GE Healthcare

Volume Viewer

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

AutoLaunch

Preprocessing enabler

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.

With an intuitive, modern user interface, Volume Viewer helps a wide diversity of users to learn and master the expanding portfolio of sophisticated tools and applications that it 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

- **Customizable protocol-driven workflows** supporting **CT, MR, PET** and **Innova 3D XA** modalities, designed to help enhance your clinical review productivity
- **Compare** multiple exams from **different modalities**, at **loading[2]** and **on the fly[2]**
- **Adaptive layouts** that take advantage of the dual monitor capabilities in landscape and portrait orientations
- **Easy** point-and-click **segmentation tools** for segmenting structures of interest
- **CT Dual Energy** and **GSI[4]** support with dedicated workflows and tools
- Advanced **4D PET** support with **Q.Freeze[6]** tool and **4D PET Dynamic** workflow
- **Interactive Summary Table** collecting measurements as they are deposited on the images.
- Rich set of **export tools** including export for **3D printing[3]**.

General Features

- **Unified user interface,** with one click access to your favorite tools and more space for displaying images.
- **Customizable protocol-driven workflows** designed to help enhance your clinical review productivity for a wide range of care areas, with 3D and 4D real time interaction.
- **"Smart layout"** protocol, which adapts the screen layout to the type of loaded exams.
- **High resolution, real-time rendering modes**: MIP/Min IP/Average; standard volume rendering and enhanced volume rendering with Volume Illumination[1] on the fly; Navigator view for endoluminal fly-through; lumen and curved views.
- **Compare mode** for reviewing multiple exams and modalities, simplified with **Dynamic Load to load and register[2]** new series into the current review session.
- Rich set of **2D/3D ROI** tools, including **AutoContour** for 3D semi-automatic contouring of structures of interest (CT, MR, PET), and **ROI color coded** for tissue classification based on voxel values.
- **Advanced tools,** to take advantage of full 3D capabilities**: AutoSelect**, for easy point-and-click segmentation; One or two clicks **Quick Vessel Trace** to analyze all vessels, in curved reformat, lumen, or MPR view; Advanced 3D processing tools.
- **Summary Table** extends reporting capabilities, while collecting measurements as they are deposited on the images.

- **Multiple Export capabilities**, in different DICOM and non-DICOM formats, including **Key Image Notes**.
- **3D Suite[3]:** STL, OBJ, VRML and 3MF file formats to export single or multi mesh objects, for 3D printing. 3D Suite is not intended for clinical use.
- **Save state**, which allows to save and restore to pause and resume the review at a later time or to facilitate collaboration workflows.

Modality Features

- **Dual energy and GSI[4] GE Healthcare CT images** supported with dedicated review protocols.
- **Bone VCAR[5]** combines spine labelling on the fly for all CT review and a dedicated layout to improve spine review.
- **MR review** support**:** Recognition of PSD name, and specific MR parameters at image loading, which simplifies protocol customization.
- Dedicated review workflows for **PET/CT** and **PET/MR** images, including **PET SUV measurements**.
- **Q.Freeze[6]** combines the quantitative benefits of **4D PET gated** imaging into an image that provides both frozen patient motion and reduced image noise.
- Dedicated protocol-driven workflows for **Innova 3D XA images[9].**

Platform features

- **"Smart Compression"** technology for fast and responsive client performance on AW Server.
- Fast automated **Pre-processing[7]**

- Multi-sessions switch on AW workstation with **AutoLaunch[8]**.
- Support of **Chinese**, **Japanese**, **Korean** and **Russian** languages.

System Requirements

- AW Server 3.2 and above, with recommended monitor resolution up to dual 2MP or single 3MP.
- AW 4.7 Workstation and above (some performances limitations can occur with Z800)
- Centricity™ Universal Viewer

Intended use / 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. This product or its feature may not be available in some other countries or regions. Please contact your sale associate.

Rx Only

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[1]Requires *Volume Illumination* license
  Volume Illumination may not be available in all countries or regions.
  Please contact your sale associate.
[2]Requires *Integrated Registration* license
[3]Requires 3D Suite license
[4] Requires *Volume Viewer GSI* license
[5] Requires Bone VCAR license
[6]Requires *Q.Freeze* license
[7]Preprocessing is compatible with the following purchasable options: *AutoBone™ Xpress, CardIQ Xpress Reveal, CardIQ Xpress Function, CardIQ Xpress Process, Advanced CTC Pro 3D EC, Colon VCAR*, and *CT Perfusion 4D* and *FastStroke. ColonVCAR* is not for sale in the US.
[8]Requires *AutoLaunch* license for AW workstation
[9]Requires *Innova Volume Viewer* license

Volume Viewer

General Features

Unified user interface

- The 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 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.
- The customizable toolbar can be docked at the top, bottom, left, or right, by a simple drag & drop. This preferred location is saved for future use for each user.
- An extensive set of advanced tools are grouped into categories on the toolbar to facilitate quick retrieval when needed.
- Each category and tool are 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, up to 6 favorite tools can be accessible from each image via a right mouse menu.
- Customization of the toolbar and tool behaviors with a user's preferences is provided in a single intuitive Preferences menu.
- Keyboard shortcuts and quick access tools for on-viewport controls

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 (continuous or contiguous)
- Free hand rotation on 3D and oblique views
- Percentage fusion, to easily change the transparency of objects on fused images. There are several fusion modes available for your use.
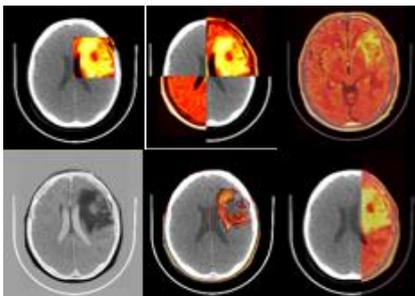
- Mag glass displays zoomed-up imagery around the cursor.

Protocol management and loading

- 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.
- Review protocols created by user with Volume Viewer can be saved as favorite protocols and accessed easily in routine.
- Progressive Load enhances image loading performance. This feature has two modes:
  - Images are loaded in sequential mode (e.g., Reformat)
  - 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 the patient list.

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.

Advanced visualization capabilities

Volume Viewer offers various capabilities to display advanced rendering modes:
- 3D Volume Rendering / Volume Illumination[1] images
- MPR views with different slice thickness. The following rendering modes are available for all Thick Slab: MIP, Min IP, 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).
- Merge multiple volume rendered models into a single view.

Volume Rendering   Volume Illumination

Predefined cut planes

Volume Viewer lets the user define cut planes to isolate specific structures in the VR model, in 16 configurations, including Left / Right / Inferior / Superior / Anterior / Posterior / Front.
You can then display the voxels values on each plane.

Multiple Volume Rendering and Volume Illumination[1] objects

- Volume Viewer allows you to merge up to 8 Volume Rendered models from the same series into a single 3D view.
- You can adjust independently the threshold, colors, and transparency of each Volume Rendering or Volume Illumination
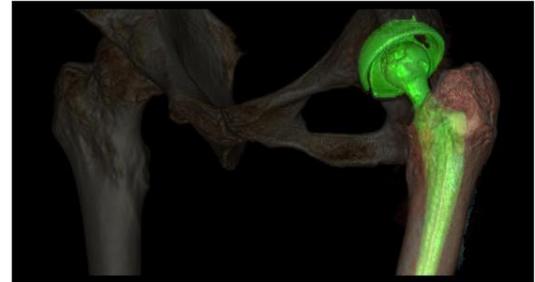

Auto-center fly through with smart cursor

- In fly-through studies (airways, colon, angiography navigation along the centerline of the structure of interest can be recorded step by step and can be exported as a movie.
- 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.
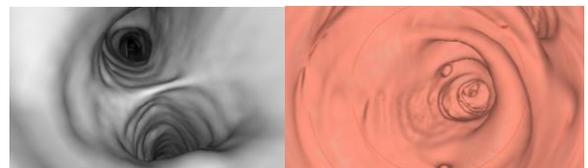
Lumen view

- Lumen View provides an unfolded 3D view around a user defined centerline. The lumen view can be interactively adjusted (rotation around the centerline, width, field of view).
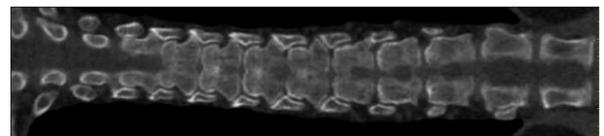
3D and 4D capabilities

- Volume Viewer allows 3D cursor 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.
- Quick access to cross reference display gives you the ability to display the current slice location or all slices, or other planes.
- Real time interaction 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 several volumes can be loaded 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 selection of 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[2] option, 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 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.
- Easy deposition and labelling of measurements.
- All 3D ROIs can be customized, and color coded to display statistics computed on different intensity range and help assessing tissue classification based on voxel values.
- All measurements are considered bookmarks and can be accessed by navigating through the list of measurements.

AutoContour tool

- AutoContour provides consistent tools for 3D contouring ROI, with the same workflow used for CT, MR, and PET images.
- For CT and MR images, the contouring tool will suggest contour boundaries after defining 1 point or a diameter on a structure of interest, which can be edited prior to validation.
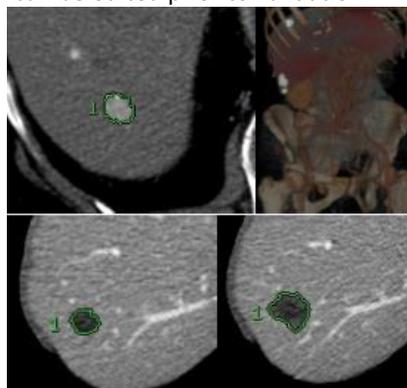
- For PET images, the contouring tool has been adapted for standard SUV calculations.
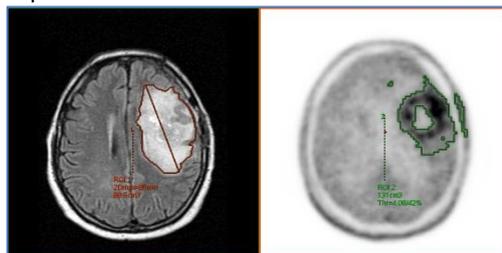
Advanced 3D tools

Segmentation tools

- AutoSelect segmentation tool helps adding or removing any continuous structures of interest by simple point and click.
- You can also access advanced segmentation tools such as Scalpel, Threshold, Dilate, Erode, Subtraction, Intersection, Addition, Filter Floaters.

Quick Vessel Trace (CT and MR images)

- You can perform vessel analysis with one or two points clicks from any CT or MR Angiography images.
- Quick Vessel Trace automatically extracts the vessel after user clicks and launches vessel tracking for fast review in curved reformat, cross-sectional, best L-section, lumen, and MRP view.

- Tracking can be extended proximally or distally for a full view of the vessel.

Summary table

- The Summary Table collects measurements and organizes them according to finding and exam date.
- The Summary Table allows interactive navigation through findings in the image viewports and can be docked or expanded.
- The Summary Table can be copied into the client clipboard and then pasted in email, reports, office software etc. (on AWS only)

Export capabilities

Volume Viewer contains multiple standard options for exporting the results of a review session:
- Save images to the database, as new DICOM 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 are used to save the work in a new series containing all the post processing data (3D Model, displays, measurements, annotations, etc), for future review.
- Save STL, OBJ, VRML or 3MF file from 3D Volume Rendering / Volume Illumination[1] viewport for 3D printing purposes through 3D Suite[3]

Additional export tools are available to create specific sequences of images to be exported:
- The Batch tool allows creating a sequence of reformatted images or a sequence of rotating 3D views.
- 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 full batch of contiguous images at the displayed thickness for 2D images, or a batch of rotations of a 3D View.
- 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 and send images from the viewport to your computer clipboard on the fly (Crtl+C/Ctrl+V on AW Server only).

## Modality Features

CT image quality

- CT filters to enhance or smooth CT images to help improve image quality on the fly.
- The lung filter helps enhance contours of images reconstructed in standard mode for excellent visualization of lung structures
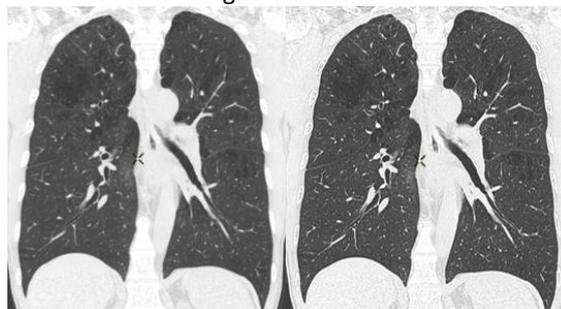
Standard recon w/o filter   Standard recon with Lung filter

- A smoothing filter reduces noise while maintaining high image contrast.
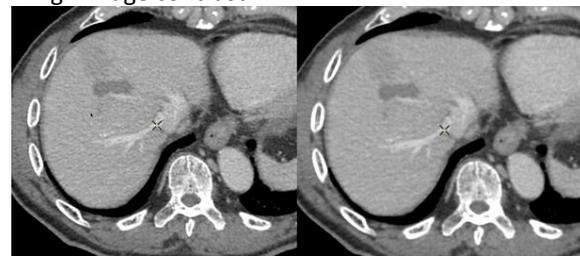
No filter   Smooth filter

No filter   Smooth 3D+ filter

CT Dual energy protocols

- Three protocols are available to enable review of dual energy images acquired on compatible GE Healthcare scanners and enhancing pixels with specific ratio: **DE Calcium** ($HU_{80}/HU_{140} \geq 1.25$), **DE Uric Acid** ($HU_{80}/HU_{140} \leq 1.25$) and **DE Custom** (cutstom threshold on HU_{Low}/HU_{High}).

- In addition, all Volume Viewer standard protocols are compatible with GSI[4] GE Healthcare CT images.

Bone VCAR[5]

- Bone VCAR is available in Volume Viewer toolbar and can be launched on the fly
- Vertebrae are automatically recognized and labelled (deep learning algorithm)
- A dedicated protocol provides a specific layout of the spine including curved views

Review of MR studies

Volume Viewer offers support for review of MR studies, through dedicated protocols.

- The MR-specific parameters (PSD name, image weighting, scan plane, etc) are recognized at loading and are used to customize the layout display.
- Anatomy-based protocols for standard review (e.g. spine, brain stroke…), with dedicated and guided review steps, to help review standard MR exams.
- 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.
- Support of MR Multi Echo, Multiphase, Diffusion series.
- Support of parametric series (e.g., ADC, MTT, and other parametric maps) created in READY View, allowing direct functional measurements.
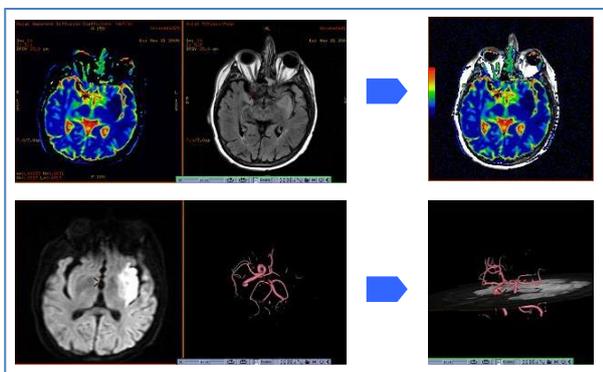

- 2D and 3D ROI propagation to other phases / series / exams allowing you to easily correlate information from multiple sources.
- Improved MR annotation consistency.
- In combination with Integrated Registration[2], enables direct access to MR image registration (inter/intra exam), image fusion and Whole Body MR Review protocols
- Ability to automatically bind several MR axial series corresponding to sequential axial locations into a single series. This 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 measurements. Several SUV scales are available like SUVbw, SUV lbm, SUVbsa, as well as SUV Peak.
- Window/level presets may be user-defined for PET images based on SUV values.
- The SUV values are available in all the basic 2D/3D ROI tools of Volume Viewer and in the AutoContour 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 images, as well as 3DMIP rendering of PET images.
- Factory protocols are customizable for your own review.
- PET 4D protocol allows users to load and display gated and dynamic PET series, as well as summing or reframing these series.
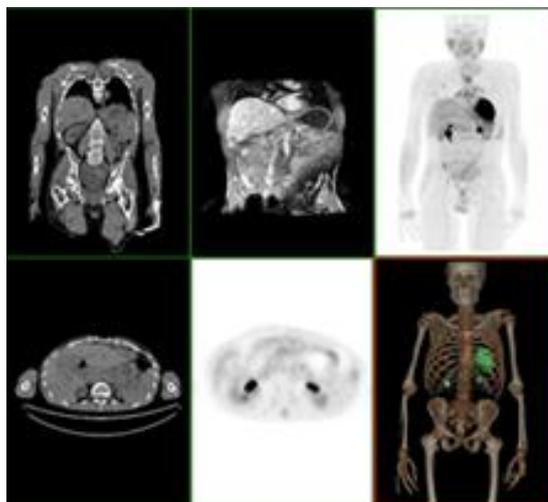
PET IQ improvements

- Enhanced 3D visualization algorithm to fully support Q.Clear PET images.
- Q.Freeze[6] option provides a respiratory motion-corrected Gated PET volume, statistically similar to conventional static PET with significantly reduced or eliminated blurring effects due to patient respiration. It provides also a corrected Gated PET series where counts are summed back to each respiratory phase.

Dedicated features for 3D XA images[9]

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 XA images:

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

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 interaction. 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.

Pre-processing[7] 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[8] features on AW workstation

- AutoLaunch is a Volume Viewer feature that automatically 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[8], this feature gives access to data already preprocessed, that you can review by just clicking on AutoLaunch window.

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 customized 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

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[9]Requires *Innova Volume Viewer* license

GE imagination at work