decomposition of water and fat with Echo Asymmetry and Least-squares estimation) technique that acquires multiple images of the anatomy at separate echo times to calculate the phase differences and determine triglyceride fat and water content per pixel. It exploits the resonance frequency differences between triglyceride fat and water, measured as phase differences in multiple echoe, to resolve triglyceride fat and water. It provides reliable and uniform water-fat separation in the presence of B0 field inhomogeneity and improves the accuracy of water-fat separation by estimating and correcting for T2* decay between echoes and by more accurately modeling triglyceride fat's spectral profile as multiple peaks rather than a single peak. The result is a triglyceride fat-fraction map image that reflects the spatial distribution of relative concentration of triglyceride fat within a voxel.

eDWI

The eDWI application includes the acquisition sequence and post-processing tools. It is designed to provide high signal-to-noise ratio diffusion images of the brain and liver with short acquisition time. Its multi-B feature is designed to provide measurement of apparent diffusion coefficient (ADC) map with reduced effect of perfusion. In addition, the "3 in 1" combining technique applies diffusion weighting to all three gradients simultaneously, helping improve sensitivity. Built in tetrahedral feature applies four different diffusion weighing combinations of x, y, and z gradients simultaneously to acquire isotropic diffusion weighted images with high signal-to-noise ratio and shorter TE. Its smart NEX feature helps to reduce acquisition time. Inversion recovery has been deployed to provide robust fat suppression.

Auto Navigator

Auto Navigator feature is designed to deliver real time robust free breathing respiratory motion compensation to improve routine and advanced body applications. It includes automated tracker placement to detect respiratory motion and delivers a simple workflow to the technologist. Further, the Auto Navigator feature is compatible with DISCO, Turbo LAVA, Turbo LAVA Flex to deliver free-breathing body imaging capability for maximum patient comfort.

LAVA

LAVA is a three-dimensional (3D) spoiled gradient echo technique designed specifically to image the liver with excellent definition, coverage, and speed. Excellent fat suppression, through a spectrally selective inversion pulse customized for the liver, is one of the reasons for the high definition of anatomical structures. The coverage and speed of LAVA are the result of short TR, innovative use of partial k-space acquisition, and advanced parallel imaging

LAVA Flex

LAVA Flex is a 3D FSPGR imaging technique that acquires fat/ water in phase and out of phase echoes in a single acquisition. Up to 4 types of images may be reconstructed within one acquisition: in phase, out of phase, water only, fat only. The water only contrast differs from a conventional fat suppressed image in that an inversion prep pulse is not applied for fat suppression. In fact, the fat information is removed leaving a water only image that may potentially be used in place of a LAVA type image. LAVA Flex uses ARC (Autocalibrating Reconstruction for Cartesian sampling), a 2D self-calibrated parallel imaging technique that allows for acceleration in both phase and slice directions for supported coils.

Turbo LAVA

LAVA Turbo provides a reduction of breath-hold timing for both LAVA and LAVA FLEX acquisitions by up to 47% compared to conventional LAVA / LAVA FLEX acquisitions.

Real Time Field Adjustment

The RTFA algorithm leads to a reduction in distortion of the diffusion image per diffusion axis. RTFA is designed to reduce image blurring and distortions typically associated with diffusion imaging throughout the body. RTFA also allows for increased utilization of single spin echo DWI which results in an increase in SNR by up to 50% compared to dual spin echo and, when combined with the improved resolution leads to an increase in image quality that can be utilized for image presentation, fusion and ADC map outputs.

Body Applications (continued)

2D Fiesta Cine

Fast Imaging Employing STeady state Acquisition is a fully balanced steady-state coherent imaging pulse sequence that has been designed to produce high SNR images at very short TR. The pulse sequence uses fully balanced gradients to re-phase the transverse magnetization at the end of each TR interval. This sequence accentuates the contrast of anatomy with high T2/T1 ratios (such as the cardiac blood pool), while suppressing the signal from tissues with low T2/T1 ratios (such as muscle and myocardium). This enhances the contrast between the myocardium and the blood pool.

PROPELLER MB

PROPELLER MB uses innovative k space filling technique and post processing algorithms to help reduce and correct for motion and minimize magnetic susceptibility artifacts. Radial k space filling pattern causes oversampling of the k space center, generating more SNR and providing excellent tissue contrast. Radial k space filling is inherently less sensitive to motion compared to the Cartesian method. In addition, a sophisticated motion correction post-processing algorithm is deployed to reduce effects of motion originating from CSF flow, breathing, patient tremor or voluntary movements. PROPELLER MB has been enabled for high quality T1 FLAIR, T2, T2 FLAIR imaging in all planes, high quality axial diffusion weighted imaging for brain, high quality T2 weighted imaging for c-spine, excellent T2 weighted imaging for Body, and excellent T2/PD weighted imaging for MSK.

3D Dual Echo

With improvements in parallel imaging and RF coil arrays, volumetric imaging in the body is becoming a standard of care. The 3D Dual Echo sequence produces in-phase and out-of-phase images in a single breath-hold. As a result, the high-resolution images are in perfect alignment, simplifying the diagnostic process. In addition, the improved SNR of the 3D acquisition permits thinner slice imaging.

3D FRFSE

Coupled with respiratory gating, this 3D FSE sequence uses a novel“recovery” pulse at the end of each echo train to recapture signal for the next repetition. These features result in high-resolution three-dimensional images for MR cholangiopancreatography (MRCP) studies.

Single-Shot Fast-Spin Echo

An ultra-fast technique that permits complete image acquisition following a single RF excitation. It can acquire slices in less than one second, making it an excellent complement to T2-weighted brain and abdominal imaging and MRCP studies, now with increased resolution through improved RF pulse trains.

Respiratory triggering

For patients who cannot hold their breath, respiratory triggering provides the answer. By synchronizing the acquisition to the respiratory cycle, high-resolution images free of breathing artifacts are obtained.

StarMap

StarMap is a technique that acquires multiple echoes at different TE times at each location resulting in images that represent variations of T2* weighting. Post-processing of the images is employed to generate gray scale and color maps of the T2* signal decay across the echoes, which can be useful in the assessment of the presence of iron.

2D Fat Sat Fiesta

Fast Imaging Employing STeady-state Acquisition (FIESTA) is designed to produce high SNR images extremely rapidly and with excellent contrast between tissues. The contrast relies on a steady state for the transverse magnetization, which builds as a series of radio frequency pulses and special gradient pulses are repeated after an extremely short repetition time, TR. FIESTA accentuates the signal from tissues that have a long T2 and short T1. FIESTA has the capability to suppress the signal from fat, especially to create more contrast between the vasculature and surrounding tissues.

FOCUS

FOCUS delivers a highly efficient method for increasing the resolution in Single Shot DW EPI sequences. The outcome delivers robust high resolution results while removing artifacts typically induced from motion, image backfolding or unsuppressed tissue. In addition, the reduced field of view imaging leads to a reduction in blurring that translates into an overall improvement to the image quality result. The sequence utilizes 2D selective excitation pulses in DW-EPI acquisitions to limit the prescribed phase encoded field of view at both 1.5T and 3.0T field strengths.

Cube 2.0

Cube 2.0 replaces several slice-by-slice, plane-after-plane 2D FSE acquisitions with a single 3D volume scan – providing you with T1, T2, T2 FLAIR or PD sequences. You can easily reformat submillimeter isotropic volume data from a single acquisition into any plane – without gaps, and with the same resolution as the original plane. Our new self-calibrating parallel imaging engine ARC helps eliminate artifacts while accelerating image acquisition.

IDEAL

This sequence and reconstruction package acquires multiple echoes at different echo times with a fast-spin echo readout to create water-only, fat-only, as well as in-phase and out-of-phase images. IDEAL is designed for imaging those difficult regions such as the neck and spine where inhomogeneous magnetic fields yield failures with traditional fat saturation techniques.

Body Applications (continued)

MR Touch

MR Touch is a non-invasive method to measure relative tissue stiffness with MR.

MR Touch is an acquisition and reconstruction technique that combines hardware, and acquisition and reconstruction algorithms to produce Elastograms, color-coded anatomical images showing varying degrees of elasticity or stiffness. The image contrast is related to relative stiffness of soft tissue and is generated from the real-time data acquisition during tissue palpation with low amplitude and low frequency sound waves. The hardware component is comprised of an active sound wave generator and a passive transducer that produces small vibrations in the area of the patient to be scanned. The MR Touch acquisition software is an evolutionary improvement to the echo planar imaging sequence. The acquisition software also triggers the sound wave generator to produce synchronized vibrations on the surface of the patient during the data acquisition. The reconstruction algorithms generate images that show the propagation of waves through the tissue (phase images) and also the corresponding strain wave and relative stiffness images. Parallel imaging is used to accelerate image acquisition.

Musculoskeletal Applications

PROPELLER MB

PROPELLER MB uses innovative k space filling technique and post processing algorithms to help reduce and correct for motion and minimize magnetic susceptibility artifacts. Radial k space filling pattern causes oversampling of the k space center, generating more SNR and providing excellent tissue contrast. Radial k space filling is inherently less sensitive to motion compared to the Cartesian method. In addition, a sophisticated motion correction post-processing algorithm is deployed to reduce effects of motion originating from CSF flow, breathing, patient tremor or voluntary movements. PROPELLER MB has been enabled for high quality T1 FLAIR, T2, T2 FLAIR imaging in all planes, high quality axial diffusion weighted imaging for brain, high quality T2 weighted imaging for c-spine, excellent T2 weighted imaging for Body, and excellent T2/PD weighted imaging for MSK.

CartiGram

CartiGram is a T2 mapping sequence and processing utility used to image cartilage and other tissues. This technique acquires multiple echoes at different TE times at each location resulting in datasets of images that represent different T2 weighting. Post processing of the images generates maps of the T2 signal decay within each voxel.

3D MERGE

This 3D technique offers excellent SNR and fat-saturation capabilities to provide high resolution, isotropic T2* weighted images of the extremities (hand, wrist, knee, ankle, and shoulder). Multiple Echo Recombined Gradient Echo (MERGE) uses multiple echoes to generate high-resolution images of the C-spine with excellent gray-white matter differentiation. By combining early echoes with high SNR and late echoes with improved contrast, the result is improved cord contrast within the spinal column.

Cube 2.0

Cube 2.0 replaces several slice-by-slice, plane-after-plane 2D FSE acquisitions with a single 3D volume scan – providing you with T1, T2, T2 FLAIR or PD sequences. You can easily reformat sub-millimeter isotropic volume data from a single acquisition into any plane – without gaps, and with the same resolution as the original plane. Our new self-calibrating parallel imaging engine ARC helps eliminate artifacts while accelerating image acquisition.

3D Fiesta

3D FIESTA (Fast Imaging Employing Steady-state Acquisition) is a technique that uses an extremely short repetition time (TR) between RF pulses such that high-resolution 3D volume images can be acquired rapidly. The 3D FIESTA technique is especially useful for the rapid acquisition of high-spatial-resolution images of static structures such as cochlea, internal auditory canal, or joints.

IDEAL

IDEAL is designed for imaging those difficult regions such as the neck and spine where inhomogeneous magnetic fields yield failures with traditional fat saturation techniques. Areas such as the foot/ankle, shoulder, and off-isocenter wrist make fat saturation a challenge. Water, fat, inphase, and out-of-phase images can be generated even in the presence of large static-field variations. This sequence produces consistent and reliable images in challenging anatomical areas

MAVRIC SL

Multi-spectral imaging technique designed to reduce metal artifact near MR conditional implants. The sequence provides T1, PD or STIR contrast.

MAVRIC SL is a magnetic resonance imaging technique that applies novel pulse sequencing with a reduction algorithm designed to image in the presence of MR compatible implants. MAVRIC SL helps significantly (more than 10-fold) reduce artifacts caused by metal in both in-plane and through-plane dimensions. MAVRIC SL is used to help image complications following arthroplasty procedures as well as any other unrelated diseases in the soft and bone tissue adjacent to metal instrumentation.

2D FSE ASPIR

Adiabatic spectral inversion pulse utilized with FSE based acquisitions to improve fat suppression homogeneity over large fields of view or off-center imaging acquisitions

Pediatric Applications‡

Pediatric Neurology

PROPELLER MB

PROPELLER MB uses innovative k space filling technique and post processing algorithms to help reduce and correct for motion and minimize magnetic susceptibility artifacts. Radial k space filling pattern causes oversampling of the k space center, generating more SNR and providing excellent tissue contrast. Radial k space filling is inherently less sensitive to motion compared to the Cartesian method. In addition, a sophisticated motion correction post-processing algorithm is deployed to reduce effects of motion originating from CSF flow, breathing, patient tremor or voluntary movements. PROPELLER MB has been enabled for high quality T1 FLAIR, T2, T2 FLAIR imaging in all planes, high quality axial diffusion weighted imaging for brain, high quality T2 weighted imaging for c-spine, excellent T2 weighted imaging for Body, and excellent T2/PD weighted imaging for MSK.

Cube 2.0

Cube 2.0 replaces several slice-by-slice, plane-after-plane 2D FSE acquisitions with a single 3D volume scan – providing you with T2, T2 FLAIR, or PD sequences. You can easily reformat sub-millimeter isotropic volume data from a single acquisition into any plane – without gaps, and with the same resolution as the original plane. Our self-calibrating parallel imaging engine ARC helps eliminate artifacts while accelerating image acquisition.

Diffusion Tensor imaging with Fiber Tracking

This package expands EPI capability to include diffusion tensor imaging, a technique that acquires diffusion information in up to 150 different diffusion directions. It generates image contrast based on the degree of diffusion anisotropy in cerebral tissues such as white matter. Readyview capabilities on the console (included with ScanTools) create Fractional Anisotropy (FA), Apparent Diffusion Coefficient (ADC) and

T2-Weighted TRACE maps.

The FiberTrak post-processing utility generates eigenvector information from the diffusion tensor acquisition and processing. Using a robust and efficient seeding process, 3D renderings of the diffusion along white matter tracts are generated.

3D BRAVO

BRAVO incorporates 1D ARC parallel imaging with 3D IR-prepared FSPGR acquisition to produce isotropic T1-weighted volumes. The center of k-space is over sampled and serves as the calibration data for the parallel-imaging reconstruction.

3D ASL (Arterial Spin Labeling)

3D ASL utilizes water in arterial blood as an endogenous contrast media to help visualize tissue perfusion and provide quantitative assessment of Cerebral Blood Flow (CBF) in ml/100 g/min. The quantitative CBF maps can be generated and stored in DICOM format.

3D ASL deploys stacked spiral FSE readout with modulated flip angle to acquire 3D volumetric data with increased SNR and minimal image distortion. The 3D data can be reformatted to axial, sagittal, coronal or oblique planes. A pulsed-continuous labeling is applied to label arterial blood close to the imaging volume thus improving conspicuity of flowing blood. Selective interwoven pulses are then used to saturate and invert the imaging volume, in order to achieve better background suppression, and reduce sensitivity to motion.

3D ASL helps generate robust, reproducible images and perfusion maps with high SNR, reduced motion artifacts and less distortion in high magnetic susceptibility regions.

Pediatric Vascular

TRICKS

Time Resolved Imaging of Contrast KineticS (TRICKS) technology uses intricate temporal sampling with complex data recombination to accelerate the temporal resolution of 3D dynamic imaging – without compromising spatial resolution. This technology is now integrated with elliptical centric data sampling to create the ideal imaging technique for contrast-enhanced MRA in even the most challenging circumstances.

Easy to set up, TRICKS rapidly generates time resolved 3D images of blood vessels to meet the challenge of capturing peak arterial phases with minimal venous contamination. With TRICKS, the different vascular phases can be extracted, quickly and easily, after image acquisition.

Inhance 3D Velocity

Inhance 3D Velocity is designed to acquire angiographic images in brain and renal arteries with excellent background suppression in a short scan time. By combining a volumetric 3D phase contrast acquisition with parallel imaging, efficient k-space sampling, and pulse sequence optimization, Inhance 3D Velocity is faster than previous generations and is capable of obtaining the whole neurovascular anatomy in approximately 5-6 minutes. Furthermore, background suppression is improved by the optimized pulse sequence design, resulting in better visualization of small branches. Respiratory triggering is also compatible with Inhance 3D Velocity to enable abdominal angiography, specifically renal arteries. This can result in excellent productivity and image quality.

Pediatric Applications[‡] (continued)

Inhance 3D Deltaflow

Inhance 3D DeltaFlow is a 3D non-contrast-enhanced MRA application for peripheral arterial imaging. Inhance 3D DeltaFlow is based on the 3D Fast Spin Echo technique and it utilizes the systolic and diastolic flow differences to help generate arterial signal contrast. A subtraction of the systolic phase from the diastolic phase images results in an arterial only image, with good venous and background suppression. Interleaved acquisition and parallel imaging (ASSET) with optimized k-space trajectory helps reduce motion misregistration and improve vessel visualization respectively. In addition, with the use of partial-Fourier and coronal plane acquisition, the scan time is considerably reduced. Inhance 3D DeltaFlow is a robust 3D NCE MRA technique that provides excellent, high SNR visualization of peripheral arteries.

Inhance Inflow IR

Inhance Inflow IR is an angiographic method, which has been developed to image renal arteries with ability to suppress static background tissue and venous flow. This sequence is based on 3D FIESTA, which improves SNR while producing bright blood images. A selective inversion pulse is applied over the region of interest, which inverts arterial, venous, and static tissue. At the null point of the venous blood, an excitation pulse is applied to generate signal. The net result is an angiographic image with excellent back-ground suppression and virtually no venous contamination. Uniform fat suppression is achieved using a spectrally selective chemical saturation (SPECIAL) technique while respiratory gating compatibility reduces respiratory motion artifacts during free-breathing renal exams.

Inhance 2D Inflow

The Inhance 2D Inflow pulse sequence is designed to acquire angiographic images of arteries that follow almost a straight path (i.e. femoral, popliteal, and carotid arteries). Arterial blood flow is faster during the systolic phase and slows down during the diastolic phase. Therefore, Inhance 2D Inflow is designed to acquire data during the systolic phase:

- Optimized spatial saturation gap to improve fat suppression and background suppression. With this saturation gap optimization, higher views per segment (vps up to 48 for slow heart-rate) can be used, resulting in significant scan time reduction
- Peripheral Gating that minimizes the pulsatile artifacts
- Optimized view ordering to improve arterial signal
- ASSET acceleration compatibility to reduce scan time

Pediatric Cardiology

ViosWorks

ViosWorks is a 3D cine-based acquisition that can be planned in any dimension and allows for velocity encoding in all directions to assess vascular flow. The acquisition delivers fast imaging with the use of Hyperkat acceleration including both, single and view sharing frames for higher temporal results. Provides high spatial resolution to enable visualization of flow through complex structures.

- 3D cine acquisition in any dimension
- Free-breathing whole chest coverage
- Allows velocity encoding in all directions
- Single and view sharing frames for higher temporal resolution
- Effortless workflow

3D IR Prepared Gated FGRE

3D IR Prepared Gated FGRE is an advanced tool for myocardial assessment. It acquires extensive volumes of data, rather than merely single slices, during breath-holds, with acquisitions gated to the cardiac cycle. The software applies a non-selective inversion-recovery magnetization preparation step to create T1-weighted tissue contrast and suppress the signal from certain tissues.

Pediatric Body

LAVA Flex

LAVA Flex is a 3D FSPGR imaging technique that acquires fat/ water in phase and out of phase echoes in a single acquisition. Up to 4 types of images may be reconstructed within one acquisition: in phase, out of phase, water only, fat only. The water only contrast differs from a conventional fat suppressed image in that an inversion prep pulse is not applied for fat suppression. In fact, the fat information is removed leaving a water only image that may potentially be used in place of a LAVA type image. LAVA Flex uses ARC (Autocalibrating Reconstruction for Cartesian sampling), a 2D self-calibrated parallel imaging technique that allows for acceleration in both phase and slice directions for supported coils.

[‡] MR Scanning has not been established as safe for imaging fetuses or infants. Carefully compare the benefits of MR versus alternative procedures before scanning to control risk to the patient. A physician needs to decide to scan pregnant or infant patients.

SIGNA Voyager Scan Parameters

Operator console

The SIGNA Voyager system comes equipped with a scan control keyboard assembly that contains intercom speaker, microphone and volume controls, and an emergency stop switch. Start-scan, pause-scan, stop-scan, and table advance to isocenter hot keys are also included.

DICOM

The SIGNA Voyager system generates MR Image, Secondary Capture, and Gray Scale Softcopy Presentation State (GSPS) DICOM objects. The DICOM networking supports both send and query retrieve as well as send with storage commit to integrate with the site's PACS archive. DICOM filming support includes both Basic Grayscale and Basic Color Print Service Classes. Additionally, the SIGNA Voyager system supports the CT and PET image objects for display allowing the user to refer to cross-modality studies.

Slice thickness and FOV	
Minimum slice thickness in 2D	0.1 mm
Minimum slice thickness in 3D	0.1 mm
Minimum FOV	5 mm
Maximum FOV	500 mm
Min / Max Matrix	32-1024

2D Fast Spin Echo	
Minimum TR (128x128)	3 ms
Minimum TR (256x256)	4 ms
Minimum TE (128x128)	1.648 ms
Minimum TE (256x256)	2.016 ms
Min slice thickness	0.1 mm
Min ESP 128x128	1.648 ms
Min ESP 256x256	2.016 ms
Max ETL	480

3D Fast Spin Echo	
Minimum TR (128x128)	59.0 ms
Minimum TR (256x256)	59.0 ms
Minimum TE (128x128)	6.0 ms
Minimum TE (256x256)	7.0 ms
Min slice thickness	0.3 mm
Min ESP	2.07 ms
Max ETL	399

2D Fast Gradient Echo	
Minimum TR (64x64)	0.636 ms
Minimum TR (128x128)	0.788 ms
Minimum TR (256x256)	1.064 ms
Minimum TE (64x64)	0.216 ms
Minimum TE (128x128)	0.216 ms
Minimum TE (256x256)	0.220 ms

3D Fast Gradient Echo	
Minimum TR (64x64)	0.6 ms
Minimum TR (128x128)	0.76 ms
Minimum TR (256x256)	1.01 ms
Minimum TE (64x64)	0.2 ms
Minimum TE (128x128)	0.2 ms
Minimum TE (256x256)	0.21 ms

2D Spin Echo	
Minimum TR (128x128)	3.0 ms
Minimum TR (256x256)	4.0 ms
Minimum TE (128x128)	1.68 ms
Minimum TE (256x256)	2.08 ms

3D Fiesta	
Minimum TR (64x64)	1.1 ms
Minimum TR (128x128)	1.38 ms
Minimum TR (256x256)	1.9 ms
Minimum TE (64x64)	0.29 ms
Minimum TE (128x128)	0.38 ms
Minimum TE (256x256)	0.48 ms

Echo Planar Imaging (EPI)	
Minimum TR (64x64)	4.0 ms
Minimum TR (128x128)	5.0 ms
Minimum TR (256x256)	5.0 ms
Minimum TE (64x64)	1.1 ms
Minimum TE (128x128)	1.3 ms
Minimum TE (256x256)	1.6 ms
Minimum FOV	4 cm
ESP at 25 cm FOV	64x64: 0.496 ms 128x128: 0.704 ms 256x256: 1.116 ms
ESP at 48 cm FOV	64x64: 0.352 ms 128x128: 0.492 ms 256x256: 0.704 ms
ESP at 99 cm FOV	64x64: 0.24 ms 128x128: 0.336 ms 256x256: 0.572 ms
Images per second	64x64: 168 128x128: 93 256x256: 52
b value	Maximum (s/mm2): 10,000 Max # for ADC: 40
Diffusion Tensor Directions	Max: 150

Note: Optional software packages may be required to achieve certain specifications above.

Siting and Other Specifications

This section provides an overview of the siting requirements for a SIGNA Voyager. More detailed information is available on request.

Room Layouts	
	System Configuration Minimum Values
Magnet Room WxD Minimum Ceiling Height	3.7 m x 5.8 m 2.5 m (98.5in) min ceiling height
Equipment Room WxD	1.8 m x 2.7 m
Control Room WxD	1.5 m x 2.1 m
Minimum Total Area (M^2)	27m^2

Fringe Field		
	Axial	Radial
0.5 mT (5 Gauss)	4m	2.5 m
0.1 mT (1 Gauss)	5.7m	3.4 m

Installation Dimensions and Weights			
	Width	Height	Weight
Magnet assembly – (not including electronics)	2.1 m	2.4 m	3900kg (8598lbs) with cryogens
Comfort Plus patient table	70 cm (27.5 in)	93 cm (36.61 in)	257 kg (453 lbs)
Control Room Equipment			69.4 kg (153.0 lbs)
MR Equipment			1631 kg (3596 lbs)

Electrical Supply Requirements

Supply system recommended configuration:

- 3-phase grounded WYE with neutral and ground (5-wire system)
- Note: Neutral must be terminated inside main disconnect control

Alternate configuration:

- 3-phase DELTA with ground (4-wire)

Recommend corner grounded Delta configuration

Voltage/Frequency: 480VAC/60Hz. 415, 400, 380VAC/50,60Hz

Power Consumption

SIGNA Voyager is designed with technology that reduces its power footprint. Power consumption is 48% lower than conventional 1.5T systems. Power consumption depends on actual usage. They include consumption by the shield cooler compressor (9 kVA). The following values are approximate and are measured per COCIR standards:

Sleep Mode (a.k.a Power off mode)	5.7kW
Standby (no scan)	11.1kW
Typical Power per COCIR Standards	16.1kW
Maximum Continuous sustained power (> 5 secs)	64 KVA
Peak Instantaneous Power (< 5 secs)	77 KVA

RF Shielding

100dB at 63.86 MHz planewave

Workspace Monitor Position

	Maximum Field Strength
LCD Flat Panel Monitor	5 mT (50 Gauss)

Temperature and Humidity Requirements

	Magnet Room	Control Room	Equipment Room
Temperature	15 - 21 °C	15 - 32 °C	15 - 32 °C
Max. Temperature Change Rate	3 °C / hour	3 °C / hour	3 °C / hour
Humidity (non-condensing)	30 - 60 %	30 - 75 %	30 - 75 %
Max humidity change rate	5% RH/hr	5% RH/hr	5% RH/hr

Altitude Requirements

Lower limit	-30m
Upper limit	2600m

Alternative environments

Modular buildings may also be available (including air-conditioning, heating, chiller, RF shielding, additional magnetic shielding in walls). Contact your local GE representative for GE-certified designs and vendors.

Siting and Other Specifications (continued)

Please ask your local GE project manager for a comprehensive installation and siting manual.

Filming considerations

Filming requires the SIGNA Voyager analog or digital filming.

Interface (purchased separately) unless DICOM Print will be used exclusively for software filming to DICOM Print peripheral devices. An Analog/VDB or Digital/LCAM Camera Interface is typically required for most installations.

Accessory Package

- SPT phantom set with storage cart
- Customer diagnostic software
- Operator manuals
- Patient log books

Emergency stop

Disconnects electrical power from RF and gradient components in the magnet room (duplicate control at the magnet).

Warranty

The published GE warranty in effect on the date of shipment shall apply.

InSite* Remote Diagnostics

GE's unique remote service and applications support including magnet monitoring. Also allows downloading of applications software such as eFlexTrials program.

Miscellaneous

Optional capabilities

Some features and capabilities listed in this data sheet are optional with a SIGNA Voyager and are subject to change without notice. Contact a GE representative for the most recent data.

GE regulatory compliance

The SIGNA Voyager complies with all applicable safety standards, including but not limited to UL60601-1 and IEC60601-1, IEC60601-2-33, IEC60601-1-2 (Electromagnetic Compatibility).

Laser alignment devices contained within this system are appropriately labeled according to the requirements of the FDA's Center for Devices and Radiological Health (CDRH) and IEC 60825-1:2007.

Mobile MR installations

Trailer-compatible configurations are available. Please contact your nearest GE representative for the list of qualified trailer companies and other details.

Imagination at work

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