



GE HealthCare

Integrated Registration

Multi-modality image management

In radiology practice today, multiple complementary imaging modalities are frequently relied on to image the same patient, as each modality provides unique anatomical and physiological information. Three dimensional (3D) modalities such as computed tomography (CT) and magnetic resonance imaging (MRI) provide information about the relationship of anomalous findings to surrounding structures and tissues.

The Integrated Registration application provides you with a streamlined workflow to combine and display images from any two of the five major modalities (CT, MRI, positron emissions tomography (PET), single-photon emission computed tomography (SPECT) and X-ray angiography (XA)—aimed at improving your ability to provide more clinically relevant diagnostic information and improving surgical and treatment planning.



Overview

- Integrated Registration provides you with the capability to align and fuse two volumetric acquisitions from either the same or different acquisition modalities. With it, you can easily compare 3D anatomical images from CT, MRI with PET, SPECT and XA¹ for a comprehensive analysis.
- Integrated Registration is available on VolumeShare 7, a multi-modality advanced visualization workflow solution that helps to enhance diagnostic precision and productivity.



Highlights

- Load and register on the fly with drag and drop
- Easy registration using automatic, manual and landmark methods
- Multiple 2D and 3D fusion capabilities
- Automatic registration propagation across series and one-click access to pre-defined protocols
- Rigid and deformable registration
- Drawing and saving of contours as RTSS DICOM objects
- Access to regional registration on the fly for an easy review of challenging areas
- Compatible with AdvantageSim™ MD and other standard treatment planning software

Features

- ✓ Allows you to load exams and series from CT, MRI, PET, SPECT or XA together for registration in the same session
- ✓ Offers you a choice of four automatic registration methods
- ✓ Allows you to customize screen layouts to suit your review needs and provides comparison of a current exam with previous exams to let you evaluate disease progression and treatment efficacy
- ✓ Combines functional and anatomical images from different modalities, providing you with enhanced perspective of the area of interest
- ✓ Allows you to define one or more contours around relevant anatomy and save them as RTSS DICOM objects
- ✓ Provides you the ability to save registered data as a new DICOM series or as a registration DICOM object (does not include SPECT)
- ✓ Define volume of interest in one model for automatic report to another model for subsequent use in Radiation Therapy (RT) planning²

Feature details

Loading

Integrated Registration allows you to load multiple exams and series from CT, MRI, PET, SPECT or XA for registration in the same session. Within an open registration protocol session, you can easily add additional series using a simple drag and drop method. You can also choose to have the registration protocol run automatically at loading or dynamic loading. Reference and Moving series are preselected; however, you can easily control and adjust these selections.

Registration

With Integrated Registration, you can employ four rigid registration methods:

- Automatic registration based on “mutual information” and “matching boundaries” for CT, MR, PET or XA. (SPECT can only be registered using manual and landmark registration)
- Automatic regional registration, which can be run by defining a region of interest (ROI) upon which the registration methods (listed above) are applied only within the designated boundaries
- Interactive manual registration, which, in real time, conveys translation and rotation made to the alignment of one data set to the second data set. This method can be used with all modality pair combinations.
- Landmark registration, which is based on manual definition of common points between the two data sets. This method can be used with all modality pair combinations.

You can combine these four methods to achieve optimal results. The methods allow registration of volumes with linear FOV rescaling and 6 degrees of freedom (translation and rotation).

Non-rigid automatic registration can be employed for CT to CT data sets only. The non-rigid transformation of the CT series can then be propagated to any other MR, PET, SPECT, or XA series.

Global registrations are possible for both rigid and non-rigid registrations. Rigid registration also benefits from regionally optimized registration using an ROI.

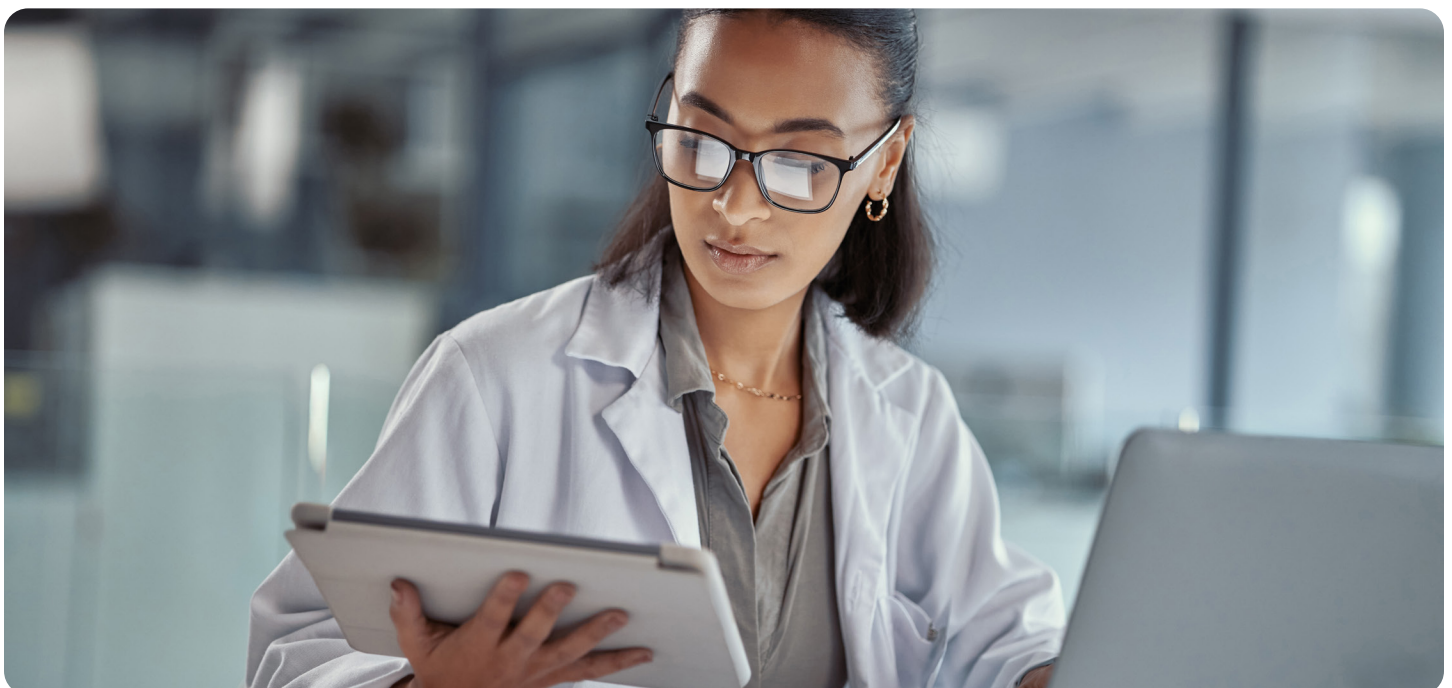
Multiple series acquired in the same exam (i.e., with the same frame of reference) are grouped together and registration that is applied to one series of the group is automatically propagated to other series of the same group by default. You can manually group or ungroup series if desired. Propagation will then be applied to manually grouped series while ungrouped series may be registered independent of their original group. Use manual ungrouping specifically to independently register series of one identical exam during which the patient has moved.

The Center, Reset and Undo/Redo options improve productivity during the registration process.

Quality control

Two methods are available to validate the accuracy of the registration:

- Qualitatively by visually inspecting registration results using all available display modes (see Visualization below)
- Quantitatively by defining pairs of common landmarks on the two exams. This includes calculation of the Maximal Error on a pair and the Root Mean Square (RMS) error on all pairs



Visualization

Optimized screen layouts are provided by default and you can also customize them to suit your needs.

The common cursor, active by default, provides a triangulated display in which the cursor is positioned at the same geometrical coordinates in all views.

You can apply dedicated display modes to fused views during your review:

Windows	An adjustable viewing window of the registered exam that can be moved anywhere over the reference exam and shows the corresponding part of the moving exam.
Tiles	The selected view is subdivided into four tiles that meet at the position of the 3D cursor. Two tiles display regions of the reference exam; two tiles display corresponding regions of the moving exam.
Fused	The moving exam is interlaced with the reference exam with an adjustable fusion percentage.
Inversed fused	The moving exam is displayed over the reference exam in inverse linear grey levels with an adjustable fusion percentage.
Threshold	The overlay exam is displayed with lower threshold on top of reference exam, all with an adjustable fusion percentage.
Swipe	Interactively splits the image vertically in 2 parts: the overlaid exam on one side and the fused exams on the other side.

You can create 2D, 3D fused, and hybrid 2D/3D fused views with a simple drag and drop method. Save the layouts you define for personalized display of registration results.

Contours

With Integrated Registration you can define one or multiple contours around relevant anatomical structures on the exam.

To help define the area, the contour appears on all exams as you draw it. You can draw the contour slice by slice or on two non-contiguous slices with interpolation on slices in between.

You can modify or remove contours from a single slice or from the entire exam. You can also save them in the patient database, linked with the corresponding exams in DICOM RT Structure Set format for analysis in AdvantageSim MD* or other DICOM RT-compatible planning systems. On AW Workstation, you have direct access to AdvantageSim MD* during the contouring and saving processes.

Integrated Registration protocols also allow you to define, save, and load RTSS objects.

Saving

You can save registered results in several ways:

- As a new reformatted series in the Reference or Moving exam geometry
- As Save State after the registration is completed; display, segmentations, and measurements are also saved
- As a DICOM spatial registration object in the same exam with the reference series in the Patient List

Operation

Registration is possible in two contexts:

- Loading a dedicated registration protocol
 - Load a DICOM 3 CT, MR, PET, SPECT or XA data set and another data set from one of these modalities into the Integrated Registration protocol. Registration is performed based on reference and moving series selection
 - Review the registration quality with visualization tools and validate the result
 - Optionally, you can define and save the contours of structures of interest
 - Save registration results
- Loading multiple volumes into a generic Volume Viewer protocol, after which registration can be performed on demand using Dynamic Load feature. The registration features are available in Visualization toolbar.

System requirements

- Recommended monitor resolution is up to dual 2MP (1600 x 1200) or a single 3MP (1536 x 2048)
- Refer to AW Applications platform compatibility document

Image requirements

Acquisition position and plane, slice resolution, number, thickness and spacing may be different in the acquisition of the two exams to be registered.

Each image set should meet basic requirements, however:

- Field of view, matrix size and display center should be the same for all images inside one series
- Orientation should be the same for all images in the series
- Series should include more than one image
- Tilted acquisitions are not supported by mutual information based automatic algorithms; they can be registered with manual, landmark, or automatic “matching boundaries” registration methods. Datasets used as reference and moving should have some matching anatomical location.

Indications for use

Integrated Registration provides easy means for comparison of 3D images from CT, MRI, PET or SPECT and XA. To help physicians in diagnostic radiology or therapy planning, Integrated Registration allows 3D registration between volumetric acquisitions that may come from the same acquisition modality or from different acquisition modalities.



Summary

Integrated Registration gives you the capability to combine findings from different modality exams into a fused model demonstrating relationships between anatomical structures and physiological processes. The program makes registration and fusion easy and fast with features such as:

- Robust automatic registration that can be run over a matter of only a few seconds
- The ability to perform automatic registration upon loading the exam from the patient list or from Dynamic Load, reducing the need for you to manually launch the registration
- Automatic registration propagation to all series acquired in the same exam (i.e., same frame of reference), speeding the registration process (specifically helpful for MRI exams where multiple series are acquired)
- Ability to load additional series into an active session. Registration applied to already loaded series of the same exam (i.e., same frame of reference) automatically propagates to the additional series
- Interactive manual registration provides flexible registration optimization based on real time visual feedback

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Regulatory compliance:

This product complies with the Regulation (EU) 2017/45 of the European Parliament and the Council of medical device (MDR)

Rx Only

This product and its feature and compatible products may not be available in some other countries or regions. Please contact your sales associate.

*Separate medical device requiring an additional license.

References:

1. For XA modality series, Integrated Registration currently supports only 3D X-ray Angiography images (stored as CT Image Storage DICOM objects) acquired with GE HealthCare Innova™ equipment and reconstructed with the Innova3DXR application.
2. Requires DICOM RT capability on RT planning system.

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