GE Healthcare

Volume Viewer

GE Healthcare's premium Advanced Visualization and Image Processing platform brings you powerful 3D capabilities to help you visualize and interpret your multimodality imaging data with confidence and ease.

Today's imaging modalities provide a wealth of diagnostic information, but also present a challenge to your Radiology workflow as image volumes continue to increase while your time for reading and reporting decreases.

Volume Viewer provides you with a rich 3D image processing toolset aimed at creating and displaying the views you need with little user input, and streamlining interpretation and reporting by providing the visualization tools you need with minimum clicks.

Now, a refreshed Volume Viewer application with an intuitive, modern user interface helps a wide diversity of users to learn and master the expanding portfolio of sophisticated tools and applications that Volume Viewer provides. This customizable user interface maximizes the real estate allocated for displaying images, and provides access to the users' favorite tools directly from the image viewport. In addition, a customizable toolbar provides one click access to commonly used tools to facilitate a productive review.

Overview

Volume Viewer provides excellent 3D visualization and processing capabilities for reading and comparing CT, MR, 3D X-ray, PET, PET/MR and PET/CT datasets. Volume Viewer also features a broad portfolio of high-performance analysis tools, automating routine tasks and helping to make 3D image processing a stress-free component of your routine workflow.

Volume Viewer is available on VolumeShare 7, a multi-modality advanced visualization workflow solution that helps to enhance diagnostic precision and productivity.

Highlights

- Refreshed user interface with more viewing space for clinical images.
- Simplified and intuitive tools for annotation and measurement.
- Customizable toolbars allowing your favorite tools to be one click away.
- Compare multiple exams from different modalities, at loading and on the fly.
- 3D reformatting, MIP/MPR. High-resolution volume rendering.
- Easy to use point-and-click tools for segmenting structures of interest.
- Comprehensive, one click or two clicks tracking for any vascular structure (Quick Vessel Trace).
- Interactive Summary Table collecting measurements as they are deposited on the images.
- Adaptive layouts that take advantage of the dual monitor capabilities in landscape and portrait orientations.
- Support of Chinese, Japanese, Korean and Russian languages.[1]

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Features

- **Customizable protocol-driven workflows** for a wide range of clinical applications, designed to help enhance your productivity.
- **Refreshed user interface,** allowing one click access to your favorite tools and more space for displaying images. **Keyboard shortcuts** and **quick access tools** for on-viewport controls.
- **Dual monitor and wide monitor** support allowing more viewing space.
- **Fast automated processing**, with Pre-processing and AutoLaunch capabilities.
- **"Smart Compression"** technology for fast and responsive client performance.
- **"Smart layout"**: Enhanced protocols capability, which adapts the screen layout to the loaded datasets.
- **3D and 4D capabilities:** Real time reformat in oblique planes and interactive multiphase cine of CT, MR, PET.
- **Compare mode** for reviewing multiple exams and modalities. **Dynamic Load** lets you can easily drag and drop new series into the current review session.
- **Multi-modality image fusion** between any 2 different series from same exams.
- Extensive set of **2D/3D ROI tools** for quantitative measurements and comparisons.
- **Summary Table** extends reporting capabilities.

- **Multiple Export capabilities**, in different formats, including **Key Image Notes and STL file[1].**
- **Save state[2]** allows save and restore to pause and resume the review at a later time.
- **High resolution, real-time rendering modes**: Volume Rendering views; Enhanced rendering of structures with high/low contrast (creation of MIP/MinIP images); Navigator view for endoluminal fly-through; lumen and curved views. Creation of **multiple volume rendered models** that may be merged into a single view.
- **Advanced tools,** to take advantage of full 3D capabilities**: AutoSelect**, allowing easy point-and-click segmentation of blood vessels and other structures of interest; **AutoContour** feature for one click contouring of findings and regions of interest on CT, MR and PET images; One or two clicks **Quick Vessel Trace** to analyze all vessels, in curved reformat, lumen, or MPR view.
- **Filters** to enhance and smooth CT images to help improve image quality.
- **Dual energy GE Healthcare CT images** supported with dedicated protocols for review.
- **MR Review** supported with dedicated features**:** Recognition of PSD name, and specific MR parameters at image loading.
- **SUV measurements** on PET images, for 2D and 3D ROIs, and for iso-contour VOI.
- Dedicated review protocols **for PET/CT** and **PET/MR images**.
- Dedicated features for **3D XA images**

System Requirements

- AW Server 3.1 and above and recommended monitor resolution is up to dual 2MP (1600 x 1200) or a single 3MP (1536 x 2048)
- AW VolumeShare7 Workstation and above
- Centricity™ Universal Viewer[3]

Indications for Use

Volume Viewer is a medical diagnostic software that allows the processing, review, analysis and communication of 3D reconstructed images and their relationship to originally acquired images from CT, MR, X-Ray Angiography and PET Scanning devices. The combination of acquired images, reconstructed images, annotations and measurements performed by the clinician are intended to provide to the referring physician clinically relevant information for diagnosis, surgery and treatment planning.

Regulatory compliance

This product complies with the European Council Directive 93/42/EEC Medical Device Directive as amended by European Council Directive 2007/47/EC.

[1] This feature is not available on AW Server 3.1.
[2] Save State is a Volume Viewer feature allowing the creation of a new series in the database, storing the exam in its current review state with any user-generated post-processing data, for future use.
[3] AW Server 3.1 is not compatible with Centricity Universal Viewer.

GE imagination at work

Volume Viewer

Detailed Features

- Customizable protocol-driven workflows for a wide range of clinical applications, including support for multiple review steps. You are guided through the review steps by a Navigation bar at the top of the User Interface.

Protocol management and loading with "My Protocols"

- Review protocols created with Volume Viewer can be saved as favorite protocols by clicking "My Protocol". The protocol selection page can be filtered to show "My Protocols" only.
- Standard review protocols are provided and can be launched directly from the AW Server applications menu.
  Progressive Load enhances image loading performance. This feature has two modes:
  (1) Images are loaded in sequential mode (e.g., Reformat)
  (2) Images are loaded in interlaced mode (e.g., 3D/VR)
  In either case, image review can begin as soon as the first image is displayed.
- Navigation through series and exams can be performed without exiting to the patient list.

Simple user interface

- The refreshed user interface provides one click access to favorite tools and more space for clinical images.
- The page layout is organized to facilitate navigation through the review steps. Guided protocols consisting of several Review Steps walk the unfamiliar user through a clear workflow of creating and manipulating volumetric data, helping to reduce the learning curve by providing a consistent workflow.
- A customizable toolbar is displayed by default at the top of the user interface, but can be docked at the left, right, or bottom instead, by a simple drag & drop. A user's preferred location is saved for future use.
- The toolbar may be customized with a user's choice of favorite tools for one click access.
- An extensive set of advanced tools are grouped into categories on the toolbar to facilitate quick retrieval when needed.
- Every menu is easily configurable by a simple drag & drop in the Toolbar ... so that they are only one click away for your future reviews!

- To reduce long mouse trips, favorite tools are also accessible from each image via a right mouse menu that may be configured with up to 6 favorite tools.
- Customization of the toolbar and tool behaviors with a user's preferences is provided in a single intuitive Preferences menu on the top navigation bar.

The following mouse modes are available to help you manipulate the images:
- Interactive VR adjustment lets you adjust VR opacity interactively with the mouse as Window Level/Window Width
- Direct Paging – just press the left mouse button
- Free hand rotation on 3D views
- Free hand rotation centered on cursor for oblique views
- Percentage fusion mouse mode to easily change the transparency of objects on fused images. There are several fusion modes available for your use.
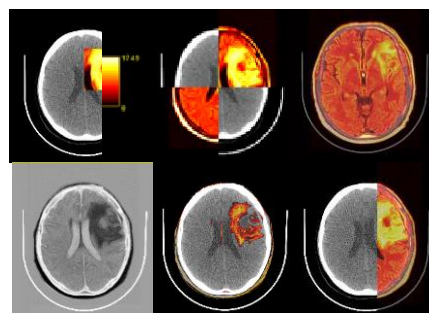
- Mag glass mouse mode displays zoomed-up imagery around the cursor.

Dual monitor and wide monitor support

- Volume Viewer provides a comprehensive list of layouts that automatically adapt to the monitor configuration.
- You can use landscape or portraits monitors.

Workflow enhancements

Pre-processing[4] features on AW Server

- Preprocessing is a Volume Viewer feature that automatically performs routine processing tasks and saves the results so they are ready for you. When new exams are transferred to the database, Volume Viewer recognizes user-defined keywords in the Series Description and launches the appropriate pre-processing. The results are stored in a Save State object with the original study so you can load it when you are ready for review.

AutoLaunch[4] features on AW workstation

- AutoLaunch is a Volume Viewer feature that automatically launches and preloads exams, so they are ready for your review.
- When you are processing a study and a new exam is transferred to the AW Workstation, this feature automatically launches the new exam with an appropriate Volume Viewer protocol in the background. When you are ready, one click in the AutoLaunch window instantly brings up the exam in the Volume Viewer application, eliminating waiting time and extra steps to load the exam into computer memory for processing.
- AutoLaunch is compatible with CT, MR and PET single volume protocols of Volume Viewer.
- When combined with optional applications[4], this feature gives access to data already preprocessed, that you can review by just clicking on AutoLaunch window.

Smart compression

- The Smart Compression technology automatically displays images with full fidelity when the image is still, then uses the selected compression level for increased interaction speed during user manipulations. This allows for diagnostic reads on full fidelity static images with responsive dynamic display even at low bandwidth. On-image visual indicators notify the user when compression is in effect.

Smart layout

- Volume Viewer General Review protocol presents an adaptive layout for single and multi-modality PACS-like reading of data. This protocol distributes and displays all loaded series of a single exam in an intelligent layout to maximize use of available monitor space. With multiple exams, the protocol automatically detects and distributes "like" series for optimal comparison.
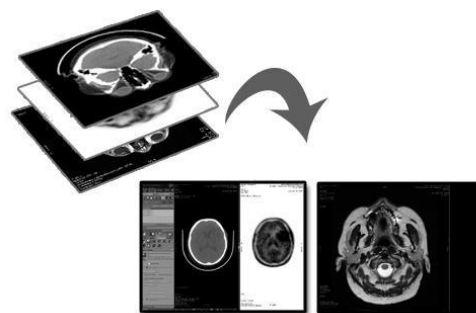
3D and 4D capabilities

- Volume Viewer allows 3D point synchronization in any orientation on the fly.
- Real time reformat in oblique planes is available for your exams, as well as simple and double oblique interactive modes.
- To simplify and improve exam screening, Volume Viewer provides an interactive viewport control that lets you perform the following functions: Continuous or contiguous slice paging; slice thickness adjustment and rendering mode (MIP, MinIP, Average, Volume Rendering).
- Quick access to cross reference display gives you the ability to display the current slice location or all slices, on other planes.
- You can review images in 4D mode, by using Cine tool on all planes and 3D views for CT, MR, and PET multiphase data.

Compare mode

- With Volume Viewer you can load several volumes either from the same exam or from different exams. This is useful for exam comparison (Compare Mode) or for Multiphase examinations (of the liver for example). The Compare Mode is also available for PET/CT examinations and takes advantage of a dual screen configuration.
- Multi-phase CT and MR data are listed as separate phases in the Series Selection screen, allowing you to select all phases or a subset of phase data for review. The Series Selection Panel displays the multi-phase data split into arterial and portal phases, for example.
- **Dynamic Load**, compatible with both Volume Viewer and Fusion protocols, lets you drag & drop 3D volumes from CT, MR, PET, and 3D XA modalities into a desired viewport. Together with the Integrated

Registration option[5], Dynamic Load allows new volumes to be registered and loaded on the fly. Save State series can be restored as a separate session. For dual monitor configurations, a Save State series can be displayed on the right monitor together with a current session on the left monitor. For single monitor configurations, a user may simply switch between the two sessions.

- The zoom and pan functions are propagated to all images displayed in the same orientation.

2D/3D ROI tools for quantitative measurements

- Volume Viewer contains a set of basic 2D/3D tools: distance, angle, report cursor, arrow tool, annotation, free hand ROI tool, that can be placed on fused images as well.
- You can easily deposit and label measurements.
- All 3D ROIs can be customized and color coded to display statistics computed on different intensity range.

- All measurements are considered bookmarks and you can navigate through the list by using the markers displayed in the slider of each image.

Summary table

- The Summary Table collects measurements and organizes them according to finding and exam date.

- The Summary Table allows you to automatically navigate through findings in the image viewports and can be docked or expanded.

Export capabilities

Volume Viewer contains multiple standard options for exporting the results of a review session:

- Save images to the database, as new series
- Save the significant images as Key Image Note objects in the database. Key Image Notes and End Review allow you to flag images of interest as Key Image Notes (IHE profile) and push them to the archiving system when you exit the application.
- Save State object helps you to save the work and create a new series containing all the post processing data, for future review. It saves the current status of Volume Viewer (3D Model, displays, measurements, annotations, etc), as an additional series in the same exam.
- Save STL file from 3D model, so that you can use it for 3D printing[1].

The following features are available to create the sequence of the images to be exported:

- The Batch allows creating of a sequence of rotating 3D views, or batch of reformatted images.
- The Movie tool creates a comprehensive movie including different rotations, zooms, and pan of the image, which can be exported as DICOM series or mpeg file.
- Quick Export: Exports in a single click a batch of rotations of a 3D View or a full batch of contiguous images at the displayed thickness for 2D images.
- Cardiac Review and Export: Processing and reviewing cardiac exams for CT, MR and PET with manual oblique reformatted protocols can be exported into a multi-phase Cine movie that allows the referring physician to review the exam in a dynamic mode.
- Capture images on the fly on your computer via standard Ctrl+C /Ctrl+V (on AW Server only).

Advanced visualization capabilities

Volume Viewer offers various capabilities to display advanced rendering modes:

- 3D Volume Rendering images.
- MPR views with different slice thickness. The following rendering modes are available for all Thick Slab: MIP, MinIP, Volume Rendering, Average.
- Navigator views which display interactive endoluminal views exportable as movies.
- Curvilinear reformatting allowing display of curved, lumen and cross section views for various structures (vessels, spine, etc).

Predefined cut planes

Volume Viewer lets the user define cut planes in order to isolate certain structures in the VR model, in the following 16 configurations:

- Left / Right / Inferior / Superior / Anterior / Posterior / Front
- Left and Right Anterior Superior / Anterior Inferior
- Left and Right Posterior Superior/ Posterior Inferior

You can then display the voxels values on each plane.

Multiple VR objects

- Volume Viewer allows you to merge up to 8 Volume Rendered models into a single 3D view.
- You can adjust independently the threshold, colors, and transparency of each VR model.
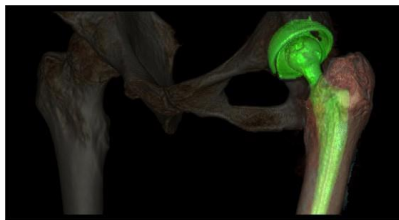

Auto-center fly through with smart cursor

- In fly-through in air or vessel contrast studies (airways, colon, angiography) you can automatically navigate along the centerline of the structure of interest, simply by pressing the forward or the backward key. You can save the fly-through movie with a simple click.
- In addition to the regular 180° or less Navigator view, Volume Viewer enables a Fish-Eye View with any wide camera angle value from 180° to 360°. This provides a view of structures both in front of and behind the users' virtual location on the same image.
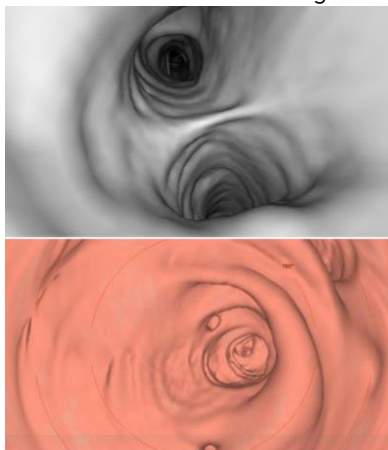
Lumen view

- Lumen View provides an unfolded 3D view of a previously outlined structure. The lumen view can be interactively rotated around the centerline of the structure and set the width and field of view.
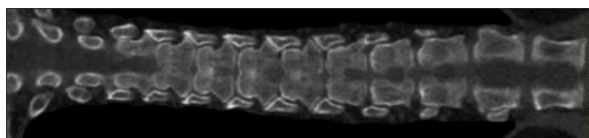
Advanced 3D tools

Segmentation tools

- Point and click the AutoSelect segmentation tool to add or remove any continuous structures of interest, including bone and vessel structures for CT and vessel structures for MR. It is also possible to remove the CT couch from images with one click.
- You can also access advanced segmentation tools such as Scalpel, Threshold, Dilate, Erode, Subtraction, Intersection, Addition, Filter Floaters.

AutoContour tool

- Autocontour gives you consistent tools for multi-modality review and comparison: the same contouring tool with the same workflow supports CT, MR, and PET images.

- For CT and MR images, the contouring tool will suggest contour boundaries of structures and let you edit and validate the result.
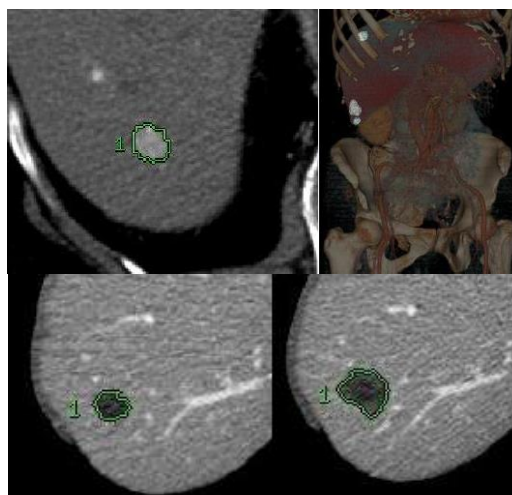
- For PET images, the contouring tool has been adapted for standard SUV calculations.
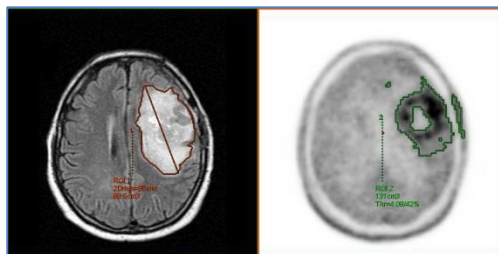
Quick vessel trace (CT and MR images)

- You can perform vessel analysis with one or two point clicks from any CT or MR Angiography images.
- When you deposit one point, the program automatically extracts the vessel and launches vessel tracking for fast review in curved reformat, cross-sectional, best L-section, lumen, and MRP view.
- You can extend tracking proximally or distally for a full view of the vessel.
- If you detect a lesion, you can quickly analyze it by dropping just one point above and one below the vessel section. The vessel tracking launches automatically.

CT image quality

- Enhancing and smoothing filters are provided to help improve CT image quality for review.
- The lung filter helps enhance contours of images reconstructed in standard mode for excellent visualization of lung structures.

STD Recon w/o Filter   STD Recon with lung Filter
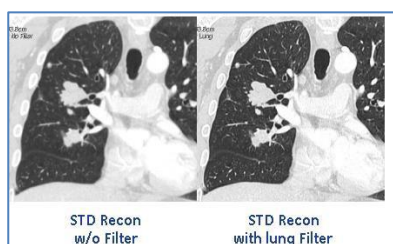
- A smoothing filter reduces noise while maintaining high image contrast:
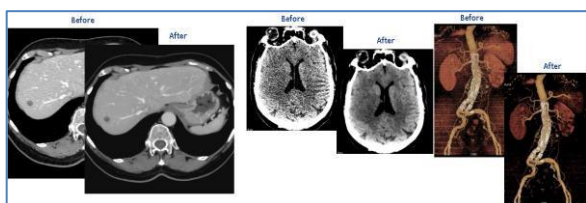
Dual energy protocols

Three protocols are available to enable review of dual energy images acquired on compatible GE Healthcare scanners:

- **DE Calcium** enhances pixels with ratio $(HU_{80}/HU_{140}) \geq 1.25$
- **DE Uric Acid** enhances pixels with ratio $(HU_{80}/HU_{140}) \leq 1.25$
- **DE Custom** enhances pixels with customized ratio (HU_{Low}/HU_{High})

Review of MR studies

Volume Viewer offers support for review of MR studies, through dedicated protocols that can be selected as My Protocol.

- The MR-specific parameters (PSD name, image weighting, scan plane, etc) are recognized at loading and are used to automatically organize the display by sequence in a specific viewport in the layout.
- Anatomy-based protocols for standardized review (e.g. spine, brain stroke...) thanks to guided layouts with display intelligence to help analyze MR data
- Dedicated MR Cardiac Viewer for single and multiple Cine Review. Enables comparison between cardiac series such as Time Course and Myocardial Delayed Enhancement (MDE) images.
- Supports MR Multi Echo, Multiphase, Diffusion series.
- Supports review of parametric series (e.g., ADC, MTT, and other parametric maps) created in READY View or Functool[6] and enables direct measurement on functional maps.
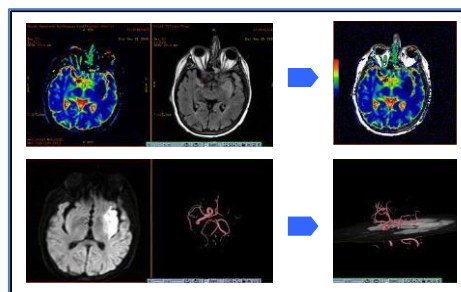

- 2D and 3D ROI propagation to other phases / series / exams allowing you to easily correlate information from multiple sources.
- Improved MR annotation consistency.
- In combination with Integrated Registration[3], enables direct access to MR image registration (inter/intra exam), image fusion and Whole Body MR Review protocols
- Ability to automatically bind several MR axial series corresponding to sequential axial locations into a single series. This may be displayed as sagittal or coronal reformats. This is useful for consolidating multi-stage acquisitions for displaying Whole Body MR scanning.

SUV measurements on PET images

- Volume Viewer supports Standardized Uptake Values (SUV) for image display and measurement. Several SUV scales are available by right-clicking the unit on–view annotation: SUVbw, SUV lbm, SUVbsa, as well as SUV Peak.
- Window/level presets may be user-defined in SUV.
- When DICOM information necessary for SUV calculation (eg height, weight) is missing from the original images, you can enter it and compute SUV values on the fly.
- The SUV values are available in all the basic 2D/3D ROI tools of Volume Viewer and in the thresholded VOI tool.
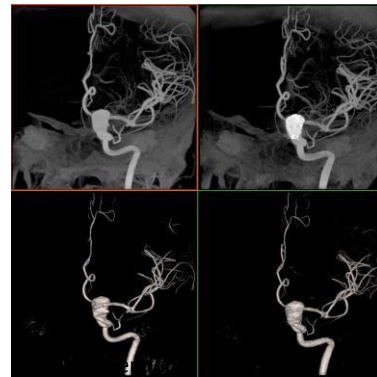
PET/CT and PET/MR dedicated protocols

- Volume Viewer contains a list of predefined protocols allowing the review of PET/CT and PET/MR data. The screen layouts contain fused views between the morphological and functional image, 3DMIP rendering of PET images.
- PET 4D protocol allows users to load and display gated and dynamic PET series.
- Factory protocols are customizable for your own review.
- Summing/Reframing tool allows you to Reframe/Rebin series for Dynamic and Gated PET data[1].
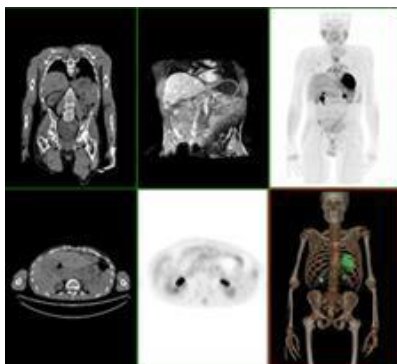
Dedicated features for 3D XA images

The optional Innova 3D XR application produces XA images (512x512 images or 256x256 images depending on your settings). This format opens the Volume Viewer world to Innova 3D images:

- Single exam: Innova Navigator, Curved Reformat, Multi Oblique, MPVR 3mm Average, Segment Structure
- Compare exam: Compare Axial, Compare Coronal, Compare Sagittal, Reformat
- Create your layouts and protocols
- The Innova options provide access to Workflow booster tools, easy multi-modality review "on-the-fly" dedicated Innova review protocols with dedicated Review Steps.

Summary of Operation

- Volumetric models are loaded by selecting the exam or series. The user can select a protocol category from an anatomical selector or go directly to a Review Layout. In either case, images are loaded progressively in the background; this gives control to the user in just a few seconds after selecting the images. Selecting a Review Layout launches a volumetric display protocol with predefined layout preferences. Review Layouts may be saved and combined to suit the user's workflow. Selecting a protocol category unlocks a variety of visual protocols that include the layout, threshold, rendering mode and filming formats. Some of these protocols direct the user through the process providing capabilities to interactively view and manipulate the model, increasing productivity and consistency for all modalities.

References

[4] Preprocessing/AutoLaunch is compatible with the following purchasable options: AutoBone™ Xpress, CardIQ Xpress Reveal, CardIQ Xpress Function, Advanced CTC Pro 3D EC, Colon VCAR, CT Perfusion 4D. ColonVCAR is not for sale in the US.

[5] Integrated Registration is a GE Healthcare product, sold separately.

[6] READY View and Functool are GE Healthcare products, sold separately.

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