Analyze 10.0

# Loading Data Into Analyze

# Exercise 1 : DICOM Tool Quick Configuration

The DICOM Tool expands DICOM support in Analyze, enabling the indexing of collections of DICOM images through a local database file. This exercise will demonstrate how to create a database and then how to import DICOM data into the database.
*Note: If you are a previous BirPacs user please contact support@analyzedirect.com for instructions on migrating your database to the DICOM Tool.*


1. Open the **DICOM Tool** (**File > DICOM Tool**).
2. The DICOM Tool will detect that there is no database present; a dialog box will be returned asking you if you would like to create a new database or browse for an existing database, click **Create a new local database**.

> *note* | If this is not the first time you have accessed the DICOM Tool, you can access the Create New Image Database window by selecting File > Create Database.

3. The **Create New Image Database** window (Figure 1) allows you to specify a database name and file system directory, configure a DICOM receiver for the database (optional), configure a database server (optional), and specify the source of initial DICOM images (optional).
4. The **Local Database Name** will default to 'SystemName_PortNumber'; chance the Local Database Name to **TEST_5679** [**A**].
5. On your system's local disk create a folder called '**AnalyzeDB**' ($:/AnalyzeDB)
6. Click the **Local Database Directory** button in the Create New Image Database window.
7. In the Browse for Folder window returned navigate to the location of the new '**AnalyzeDB**' folder ($:/AnalyzeDB), select the folder, and click **OK**. You have now specified the location of your local database [**B**].
8. To create the local database click the **Create Local Database** button [**C**].
9. Once the database has been created a dialog box will be returned stating 'All Done', click **OK**.

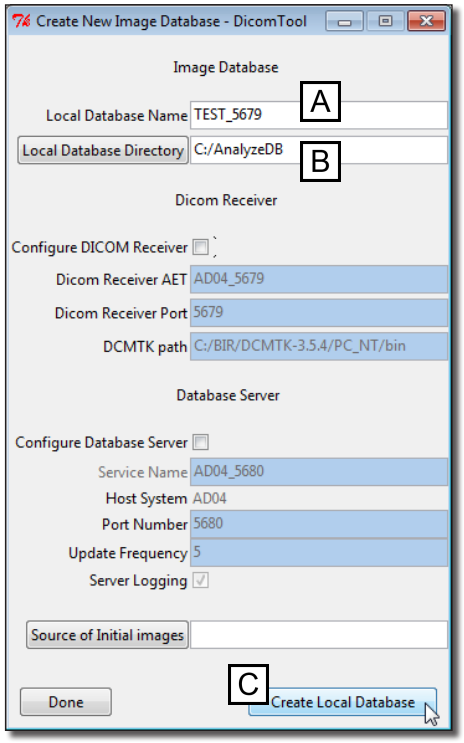



Figure 1

10. To import DICOM data into the DICOM Tool right-click anywhere in the white space and select **Import DICOM Images** from the menu (Figure 2). Alternatively, select **File > Import DICOM Images**.

11. In the Browse for Folder window returned navigate to and select the folder **$:\BIR\images\TutorialData\ImportExportTutorial**, then click **OK**.

12. A dialog box will be returned asking you to confirm that you would like to 'Import all DICOM files found below <C:/BIR/images/TutorialData/ImportExportTutorial>', click **Yes** to confirm.

13. All 121 DICOM images contained within the folder will be copied into the database. The DICOM Tool will automatically sort and index the data by patient, study, series, and volume.

14. Data can be selected and viewed in the DICOM Tool (Figure 3). To load a selected data set into the Analyze workspace click **Load Volume [D]**; if you wish to resize or resample the data click **Load As**, this will load the selected data into the Load As module (see exercise 4 for instructions on how to use the Load As module).

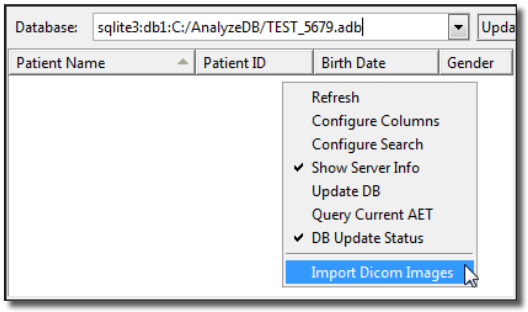



Figure 2

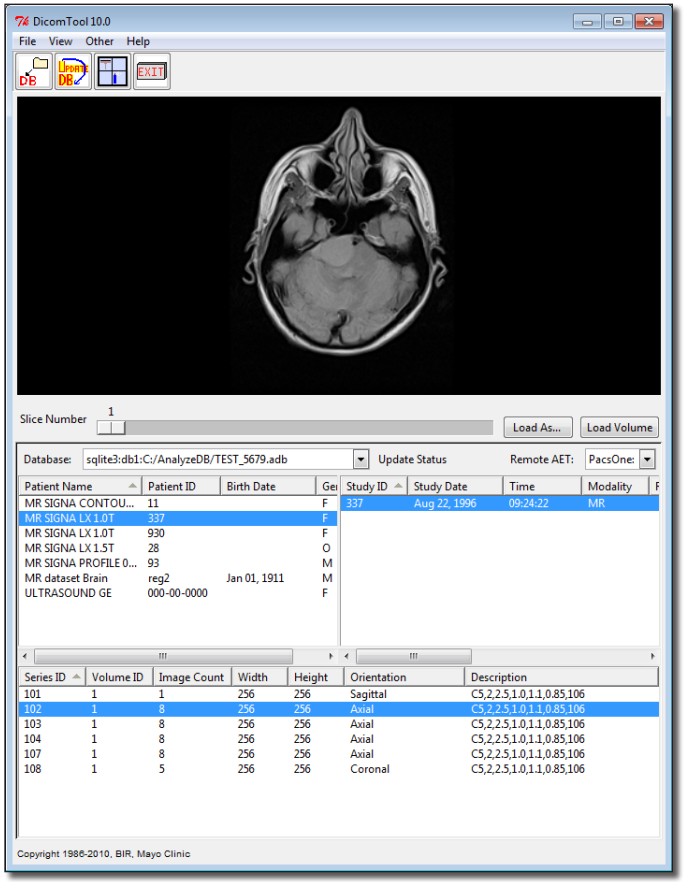



Figure 3

# Exercise 2 : DICOM Tool Advanced

The DICOM Tool expands DICOM support in Analyze, enabling the indexing of collections of DICOM images through a local database file. With the DICOM Tool, databases can be created, updated, and shared with other users with file system access to the images and the database file. This exercise will demonstrate how to create a database, configure a DICOM receiver and Database sender and then how to import DICOM data into the database.
*Note: If you are a previous BirPac user please contact support@analyzedirect.com for instructions on migrating your database to DICOM tool.*

1. Open the **DICOM Tool** (**File > DICOM Tool**).
2. If you have already completed exercise 1, choose **File > Create Database**. If the DICOM Tool detects that no database is present, a dialog box will be returned asking you if you would like to create a new database or browse for an existing database, click **Create a new local database**.

## Specification of the Database Name and Directory

3. In the **Create New Image Database** window you can specify the database name and file system directory, specify a DICOM receiver for the database (optional), specify database server (optional), and specify the source of initial DICOM images (optional).
4. The **Local Database Name** will default to 'SystemName_PortNumber'; change the Local Database Name to **TEST2_5679**.

> *note* | Any name can be chosen for the local database, however when creating multiple databases, following a coherent naming convention will simplify database management.

5. The **Local Database Directory** option enables you to specify the directory on your system in which the database and all of the DICOM images will be stored.
   i. On your system's local disk create a folder called '**AnalyzeDB**' ($:/AnalyzeDB). Note that if you have completed exercise 1, **DICOM Tool - Quick Configuration**, this folder should already exist.
   ii. Once the directory has been created, click **Local Database Directory** [**A**] in the Create New Image Database window, and navigate to the location of the new 'AnalyzeDB' folder ($:/AnalyzeDB).
   iii. Select the folder and click **OK**. You have now specified the location of your database.

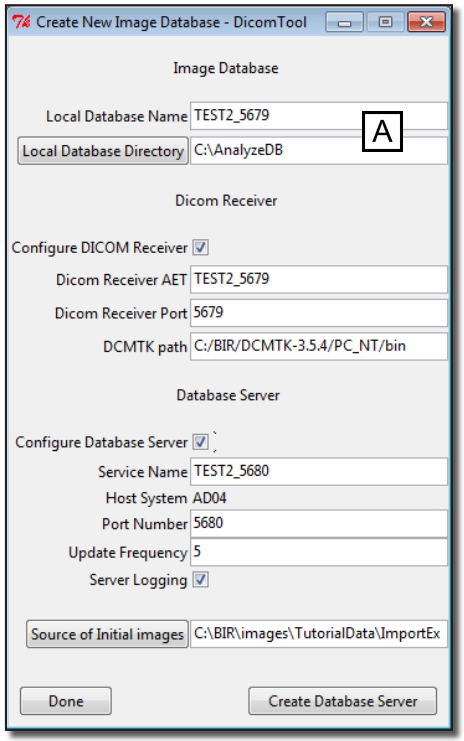



Figure 1

## Specification of a DICOM Receiver (optional)

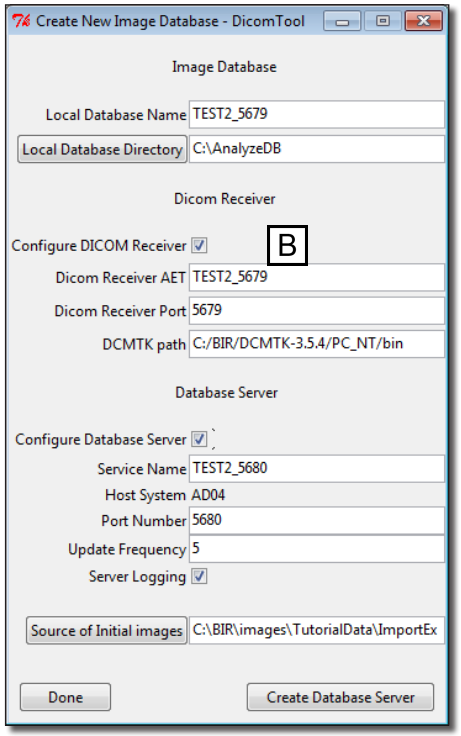
6. The Configure DICOM Receiver option allows you to configure a DICOM receiver for the database. This step is optional, if you do not want to configure the receiver please move on to step 8, otherwise check the Configure DICOM Receiver option [**B**].

7. DICOM Receiver configuration requires three key pieces of information: the Receiver AET, the Receiver Port on the local system, and the directory where the DCMTK executable programs are installed.

   i. **DICOM Receiver AET**: By default is set to 'SystemName_PortNumber'. To reflect the receiver's connection to the database defined in step 4, change the DICOM Receiver AET to **TEST2_5679**.

   ii. **DICOM Receiver Port**: Specifies the TCP/IP port number on which the DICOM Receiver listens for connections to receive messages. For this exercise, the DICOM Receiver Port can remain **5679**.

   iii. **DCMTK Path**: The DCMTK executable files are automatically installed with Analyze in the **$:\BIR\DCMTK-3.5\$System_Type$\bin** directory (where $System_Type$ is your system platform, e.g. PC_NT) and the DCMTK Path will point to this directory by default. However, if Analyze is being run from a network rather than local installation, the DCMTK files should be installed locally and this path should point there.



## Specification of a Database Server (optional)

8. The **Configure Database Server** option allows you to configure an optional database server to manage automatic updates and multiple client access to the database over a network. The database server is a dedicated process attached to one database and accessible by system name and port number. It responds to connection requests, SQL statements, and requests for images, and polls the image storage area for newly received images to register. Configuring and installing a database server is very similar to configuring the DICOM receiver. This step is optional, if you do not want to configure the database server please move on to step 10, otherwise check the **Configure Database Server** option [C].

9. The Database Server fields are used to configure the database server process that controls access to the database.

   i. **Service Name**: The name by which the servicer is identified, for this exercise use **TEST2_5679**.

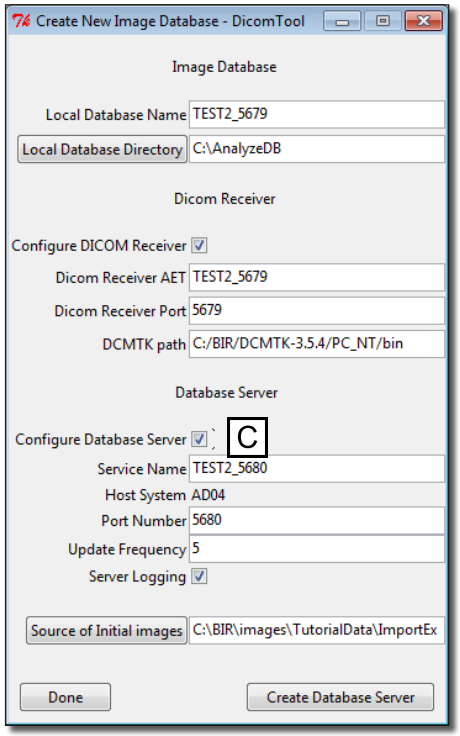
   *note* | On Windows systems this becomes the name of the Windows Service; on UNIX systems it is used to name the daemon script which starts, stops and checks server status.

   ii. **Host System**: Identifies the system name this program is running on. You can create servers to run on your system, and any server should be attached to a database local file system.

   iii. **Port Number**: Specifies the port number client systems will use to connect to server. It cannot be the same port as the one used by the DICOM receiver (STORESCP). For this exercise set the port to **5680**.

   iv. **Update Frequency**: Specifies the interval in minutes at which the server will poll the image storage directory to see if the DICOM receiver has deposited images to be in the database. For this exercise, you can leave this set to **5**.

   v. **Server Logging**: Creates a log file of the database server for diagnostics.

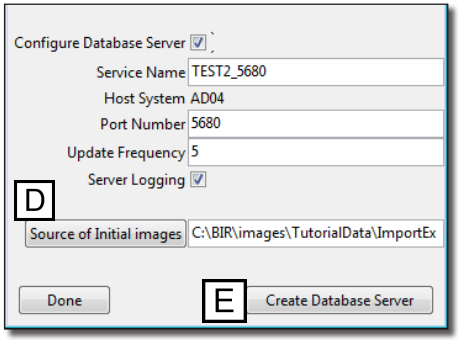



*tip* | It is recommend using a closely related port number so they can be easily remembered; e.g., if the receiver is running at port n, run that database server at port n+1.

## Specification of the Source of Initial Images (optional)

10. The **Source of Initial Images** option allows you to specify a directory containing DICOM images; click **Source of Initial Images** [**D**].

11. In the Browse for Folder window returned, navigate to the **$:\BIR\images\TutorialData** directory, select the **ImportExportTutorial** folder, and click **OK**.




## Creating the Database Server

12. To create the local database, click **Create Database Server** [**E**]. Note, creating a Database Server requires administrative privileges; a dialog box will automatically be returned stating that you will receive a prompt from your operating system, click **OK**. You will then need to enter the administrator password.

13. The DICOM Tool will now copy the DICOM images from the initial source to the location (if selected) specified in step 5. The data will automatically be sorted and indexed by patient, study, series, and volume.

14. Once the process is complete, the Create New Image Database window will automatically be dismissed and the data will now be available in the DICOM Tool (figure 2).

## Viewing and Loading Data

15. Data can be selected from the Patient information panel [**F**] in the DICOM Tool.

16. Select the data set with the 'Patient Name' **MR SIGNA LX 1.0T** and 'Patient ID' **337**. The data set will be highlighted, note the other information panels will automatically update with relevant Study, Series, and Volume information (when available).

17. Note there are two data sets available for selection in the Series information panel [**G**] below. Select **Series 102**.

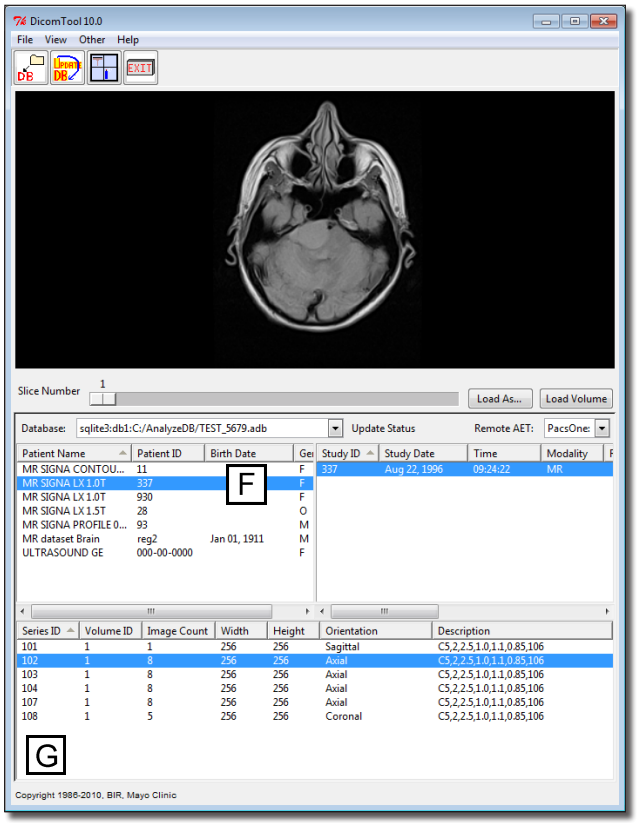



Figure 2

18. Review the data slice-by-slice by using the Slice Number slider bar under the image display.

19. Right-click on the image display to open the **Intensity** window (figure 3). Here you can change the intensity display of the image; use the slider bar to take the Maximum intensity level down to 500. The image display will interactively update. Click **Done** to dismiss the Intensity window.

20. To load this data set into the Analyze workspace, click **Load Volume**. The data set will automatically load into the Analyze workspace.

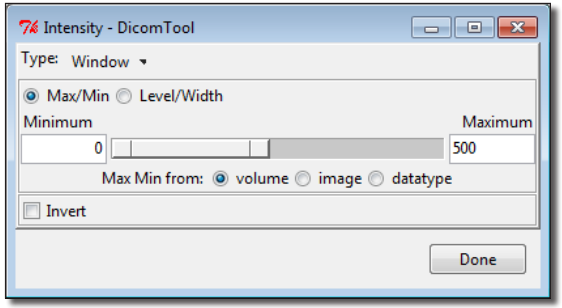



Figure 3

## Other DICOM Tool Options

21. Move the cursor over any of the information panels and right-click. The menu returned provides most of the options available for management of the images in the DICOM database, these options include:

**Refresh**: Deselects any selected data and refreshes the data
**Configure Columns**: Configure the column properties for the data display
**Configure Search**: Focus the scope of the displayed data with an information search
**Show Server Info**: Enable/disable display of recent databases and remote AETs
**Update DB**: Register any recently received unregistered images in the database
**Query Current AET**: Perform query retrieve on remote AET to retrieve images
**DB Update Status**: Enable/disable display of Database Update Status
**Import DICOM Images**: Copy and register images from the file system to the database
**Load Patient**: Load patient data from files
**Export Patient**: Export patient data to files
**Delete Patient**: Delete the patient data from the database
**Send Patient**: Send patient data to listening server
**Anonymize Patient**: Anonymize the patient information (only available from the patient pane)

*note* If you wish to resize or resample the data use the Load As button option, this will load the selected data into the Load As module (see exercise 4 for instructions on how to use the Load As module).

22. On your system's local disk create a folder called '**test_export**' ($:/test_export).
23. Select the 'Patient Name' **MR dataset Brain** and then right-click and select the **Export Patient** option (figure 4).
24. In the Browse for Folder window returned, navigate to and the new '**test_export**' directory, then click **OK**. The DICOM images will be exported out to this directory.
25. Now navigate to the '**test_export**' directory on your system's local disk; note the file names have changed to new DICOM UIDs.
26. In the DICOM Tool, with **MR data set Brain** still selected, right-click and select the **Delete Patient** option.
27. A dialog box will be returned asking you to confirm that this is what you want to do, click **Yes**. A delete confirmation window will be returned, click **OK** to dismiss it.
28. To import this data back into the DICOM Tool right-click in any of the information panels and select the **Import DICOM Images** option. In the window returned navigate to and select the 'test_export' directory on your system disk, then click **OK**.
29. You will be asked if you would like to 'Import all DICOM files found below <$:/test_export >', click **Yes** to import these images back into the database. The data will be automatically sorted and imported into the DICOM Tool database, and the data set will appear in the Patient information panel.

> *tip* | Multiple databases can be created for the DICOM Tool, so multiple DICOM receivers can be configured for the tool; you can select different databases from the Local Databases drop-down menu option.

30. Close the DICOM module before proceeding to the next exercise.

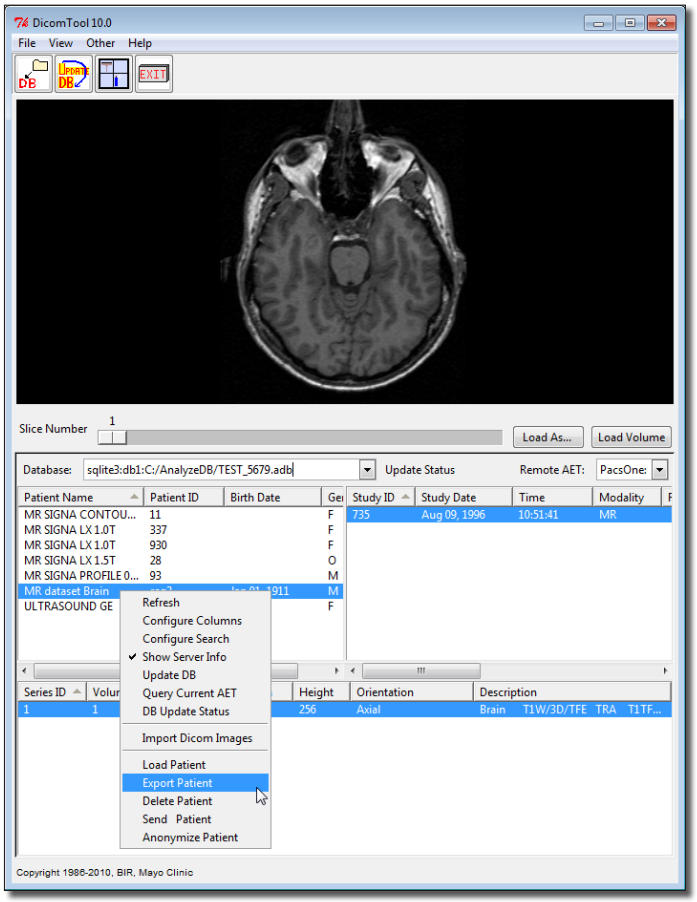



Figure 4

# Exercise 3 : Switching On Support for Additional Formats

Analyze supports over 45 different file formats. By default, only the most common formats are enabled. The Import/Export module's External Libraries tool can be used to enable and disable these formats. This exercise will show you how to use the External Libraries tool to switch on support for additional formats.

1. Open the **Import/Export** module (**File > Import/Export**).
2. To view the file formats currently supported in Analyze, choose **Help > Formats**.
3. File formats currently supported are listed in the bottom '**Formats**' section of the Supported Formats window (figure 1). When a format is selected, the associated properties will automatically become checked in the '**Properties**' section of the window. Experiment by checking several different formats and noting their properties. Click **Done** to dismiss the window.


4. Open the **External Libraries tool** (**Tools > External Libraries**).
5. The External Libraries tool provides a graphical interface listing all formats supported by Analyze (figure 2). The green and red status indicators note whether a format is currently '**Loaded**' (L) and '**Configured**' (C) - green indicating yes and red indicating no.
6. If you wish to switch on support for a specific file format (for example, PICKERMRI), click on the format in the External Libraries tool. A Configure 'X' Format window will be returned (where 'X' is equal to the selected format) (figure 3).
7. In the Configure 'X' Format window, click **Load Now** to change the 'Currently Loaded' status to a green **Yes**.

*note* | Users running multiple operating systems need to configure support for each file format for each operating system. The 'Platforms' option allows the format to be configured for all operating systems (ALL) or for a specific operating system (SPECIFIED).

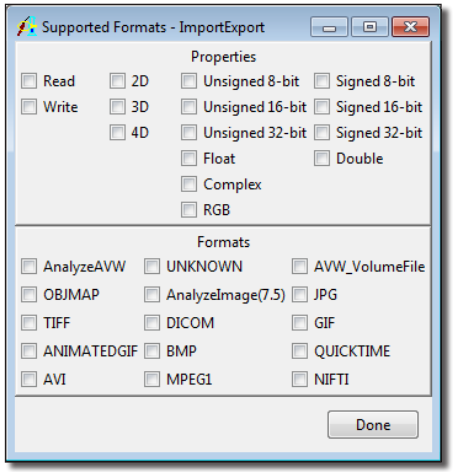



Figure 1

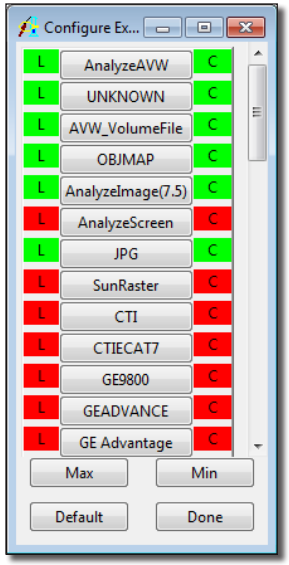



Figure 2

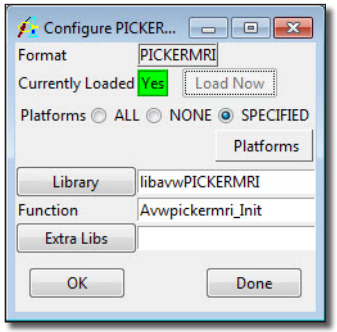



Figure 3

8. Click **OK**. A dialog box will be returned stating that your 'EXTEND.conf' file will be updated, click **OK** (figure 4). The format is now supported by Analyze.

9. If you would like to load and configure all supported formats for your system, click **Max** in the External Libraries tool. All image file formats will now be supported by Analyze. The 'L' and 'C' status indicators will appear green next time you open the External Libraries tool (figure 5).

> *note* | Each file format enabled increases the amount of memory used by your system; it also increases the time taken for a module to open. However, this is typically only an issue on older systems or systems where memory resources are scarce.

10. Click **Done** to close the External Libraries tool.

11. Close the Import/Export module before proceeding to the next exercise.

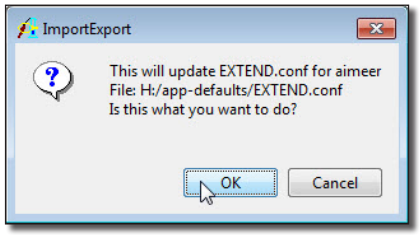



Figure 4

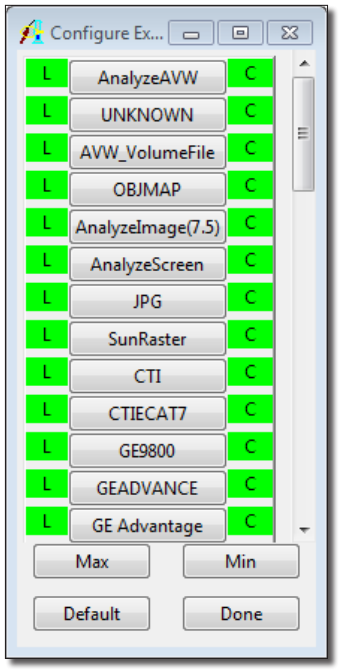



Figure 5

## Supported File Formats

### Analyze

| | |
|---|---|
| **AnalyzeAVW** | used internally for memory mapping, supports all data types, 2D, 3D, and 4D. |
| **UNKNOWN** | enables reading raw binary data into images, and exporting image data as raw. |
| **VolumeFile** | enables lists of 2D files to be used as a 3D entity |
| **OBJMAP** | enables object maps to be treated as regular images |
| **ANALYZEIMG** | *old* Analyze 7.5 format, i.e. .hdr & .img pairs |
| **ANALYZESCRN** | *old* Analyze 7.5 format of old Screen Edit program |

### Raster

| | |
|---|---|
| **BMP** | Microsoft Windows Bitmap |
| **GIF** | a common color indexed format |
| **JPG** | common format featuring lossy compression |
| **PBM** | ascii and binary formats used in Portable Bitmap Library |
| **PGM** | grayscale Portable Bitmap Library |
| **PPM** | 24 bit Color Protable Bitmap Library |
| **PIC** | format used by Softimage |
| **PNG** | Portable Network Graphics |
| **PS** | output to a PostScript raster dump |
| **SGI** | format used by Silicon Graphics |
| **SUNRASTER** | format used by Sun Microsystems |
| **TARGA** | a common color format |
| **TIFF** | tagged information file format, a common format |
| **XBM** | an ascii ‘c programming language’ format used by the X Windows system |
| **XWD** | X Windows dump |

### Video

| | |
|---|---|
| **QUICKTIME** | common movie format |
| **YUV** | single frame color video format |
| **AVI** | video format used by Microsoft Windows |
| **MPEG1** | standard movie format |

### Standard Radiological File Formats

| | |
|---|---|
| **DICOM** | the standard medical image file format based on Mallincrodt ctn_3_0_3. |
| **ACR/NEMA** | precursor to DICOM |
| **PAPYRUS2** | 3D extensions to DICOM from OSIRIS |
| **PAPYRUS3** | 3D extensions to DICOM from OSIRIS |
| **NIfTI** | Neuroimaging file format |

### Vendor-Specific Radiological File Formats

| | |
|---|---|
| **GE9800** | older CT format |
| **GEADVANCE** | Advance, nulcear medicine format |
| **GEADVANTAGE** | format for CT and MRI |
| **GESIGNA** | older MRI format Signa 4.x |
| **GESTARCAM** | older PET format |
| **INTERFILE** | a standard format for nuclear medicine |
| **PICKER MRI** | old MRI format used by Picker |
| **SIEMENSCT** | old Siemens CT format Somatom DR3 |
| **SIEMENSMAGVIS** | Siemens Magnetom Vision (MRI format) |
| **CTI** | PET format used by CTI, early version of ECAT7 |
| **7CTI** | PET format used by CTI; CTIECAT7 |
| **IMATRON** | proprietary CT format |
| **SMIS** | proprietary MRI format |
| **BRUCKER MRI** | proprietary MRI format |
| **BIO RAD** | proprietary format |
| **VARIAN FDF** | Varian MRI format |

# Exercise 4 : Load As Loading and Resizing Anisotropic

Scanner acquired data is rarely isotropic (cubic) which means that the voxel width, height, and/or depth have different sizes (most often a different slice thickness than the in-plane resolution). This exercise will demonstrate how to load an anisotropic (non-cubic) volume image with the same resolution as when acquired, and then load it again to resize the volume image to create an isotropically sampled volume (cubic) for further use in Analyze.

1. Open the **Load As** module (**File > Load As**).
2. Click **File** [**A**] and navigate to and select the **MRI_Head.avw** data set in the **$:\BIR\images\TutorialData** directory.
3. Uncheck the **Auto Exit After Load** option [**B**] and click **Load**. The data will be loaded into the Analyze workspace as it was acquired (anisotropic).
4. To load the data as isotropic (cubic), select the **Resize** tab [**C**] (figure 1).
5. Check the **Force Cubic** option [**D**] and click **Load**; the data will be resampled at the cubic resolution and then loaded. The highest spatial resolution in the acquired volume image is used as the cubic resolution for resampling.
6. Two volumes are now loaded into the Analyze workspace, 'MRI_Head' and 'MRI_Head0'. The latter volume is the cubic volume. To examine the effects of this isotropic sampling, proceed to **Exercise 8: Multiplanar Sections**.
7. If a specific cubic voxel resolution is desired, the voxel size can be changed. To set the output voxel dimension to 1.5 mm, enter **1.5** in the **Output Voxel Size** field [**E**] and press <**Enter**>. Notice that the 'Output Axis Dimensions' and 'Memory' fields automatically adjust when the voxel dimension is changed.
8. It is also possible to set a specific dimension for the resulting volume image. For example, if you wanted an output volume with an X dimension of 200, enter 200 in the **Output X Axis Dimension** field [**F**] and press <**Enter**>. Again, the other parameters will automatically adjust.
9. You may encounter data sets that are too large to be accommodated by the computer on which you are running (usually due to memory limitations), particularly at the resampled cubic resolution. Specifying a maximum memory size while the Force Cubic option is checked forces each parameter to adjust to the largest value possible that still fits within the specified memory size. Enter **16** into the **Output Memory Mb** field [**G**].
10. Close all windows related to the Load As module before proceeding to the next exercise.

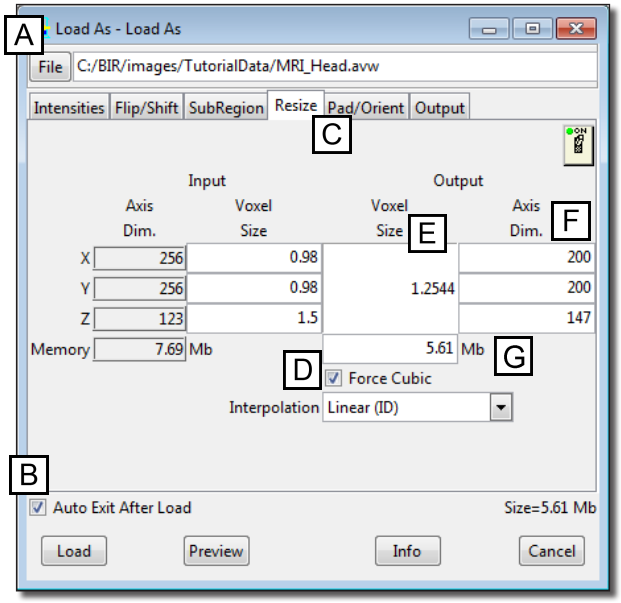



Figure 1

# Exercise 5 : Import/Export Converting Raw Data into Images

Occasionally it is necessary to import raw data or image data of an unknown file format into Analyze. Such data can be imported if pixels are uncompressed and in contiguous images within the file. The Raw Data tool provides several interactive options to view data as images, ASCII strings, or as the actual binary values of bytes and words. Data can be directly loaded into Analyze or converted into Analyze format image files. Most image file formats consist of some initial header information describing the image(s) and the actual image data. This exercise will demonstrate how to convert raw data from a scanner, which currently has no direct file format support in Analyze.


1. Open the **Import/Export** module (**File > Import/Export**).
2. Open the **Raw Data tool** (**Tools > Raw Data**).
3. With the **Files** tab selected, click the **File** button under 'Input' (figure 1).
4. In the **Import/Export** – Input File window returned navigate to the **$:\BIR\images\TutorialData\ImportExportTutorial** directory and select the file **UNKNOWN1**.
5. Select the **Image Parameters** tab (figure 2).
6. For this exercise, assume that we know that this file contains one 256 x 256 image, a signed 16-bit integer. An image of this size requires 131072 bytes of storage (256 x 256 x 2), however the file size is 137210 bytes. This indicates that there is an additional 6138 bytes of header information present. This needs to be skipped to get to the first byte of image data. Finally, we know that the 16-bit image data in the file is stored in Big-Endian byte format.
7. To accommodate this, set the following parameters:
   - **Byte Offset: 6138** [**A**](or check 'Auto Offset' to compute this automatically)
   - **Width: 256** [**B**]
   - **Height: 256** [**C**]
   - **Data Type: signed 16-bit** [**D**]
   - **Byte Swap: Pairs** (this only needs to be set on a little-endian architecture, i.e., PC-based systems) [**E**]

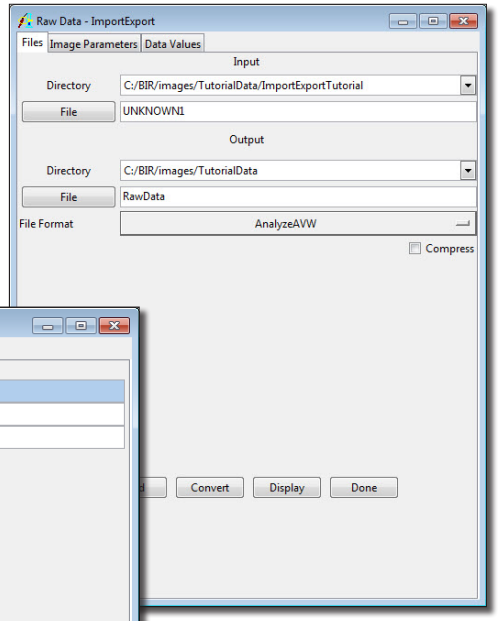



Figure 1

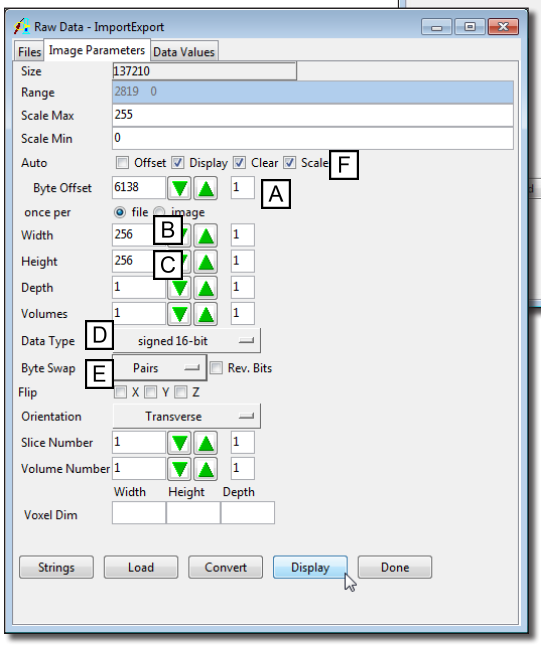



Figure 2

8. Check the following **Auto** options [**F**]:
   - **Display**: Image display will update anytime a control parameter is changed.
   - **Clear**: Image display is cleared before a new image is displayed.
   - **Scale**: Data is automatically scaled from its entire dynamic range to 8-bits for display.
9. Click **Display** to view the current image in the main Import/Export window (figure 3).
10. Click **Load** in the Raw Data tool to load the image specified in the file into the Analyze workspace.
11. Experiment with the display effects by changing the image parameters to incorrect values, use the up and down arrow buttons found next to the Width and Height fields.
12. Click **Done** to close the Raw Data tool.

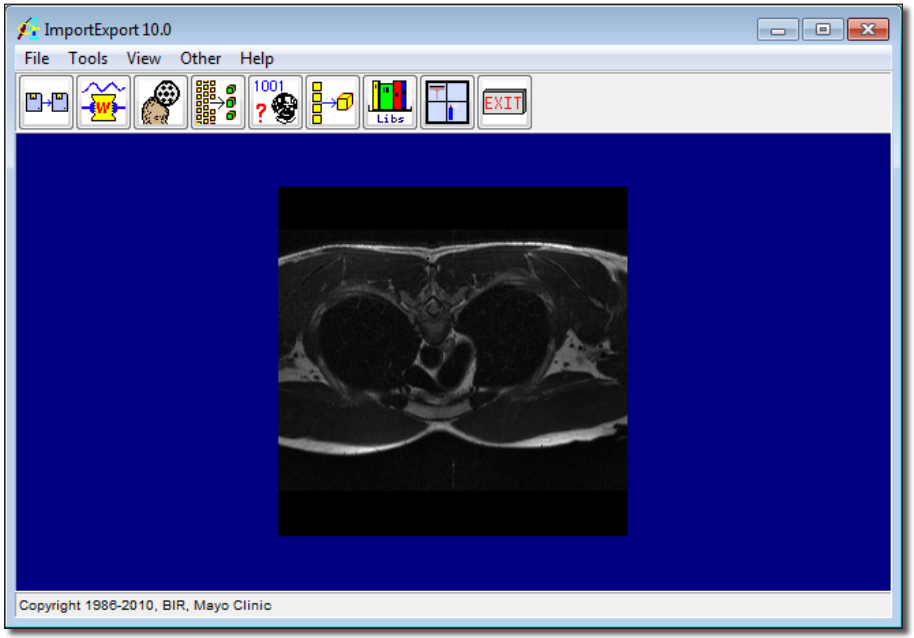



Figure 3

# Exercise 6 : Import/Export Volume Tool

Most medical image formats do not support 3-D directly, since each slice in a study is written to a separate file. The Volume Tool provides a way to create a pseudo format for handling groups of 2-D files as a single 3-D entity. Analyze uses the AVW_VolumeFile, or volume file (.vol), as a way to organize a list of 2-D files into a 3-D volume. The files must contain images of the same size and data type. This exercise will show you how to use the Volume Tool to create a volume file from a list of 2-D TIFF files.

1. Open the **Import/Export** module (**File > Import/Export**).
2. Open the **Volume Tool** (**Tools > Volume Tool**).
3. In the Volume Tool, click **Wild Cards**.
4. In the window returned (figure 1), click **Directory** and navigate to **$:\BIR\images\TutorialData\VolumeToolTutorial** - the directory containing the 2-D TIFF data for this exercise.
5. The **Filter** field is set to * by default so everything in the directory is selected. As this directory only contains TIFF data specific to the data set we wish to load, leave the filter as is.
6. Click **Apply**. The TIFF files will now be copied to the Volume Tool (figure 2).
7. In the Volume Tool, click **Verify** to ensure that all the slices selected are the same size and data type.
8. A dialog box (figure 3) will be returned upon successful verification stating 'Verify Succeeds'; click **Continue**.
9. Click **Save** and save the volume file as **TIFF_Head.vol** in the **$:\BIR\images\TutorialData** directory.

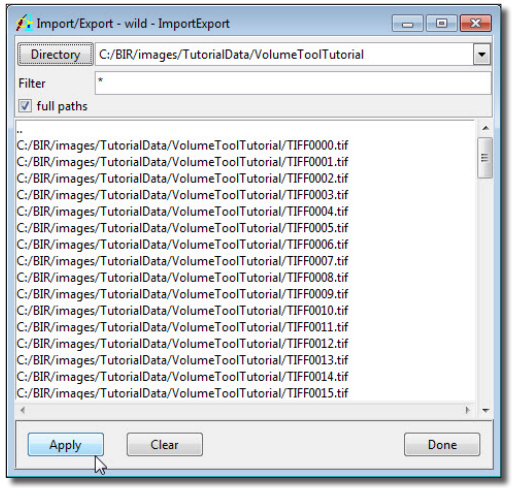



Figure 1

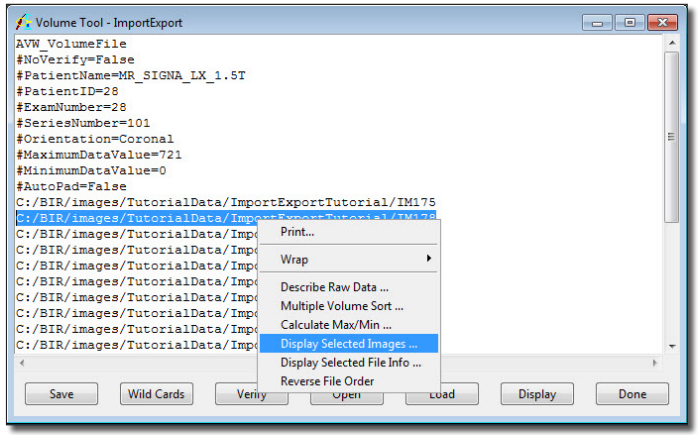



Figure 2

*tip* The volume file saved can now be loaded into Analyze using the Load or Load As modules. Alternatively you can load the volume file directly into the Analyze workspace from the Volume tool by clicking 'Load'.

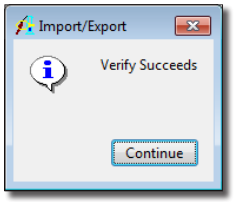



Figure 3

10. Close the Import/Export module before proceeding to the next exercise.

# Exercise 7 : Saving Data Out of Analyze

At some point it will become necessary for you to save your data out of Analyze. This exercise will demonstrate how to do this using the Save module.

1. Select a data set from the Analyze workspace. If there is no data loaded, load **MRI_Head.avw** from the **$:\BIR\images\TutorialData** directory.
2. Open the **Save** module (**File > Save**).
3. Click **File** and navigate to the directory where you would like to save the data set and specify a name. Click **Save** to return to the main module window.
4. Use the **Format** drop-down menu to specify the format in which you wish to save the data set.

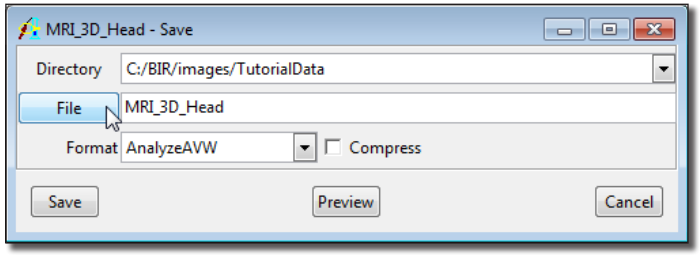


Figure 1

> *note* | Only formats enabled in the external libraries tool will be available. To switch on support for additional formats, please refer to Exercise 3: Switching on Support for Additional Formats.

5. Click **Save** to save the data set and close the Save module.

> *tip* | You can also save your data out of Analyze using the Save As module. The Save As module provides the same tools as the Load As module, allowing you to resize, change orientation, sub-region, and perform other manipulations on your data while saving it out of Analyze.