

Medical Imaging Toolbox™ Release Notes



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Medical Imaging Toolbox™ Release Notes

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R2023a

Version: 1.1

New Features

Bug Fixes

Compatibility Considerations

3-D Medical Image Volumes: Display volumes in patient coordinate system

New functions enable convenient display of 3-D medical image data. These functions accept a `medicalVolume` object as input and automatically scale and orient data in patient coordinates using properties extracted from the associated file metadata.

- Display medical volume slices as a montage by using the `montage` object function.
- Display a medical volume in 3-D by using the `volshow` object function.
- Scroll through medical volume slices in one plane (coronal, sagittal, or transverse) by using the `sliceViewer` object.

For an overview of medical image display options, see “Choose Approach for Medical Image Visualization”.

2-D Medical Images and Image Series: Display image series as video or montage


New functions enable convenient display of 2-D medical image data. These functions accept a `medicalImage` object as input and automatically set the intensity display range or colormap using properties extracted from file metadata:

- Display the frames of an image series as a montage by using the `montage` object function.
- Play an image series, such as an ultrasound sequence, in the **Video Viewer** app by using the `implay` object function. The app plays the video at the frame rate specified by the properties of the corresponding `medicalImage` object.

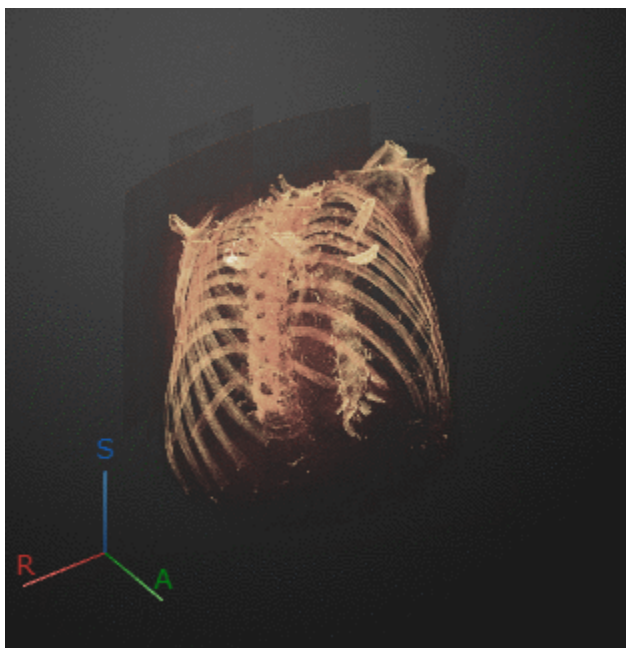
For an overview of medical image display options, see “Choose Approach for Medical Image Visualization”.

Medical Image Labeler App: Display slice crosshairs and generate animations

The **Medical Image Labeler** app includes these new capabilities:

- **Crosshair Navigation** — In a volume session, view and navigate 2-D slice positions using crosshairs. To turn on the crosshair indicators, in the app toolstrip, select **Crosshair Navigation**. The indicators show the relative position of the slices in the other 2-D views. To navigate slices, pause on a crosshairs until the cursor changes to the fleur shape, , and then click and drag to a new position. The other slice views update automatically. To hide the crosshairs, in the app toolstrip, clear **Crosshair Navigation**.
- **Animation Generator** — Configure, preview, and export animations from the app. In a volume session, generate animations that loop through slices in the coronal, sagittal, or transverse plane, or show a rotating 3-D volume. In an image session, generate animations that loop through the frames of an image series, such as an ultrasound video.

Optionally include labeled regions in animations, and customize parameters such as step size, loop count, and total animation length in seconds. To open the **Animation** pane, in the app toolstrip, click **Generate Animations**. For details, see “Visualize 3-D Medical Image Data Using Medical Image Labeler”.



This table describes enhancements for these labeling apps:

- **Image Labeler**
- **Video Labeler**
- **Ground Truth Labeler**
- **Lidar Labeler**
- **Medical Image Labeler**

Feature	Image Labeler	Video Labeler	Ground Truth Labeler	Lidar Labeler	Medical Image Labeler
New Image Labeler interface.	Yes	No	No	No	No
Use the Point ROI label to mark one or more keypoints in objects.	Yes	Yes	Yes	No	No
New naming scheme for pixel label file names when you export ground truth data. For more details, see the “Pixel Label File Naming: Unique filenames for image files related to pixel labels” (Computer Vision Toolbox) release note.	Yes	Yes	Yes	No	No
Use the Smart Voxel tool to refine point cloud labeling by marking the foreground and background within a region of interest.	No	No	No	Yes	No

Feature	Image Labeler	Video Labeler	Ground Truth Labeler	Lidar Labeler	Medical Image Labeler
Label a planar region within a point cloud by selecting any three points on the plane.	No	No	No	Yes	No
Configure, preview, and export 2-D and 3-D animations of medical image data.	No	No	No	No	Yes
View and navigate 2-D slices of a medical volume using crosshair navigation.	No	No	No	No	Yes

DICOM Files: Parse and modify metadata selectively and access pixel data of DICOM files

Use the `dicomFile` object and its object functions to selectively read, parse, modify, and write the metadata from DICOM files. You can also use the `dicomFile` object to access the image pixel data in a DICOM file.

New Examples: Explore medical imaging workflows

R2023a includes these new examples:

- “Cardiac Left Ventricle Segmentation from Cine-MRI Images Using U-Net Network”
- “Automate Labeling in Medical Image Labeler”
- “Medical Image-Based Finite Element Analysis of Spine”

Functionality being removed or changed

The `medicalVolume` object converts DICOM intensities from unsigned to signed values

Behavior change

Starting in R2023a, when reading DICOM files, the `medicalVolume` object converts intensity values of data type `uint16` to data type `int16` or `single`. If the DICOM file specifies the `RescaleIntercept` and `RescaleSlope` metadata attributes, `medicalVolume` converts the values before rescaling them. By converting unsigned `uint16` values to signed values before rescaling, the new behavior preserves the full data range of the rescaled intensities, including negative values.

- If the `RescaleSlope` attribute value is unspecified or an integer, then `medicalVolume` converts the intensities from `uint16` to `int16`.
- If the `RescaleSlope` attribute value is fractional, then `medicalVolume` converts the intensities from `uint16` to `single`.

In R2022b, `medicalVolume` stored intensity values using the same data type as in the DICOM file. For DICOM files that stored intensities as data type `uint16`, `medicalVolume` limited rescaled values to the range $[0, 2^{16}-1]$, and set all negative values to 0 before storing them in the `Voxels` property.

R2022b

Version: 1.0

New Features

Introducing Medical Imaging Toolbox: Import, visualize, register, label, and segment 2-D and 3-D medical images

Medical Imaging Toolbox™ provides apps, functions, and workflows to design and test diagnostic imaging applications. You can perform 3-D rendering and visualization, multimodal registration, segmentation and labeling of radiology images, and training of predefined deep learning networks.

You can import, preprocess, and analyze radiology images from various imaging modalities, including projected X-ray imaging, computed tomography (CT), magnetic resonance imaging (MRI), ultrasound (US), and nuclear medicine (PET, SPECT). The **Medical Image Labeler** app lets you semi-automate 2-D and 3-D labeling for use in AI workflows. You can perform multimodal registration of medical images, including 2-D images, 3-D surfaces, and 3-D image volumes. The toolbox provides an integrated environment for end-to-end computer-aided diagnosis and medical image analysis.

3-D Medical Image Volumes: Import and define spatial referencing

The `medicalVolume` object imports volumetric image data from the DICOM, NIfTI, and NRRD file formats. A `medicalVolume` object stores the voxel data and spatial referencing information for an image. You can use the properties and object functions of `medicalVolume` to access voxel data, spatial referencing, and intensity scaling information for the associated image volume. For example, you can extract an image slice in the coronal, sagittal, or transverse anatomical planes by using the `extractSlice` function.

The `medicalref3d` object defines the spatial referencing for a 3-D medical image volume. A `medicalref3d` object defines the mapping between the intrinsic image coordinate system, the patient coordinate system, and the left/right, anterior/posterior, and inferior/superior anatomical axes.

2-D Medical Images and Image Series: Import and extract frames

The `medicalImage` object imports image data from DICOM files that contain a 2-D image or a series of 2-D images related by time, such as an ultrasound sequence. Use the `medicalImage` object to access pixel data and metadata attributes such as the pixel spacing in millimeters, frame times, and display window values. Use the `extractFrame` object function to extract one frame of an image time series.

NRRD Files: Read images stored in the NRRD file format

Work with the nearly raw raster data (NRRD) file format using these functions:

- `isnrrd` — Check if file is valid NRRD file.
- `nrrdinfo` — Read metadata from NRRD file.
- `nrrdread` — Read image data and metadata from NRRD file.

Preprocessing and Augmentation: Remove noise and apply random augmentations to medical image data

Use the `specklefilt` function to reduce speckle noise in 2-D images, such as ultrasound data, using a speckle-reducing anisotropic diffusion (SRAD) algorithm.

Use the `jitterIntensity` function to randomly adjust the intensity of grayscale images and image volumes.

Image Registration: Align 2-D and 3-D medical images and surfaces

Medical Imaging Toolbox introduces these image registration functions:

- `imregicp` — Register 3-D surfaces using the iterative closest point (ICP) algorithm.

Note The `imregicp` function is not supported on Mac computers with Apple silicon chips.

- `imregmoment` — Register 2-D or 3-D grayscale images using the efficient moment of mass algorithm.
- `imregdeform` — Register 2-D or 3-D grayscale images using the total variational method for deformable image registration.
- `imreggroupwise` — Reduce sliding motion between slices of a series of 2-D grayscale images.

Surface Extraction: Extract 3-D surfaces from grayscale and binary image volumes

Use the `extractIsosurface` function to calculate the faces and vertices of the isosurface for a 3-D grayscale image volume or binary mask.

The `Create STL Surface Model of Femur Bone for 3-D Printing` example shows how to convert extracted surfaces to STL files suitable for 3-D printing workflows.

Medical Image Labeler App: Label ground truth data in 2-D and 3-D medical images

The **Medical Image Labeler** app enables you to label pixels in 2-D and 3-D medical images. The app reads images stored in the DICOM, NIFTI, and NRRD file formats. Using the app, you can:

- View images as coronal, sagittal, and transverse slice planes or volumes with anatomical orientation markers and scale bars.
- Create multiple pixel label definitions to label regions of interest. Label pixels using built-in automatic, semi-automatic, and manual techniques.
- Write, import, and use your own custom automation algorithm to automatically label ground truth data.
- Export the labeled ground truth data as a `groundTruthMedical` object. You can use this object to share labels with colleagues or for training semantic segmentation deep learning networks.

Ground Truth Object: Manage ground truth data for medical images

Work with labeled ground truth data for semantic segmentation workflows using these functions:

- `groundTruthMedical` — Ground truth pixel label data for medical images. Export a ground truth object from the **Medical Image Labeler** app, or create one programmatically at the command line.

- `ImageSource` — Specify the file names of 2-D medical image data sources for a `groundTruthMedical` object.
- `VolumeSource` — Specify the file names of 3-D medical image data sources for a `groundTruthMedical` object.

Deep Learning: Medical image segmentation using deep learning networks

Medical Imaging Toolbox includes examples that show you how to perform medical image segmentation using deep learning networks. These examples require Deep Learning Toolbox™ and Computer Vision Toolbox™.

- **Create Datastores for Medical Image Semantic Segmentation** — Create training data for semantic segmentation deep learning networks using ground truth labels stored in a `groundTruthMedical` object.
- **Segment Lungs from CT Scan Using Pretrained Neural Network** — Perform semantic segmentation of a lung CT image using a pretrained network imported as an Open Neural Network Exchange (ONNX) model.
- **Brain MRI Segmentation Using Pretrained 3-D U-Net Network** — Perform semantic segmentation of brain MRI images using a pretrained UNET deep learning network.
- **Breast Tumor Segmentation from Ultrasound Using Deep Learning** — Perform semantic segmentation of breast ultrasound images by training a ResNet50 deep learning network.