

Auto-PERCIST™

A PET Image Volume Viewer with
Integrated PERCIST-based
Computer Assisted Analysis

Installation and Usage Manual

Version 0.6 (beta release)

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1 WELCOME

This manual describes the installation and usage of *Auto-PERCIST™*, a PET Image Volume Viewer with Integrated PERCIST-based Computer Assisted Analysis.

Auto-PERCIST™ is currently only available as a beta-release and is subject to frequent changes, therefore while every effort has been made to keep this documentation as current as possible, the actual version of the program which has been distributed to you may be more current than the description provided in this document. If you should encounter such a discrepancy, please don't hesitate to contact the authors with your comments or questions at iratlab@jhmi.edu.

We appreciate your willingness to beta-test *Auto-PERCIST™* and welcome any and all feedback with respect to your experience using *Auto-PERCIST™*, from issues related to installation and/or documentation, to usage or feature requests. All comments should be directed to us via e-mail at iratlab@jhmi.edu.

2 DISCLAIMER

Auto-PERCIST™ is a beta-release product. The use of *Auto-PERCIST™* is intended for research purposes only, and the software is provided AS IS without any express or implied warranty. The Johns Hopkins University makes no warranty or representation about the suitability of the software for any reason.

The Johns Hopkins University shall not be liable for any direct, indirect, special or consequential damages resulting from the loss of use, or data, or projects arising out of or in conjunction with the use or performance of this software.

The Johns Hopkins University cannot give support for this software.

It is expected that academic usage of this software will be acknowledged in publications. Questions with respect to support, installation, other types of usage and other aspects related to the software should be directed to the authors at iratlab@jhmi.edu.

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4 PRE-REQUISITES

4.1 CLIENT COMPUTER

The *Auto-PERCIST™* program has been written in the Java programming language and, as such, can theoretically run on any computing platform for which a valid Java Virtual Machine (VM) exists. At this time we have only tested *Auto-PERCIST™* on the Microsoft Windows (XP, 7, and 8) and Linux Ubuntu platforms. Any feedback on your use of *Auto-PERCIST™* on alternative platforms would be most welcome.

Auto-PERCIST™ runs best when executed in a 64-bit operating environment. It will run on a 32-bit platform but will be constrained by the memory limitations imposed by a 32-bit Java virtual machine. In addition, much of the computationally intense code in *Auto-PERCIST™* is written to take advantage of a multi-core processor. The default operating mode of *Auto-PERCIST™* is to take advantage of any multi-processing abilities provided by the host processor, though this capability can be disabled by the user. For performance reasons we recommend you don't disable this feature unless you experience runtime errors associated with multi-threading.

4.2 DATABASE

Auto-PERCIST™ works best when it is able to communicate with a database system for both input and output. With respect to input, *Auto-PERCIST™* can be connected to a DICOM archive (see next subsection) for navigation and retrieval of image data. This connection is mediated by *Auto-PERCIST™* communicating directly with the back-end database of the DICOM archive. With respect to output, *Auto-PERCIST™* can store the results of its processing into a user-selectable database. This then allows the user to either use the supplied default reporting template for reporting of results or to develop their own SQL based reporting template which may be more suitable to the user's own needs.

The database system currently supported by *Auto-PERCIST™* is the community version of the Oracle MySQL database. It is available for free download at:

<http://dev.mysql.com/downloads/windows/installer/>.

At this time there are no additional data management tools provided within *Auto-PERCIST™* directly, though the download package from Oracle for MySQL includes a robust set of administrator tools for managing your databases.

4.3 DICOM ARCHIVE

Auto-PERCIST™ is able to query and retrieve image data associated with a shareware DICOM archive called *conQuest*. It is available for download at: <http://ingenium.home.xs4all.nl/dicom.html>. When *conQuest* is installed and configured to use the MySQL database (Section 4.2 above), *Auto-PERCIST™* is

able to query and retrieve image data directly from its database. This allows the user to configure their *Auto-PERCIST™* workstation as a DICOM node to which their image data can be sent directly. The user can also use the *conQuest* interface to query and retrieve data from other DICOM nodes (though this capability is not provided from directly within *Auto-PERCIST™* at this time).

4.4 AUTO-PERCIST™ DOWNLOAD

4.4.1 Download

Please refer to the separate document entitled “Auto-PERCIST Download Instructions” for directions on accessing our lab’s secure FTP server and selecting the correct files for download.

4.4.2 Installation

Remember the installer file name (either *install.exe*, *install.bin* or *install.zip*, depending on your host platform) and the location in which this file was saved. The next section (Section 5 below) details the complete installation process.

5 INSTALLATION

5.1 DATABASE SERVER

You must first download the database installer components from

<http://dev.mysql.com/downloads/windows/installer/>. The web page, as it appeared at the time of this writing, appears below:

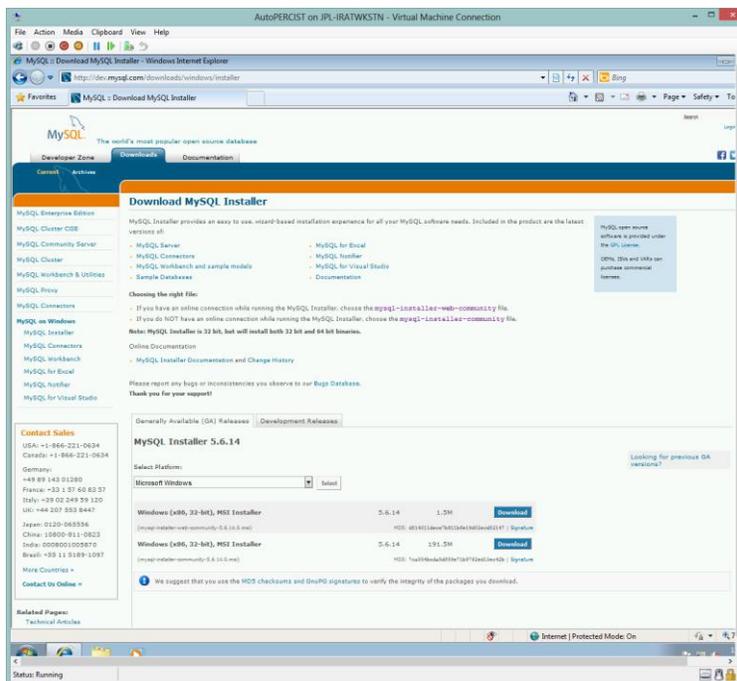


Figure 5-1 MySQL download web page

As stated on the download web page, the installer is a 32-bit program but will install either the 32-bit or 64-bit version of the database system depending on the architecture of your computer.

After selecting a download option, you will be presented with a *File Download – Security Warning* dialog box. You can choose to either directly run the download or to save the download to the file system.

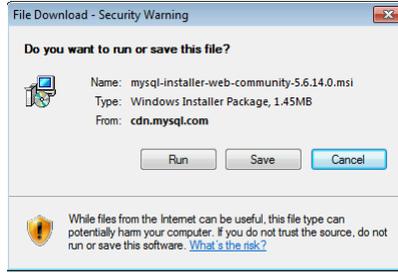


Figure 5-2 File Download Security Warning

Whether you run the file directly, or save to disk and run later, does not matter. However, once you begin the process you may be prompted to install pre-requisite components, such as ‘Microsoft .NET Framework 4’, etc. (Figure 5-3).

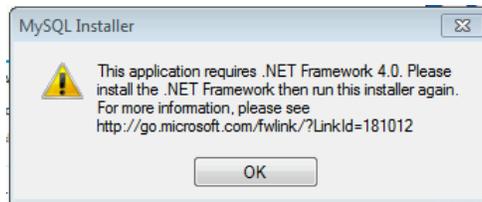


Figure 5-3 Pre-requisite Prompt

Proceed to install the pre-requisite components if so prompted. Once all the required pre-requisites have been installed, run the *MySQL* installer again. You will be presented with a dialog box similar to the one below:

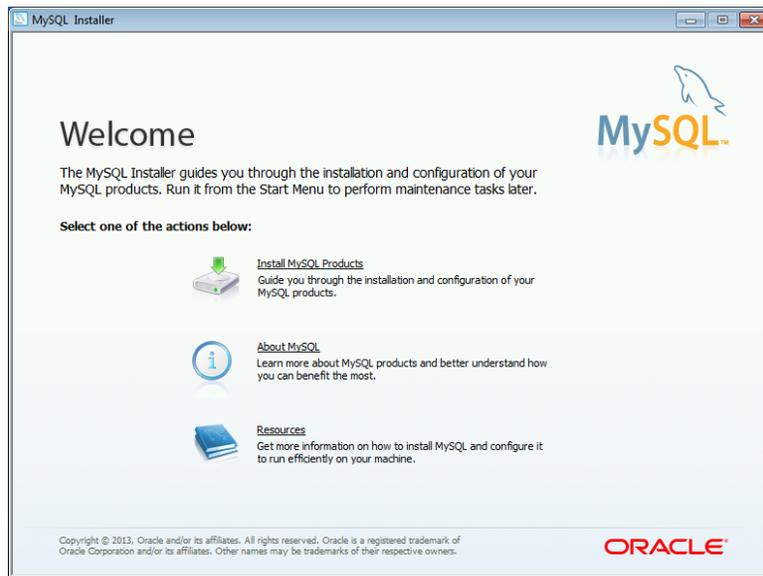


Figure 5-4 MySQL Installer

Select the *Install MySQL Products* link to continue. Accept the license agreement and accept the online check for updates. When presented with the *Setup Type* dialog (Figure 5-5), select either the *Developer Default* or *Full* installation types.

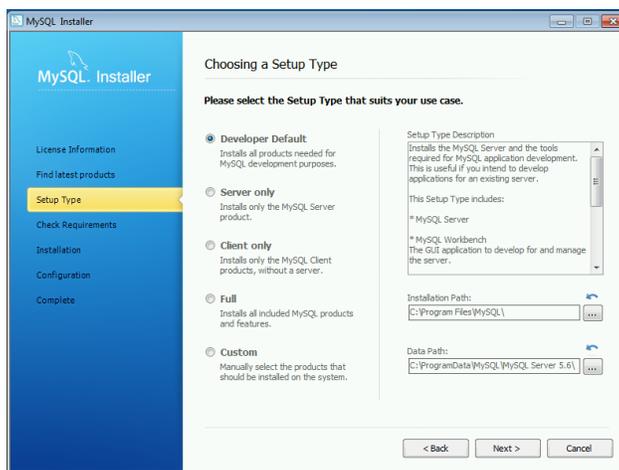


Figure 5-5 MySQL Setup Type Dialog

It is easiest to just accept the default settings for the location of the database files. Once you've accepted a type of setup to perform, click **Next** to proceed. You may or may not be presented with additional pre-requisite requirements. One you have installed any additional pre-requisites, you can continue the installation by selecting the **Execute** button.

After you have met all the system requirements you will be presented with an *Installation Progress* dialog (Figure 5-6).

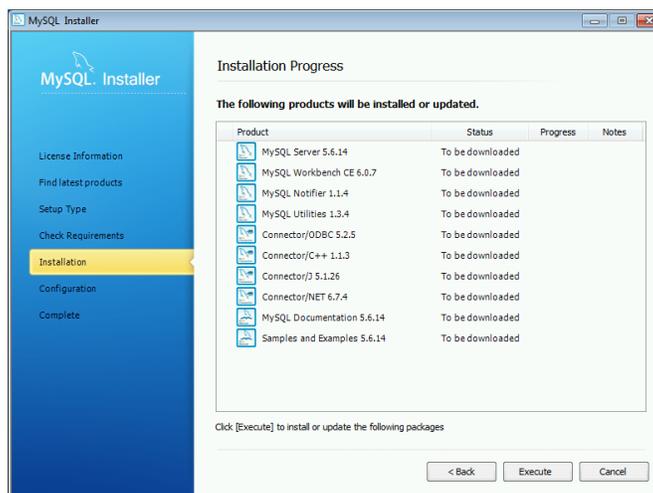


Figure 5-6 MySQL Installation Installer Progress

Select **Execute** to begin the download and installation process. If at first you downloaded the *complete* package and not just the *internet installer* package, your dialog may look a bit different, though the packages to be installed will be similar.

Once the packages have installed, you will need to configure the database. You will do this in the *MySQL Server Configuration* dialog (Figure 5-7). It is easiest to just accept the default options (though make sure to note the TCP/IP *port* number on which the server is run, the default of which is **3306**). During this process you will assign a *root* password for the database. Please remember this password as you will need it to allow both the DICOM server and *Auto-PERCIST™* to connect with the system.

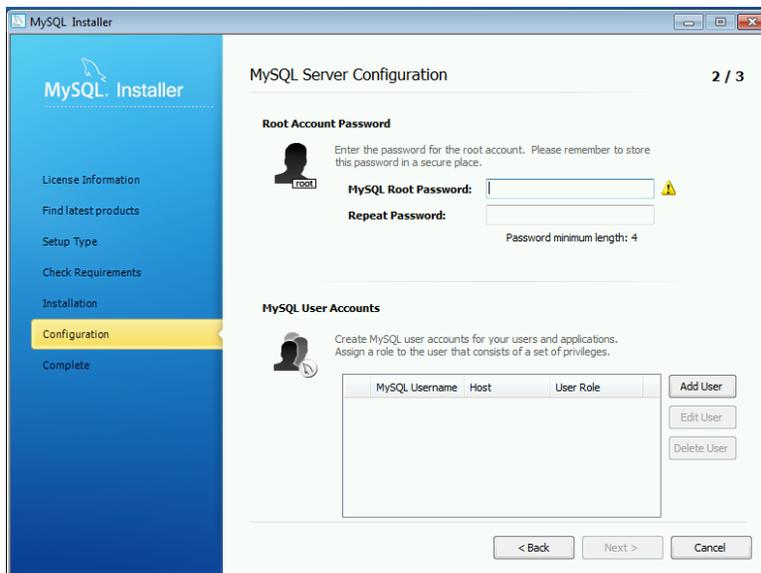


Figure 5-7 MySQL Installer Server Configuration

Best practices would require that you create a user account for the DICOM server and the *Auto-PERCIST™* application. If you decide to use non-root accounts for these applications, you will need to make sure that they are created with *DB Admin* roles so that they have the authority to create databases on the server. Accept the default settings for the remaining setup screen and complete the system configuration.

5.2 DICOM ARCHIVE

The *conQuest* DICOM server can be downloaded from <http://ingenium.home.xs4all.nl/dicom.html>. Multiple packages and configurations of the DICOM archive will be available for download. You should choose the 'complete' system, named 'dicomserver####.zip' (where '####' refers to the current version, which at the time of the writing of this manual is '1417'). Download this *zip* file (or for Linux the *tar* file) to your computer and then extract the contents of this archive file. Be sure to select a location for the

extracted files which has plenty of disk space as the image files sent to this archive will be stored in a subdirectory of this target destination.

!!!Note: The installation described below is specific for a Windows computer based installation. You can also install the 'conQuest' archive on a Linux computer, though the process is a bit different and the details of a Linux installation are not provided here. However, system configuration differences are provided below.

The configuration is fairly straightforward. After extracting the contents of the downloaded archive file, you will find the executable file named *ConquestDICOMServer.exe*. This is the user-interface for the DICOM server system. Run this program. When you run this program for the first time you will be possibly be presented with both security and *Windows Firewall* dialog boxes. Progress through these dialog boxes by answering in the affirmative, including allowing access through the firewall (if one is installed and running).

After you have proceeded through these dialogs, you will be presented with a *New Installation* dialog (Figure 5-8) in which you will have to choose the underlying database type for the system.

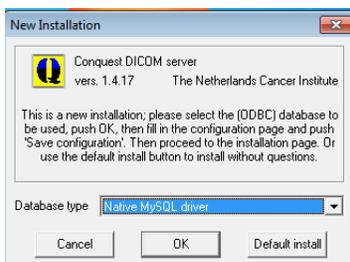


Figure 5-8 ConQuest DICOM Server DB Installer

!!! IMPORTANT: Be sure to select 'Native MySQL driver'! Upon doing so, you will be presented with the main archive user-interface (Figure 5-9).

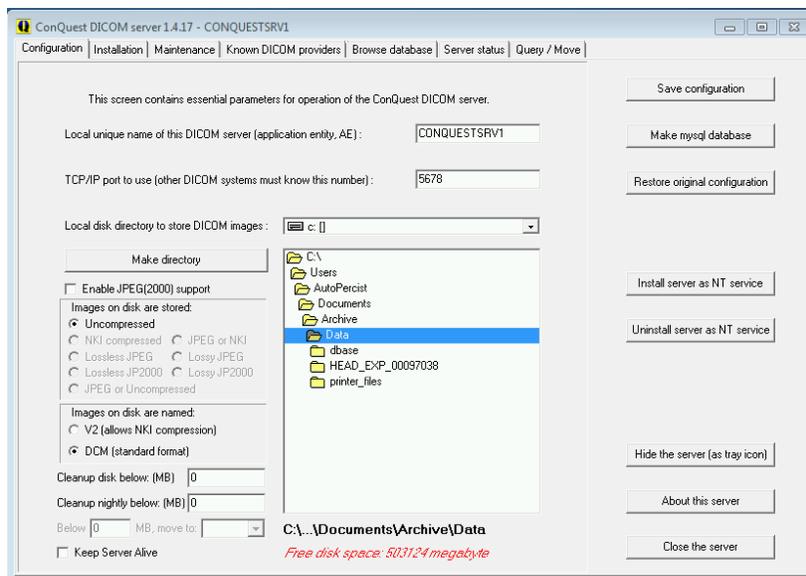


Figure 5-9 ConQuest DICOM Server Configuration

From this screen you can select the remaining user options and start the archive server.

!!! NOTE: It is important to remember to NOT enable image compression for this archive. Auto-PERCIST™ must have access to the image data in non-compressed form!!!

In the installation directory you will find a more detailed description of the installation and usage of this system in a file named *windowsmanual.pdf*, however the following brief description will get you started.

!!!Note: There is also a *linuxmanual.pdf* file, however it only covers the installation process for Linux based systems and not the entirety of the configuration issues discussed in the “*windowsmanual.pdf*”. For Linux based installations, both manuals should be referenced.

You can change the *AE Title* of the archive to one of your choosing, providing it is limited to 16 characters and does not include spaces or special characters. You can also select the TCP/IP *port* of your choosing as long as it does not interfere with any other network services running on your system. A common desktop DICOM *port* setting is 104. You may want to consult with your local PACS administrator for network and client DICOM node configurations.

Once you have set the *AE Title* and TCP/IP *port* press the **Save Configuration** button. This will install the back-end DICOM server and may result in an additional *Windows Firewall* security dialog. As before, allow the application to access the network.

The dialog will now change to the *Installation* page (Figure 5-10). On this page you will create and test your archive’s database.

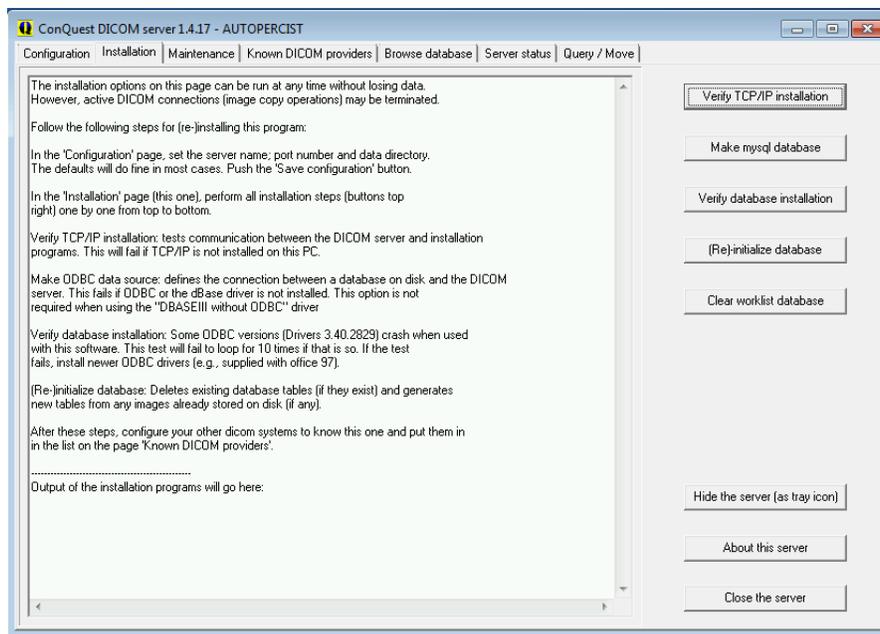


Figure 5-10 ConQuest DICOM Server Installation

You will first verify that the network installation is working properly by selecting **Verify TCP/IP installation**. Next you will create the database by selecting **Make MySQL database**. You will be asked to confirm the creation of a database, to which you will reply **Yes**. You will then give the database a name. You can accept the default (CONQUEST) or select your own.

!!! NOTE: Remember this name for later configuration of Auto-PERCIST™.

After providing a name you will be asked for the *root password* of the MySQL server which you specified during the MySQL installation. If you entered a valid name and password, the create database process should have completed successfully and a message stating so should appear in the log window within the dialog box. To verify the database installation press the **Verify database installation** button. The log window should report a successful test of the database. To complete the process, you can re-initialize the database by selecting the **(Re)-initialize database** button. You may get error messages the first time you attempt this and, if you do, just try a second time. If it is not successful on a second attempt then you most likely have a configuration problem. Refer to the DICOM.INI configuration section (Section 5.2.1 below) for possible solutions. At this time you should have an active DICOM archive running on your system. The database may be pre-populated with an example study.

You can connect your archive to other DICOM nodes from within the **Known DICOM providers** tab. You can also access the database for management purposes from the **Browse database** tab, and DICOM *Query/Retrieve* functions from the **Query/Move** tab. Please consult the *conQuest* documentation and your local PACS administrator for configuring connectivity to additional DICOM nodes.

!!! NOTE: It is important to remember to NOT enable image compression when configuring DICOM nodes in this archive. Auto-PERCIST™ must have access to the image data in non-compressed DICOM Part 10 format!!!

5.2.1 DICOM.INI Configuration

The main configuration file for the *conQuest* DICOM archive is a text file named *DICOM.INI*. It is automatically generated during the installation with default settings which may need to be changed to work properly with *Auto-PERCIST™*. On Windows based systems, many of these edits are accomplished through the user interface (Section 5.2 above). However, not all changes can be made through the user interface, and on Linux systems all changes must be made manually. Those changes are described below:

5.2.1.1 Network Configuration

In the Network Configuration section (Figure 5-11) of the *DICOM.INI* file, you will want to confirm both the *AE Title* (A) and the *DICOM Port* (B) settings for your archive.

```
# Network configuration: server name and TCP/IP port#
A→MyACRNema           = AUTOPERCIST
B→TCPPort              = 104
```

Figure 5-11 DICOM.INI Network Configuration

5.2.1.2 MySQL Database Configuration:

In the *MySQL* Configuration section (Figure 5-12), you will want to confirm the network location of the *MySQL* server (A). If the archive is running on the same machine as the database, then the *localhost* setting is appropriate, otherwise a valid TCP/IP address is required. Next is the name of the *MySQL* database which has been established for *conQuest* (B). The user name (C) and password (D) for an account with appropriate permission to access and write to the database are set. Finally, a flag to tell the system that the database type is *MySQL* (E) should be set to **1** (meaning *true*) and a configuration setting for how to handle *Back slash* ('\') characters in strings passed to the database (F) should also be set to **1**.

```
# Host, database, username and password for MySQL database
A→SQLHost              = localhost
B→SQLServer            = conquest
C→Username             = root
D→Password             = #####
E→MySQL                = 1
F→DoubleBackSlashToDB = 1
UseEscapeStringConstants = 0
```

Figure 5-12 DICOM.INI MySQL Configuration

5.2.1.3 General Database Configuration

In the Configure Database section (Figure 5-13), there is one setting that requires manually editing. This setting – *FileNameSyntax* - provides the syntax format which the archive should use when it saves received DICOM image files to the storage device. The preferred syntax to use is provided for Windows (A) and Linux (B). The specified format is recommended but not required, though it is a requirement that the image files be stored in a DICOM Part 10 format and not in one of the alternative compressed formats which are also available to the *conQuest* archive.

!!!Note: Auto-PERCIST™ will not be able to read compressed DICOM files!!!

```
# Configure database
:
(A) → FileNameSyntax = %name%\%studydate%\%studydesc%\%modality%\%v0008,103E%\%sopuid.dcm
(B) → FileNameSyntax = %name/%studydate/%studydesc/%modality/%v0008,103E/%sopuid.dcm
```

Figure 5-13 DICOM.INI Database Configuration

5.2.1.4 Image Storage Configuration

The last configuration section of *DICOM.INI* which requires manual attention is the setting which established the directory in which the received DICOM images are to be stored (Figure 5-14). This is the *MAGDevice0* setting (A). In the example provided here, syntax for a Windows hosted installation is provided. If you are installing *conQuest* on a Linux based machine, make sure that you use appropriate syntax (i.e. forward slash '/' instead of back slash '\') when constructing your path. Remember this setting as it you will need it when configuring *Auto-PERCIST™* to retrieve images from your archive.

```
# Configuration of disk(s) to store images
MAGDeviceThreshold = 0
MAGDeviceFullThreshHold = 30
IgnoreMAGDeviceThreshold = 0
MAGDevices = 1
(A) → MAGDevice0 = D:\archives\conquest\data\
NightlyCleanThreshold = 0
```

Figure 5-14 DICOM.INI Image Storage Configuration

5.2.2 ACRNEMA.MAP Configuration

The configuration file *ACRNEMA.MAP* (Figure 5-15) contains the information needed to establish communications between your archive and other DICOM devices.

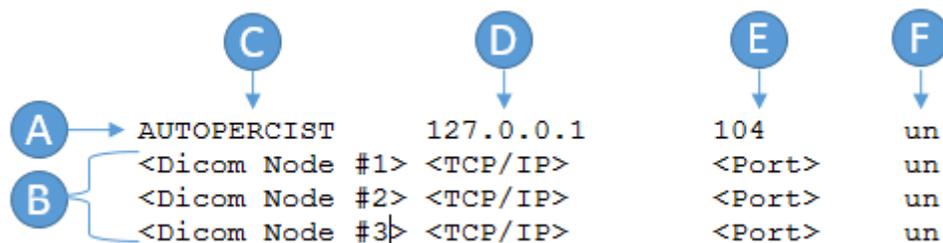


Figure 5-15 ACRNEMA.MAP Configuration

The first non-commented row in the file is an entry which identifies itself (**A**), all additional rows identify connected systems (**B**). Each entry contains four (4) elements: The *AE Title* of the device (**C**), the network address of the device (**D**), the network *port* on which the DICOM service is running (**E**), and the type of *compression* which is used (**F**). It is important that the Compression field (**F**) be set to 'un' (uncompressed) for all entries, as *Auto-PERCIST™* is unable to read compressed images.

Your system is now ready to receive images!

5.3 AUTO-PERCIST™

Auto-PERCIST™ is currently available for multiple computers in multiple configuration. However, the only installation packages which have been tested are those for Windows-based computers. There are four installation packages for Windows; one set for both 32 and 64-bit operating systems, and one exclusively for 64-bit version of Windows. Each set contains one installation which includes an embedded Java Virtual Machine (VM) and one which does not. It is recommended that, unless the user is an expert in Java VM installation and configuration, that the installation package with the embedded Java VM be used. See Section 4.4 above for instructions on downloading the appropriate *Auto-PERCIST™* installer for your system.

When you run the installer you will once again be presented with a security dialog box (a *User Account Control* dialog). Respond in the affirmative to allow the program to proceed with the installation. After the installer unpacks its contents it will present the user with an *Introduction* to the installation of *Auto-PERCIST™* (Figure 5-16).

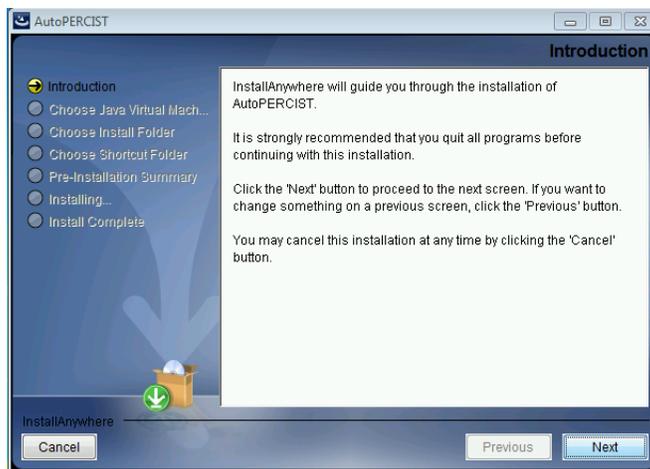


Figure 5-16 Auto-PERCIST™ Installation Introduction

Please click on the **Next** button to continue. At this point of the installation you choose which Java Virtual Machine (VM) the program should use (Figure 5-17). If there are none already installed on your machine, or none detected that are the correct version for this program, you can choose to use the Java virtual machine included in the installer. Otherwise, you can choose one that is already installed on the computer. *Auto-PERCIST™* requires Java version 1.7 or greater, and runs best on a 64-bit VM.

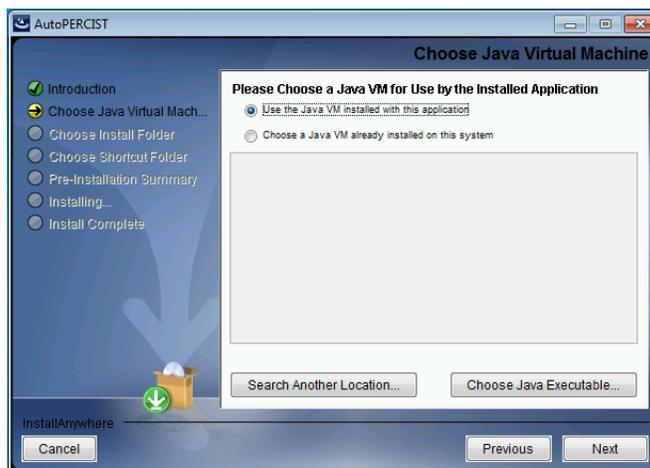


Figure 5-17 Auto-PERCIST™ Installation Java VM Selector

Click **Next** to select an installation location for the software (Figure 5-18).

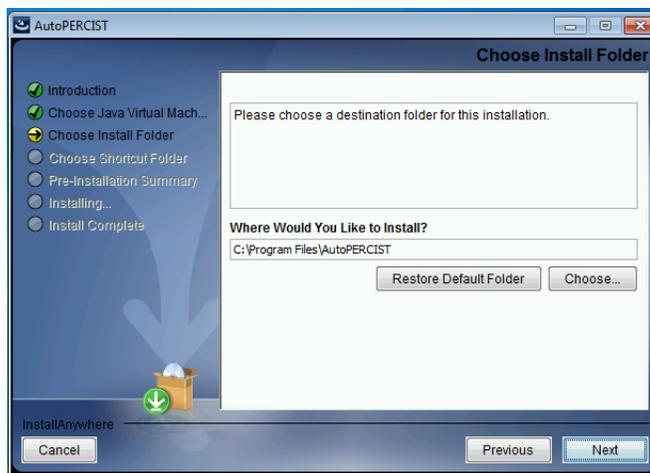


Figure 5-18 Auto-PERCIST™ Installation Destination Folder

Once again, you should allow the program to install itself in the default location and select **Next**. You will now be allowed to choose the location and type of program shortcuts to install (Figure 5-19).

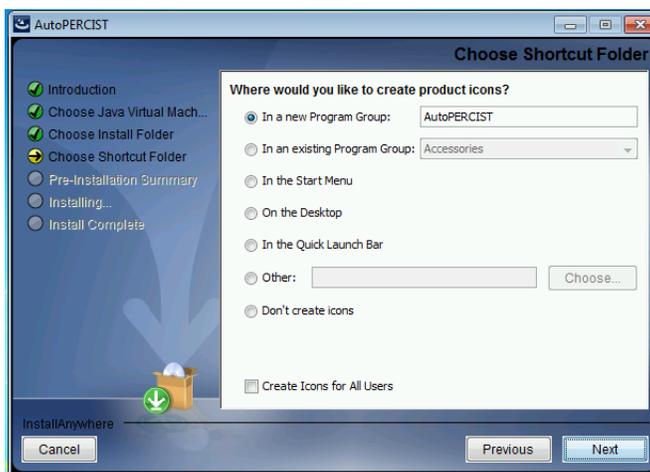


Figure 5-19 Auto-PERCIST™ Installation Shortcut Selector

If there are multiple user accounts on the installation machine, you may want to select *Create icons for All Users*. All other options are at the user’s discretion.

At this point all user installation options have been established and a summary of those options are presented in a text window of the dialog box. If you would like to change any settings you can do so by selecting the **Previous** button and re-selecting your options. If you are satisfied with the options you have selected you can proceed with the installation by click the **Install** button.

The installation process will now proceed. Once completed, you should be able to close the dialog box to quit the installer.

In order to run *Auto-PERCIST™* you must now obtain a license.

5.3.1 Licensing

Auto-PERCIST™ is licensed through a software *license key* which is specific to the machine on which it is installed. In order to obtain a *license key* you must first generate a request which contains encoded information specific to your computer which is used to generate the *license key*. In order to generate that request, run the *License Manager* program found in the **AutoPERCIST** program group, accessible via the **Start** menu (Figure 5-20, as found on Windows 7).

!!! IMPORTANT: You should run the *License Manager* with administrative privileges for your machine so that the license file can be written to a protected application directory.

When you run the *License Manager* you will once again be presented with a security dialog. Please respond in the affirmative. The program will check the system for a valid *license key* and, if not found, will present the user with an error dialog (Figure 5-21) from which they can either direct the *License Manager* to a location of a valid *license key* or generate the information required to request a *license key*.

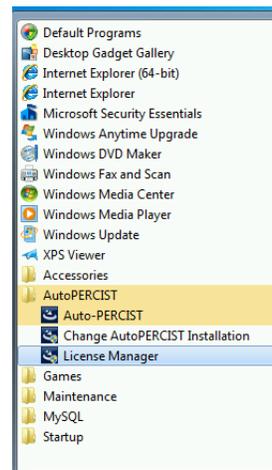


Figure 5-20 *Auto-PERCIST™ License Manager*

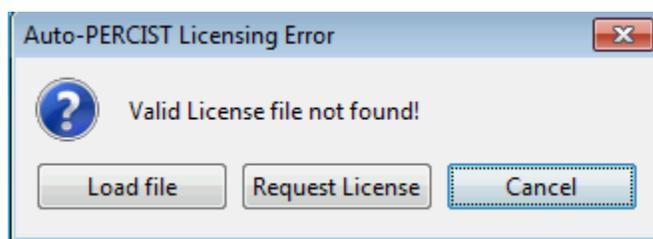


Figure 5-21 *Auto-PERCIST™ License Manager Error Prompt*

If you do not have a valid *license key* and need to request one, select the **Request License** button to be presented with a *license key* request form (Figure 5-22). Complete the editable text fields of the form and select the **Generate Request** button.

Please note that the “Machine ID” field will be unique to your particular machine!

You can then select the **Copy to Clipboard** button and paste the contents of the request into an e-mail and send it to iratlab@jhmi.edu. A machine specific *license key* file will be sent by reply e-mail.

Figure 5-22 Auto-PERCIST™ License Manager Request Form

Once you have received your machine specific *license key* file, re-run the *License Manager* program. This time, press the **Load file** button and navigate the file open dialog until you locate and select the *autopercist.lic* file. If the *autopercist.lic* file is valid, a dialog box will appear that reports so, otherwise record any resulting error message and send it in an e-mail to iratlab@jhmi.edu and we will attempt to correct the situation.

At this point you should be able to run the *Auto-PERCIST™* program! If the *Auto-PERCIST™* program locates a valid *license key* file, the first dialog you will see is a *Terms of Use* statement (Figure 5-23).

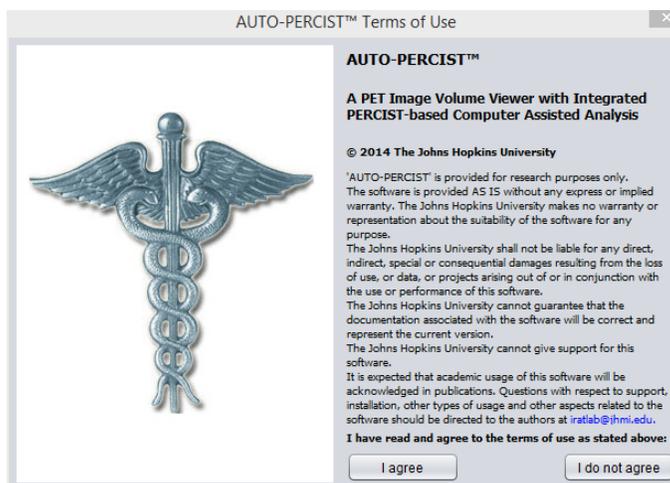


Figure 5-23 Auto-PERCIST™ Terms of Use

You must agree to the *Terms of Use* each time you launch the *Auto-PERCIST™* program. After you agree to the *Terms of Use*, the dialog will clear and the main application window of *Auto-PERCIST™* will appear:

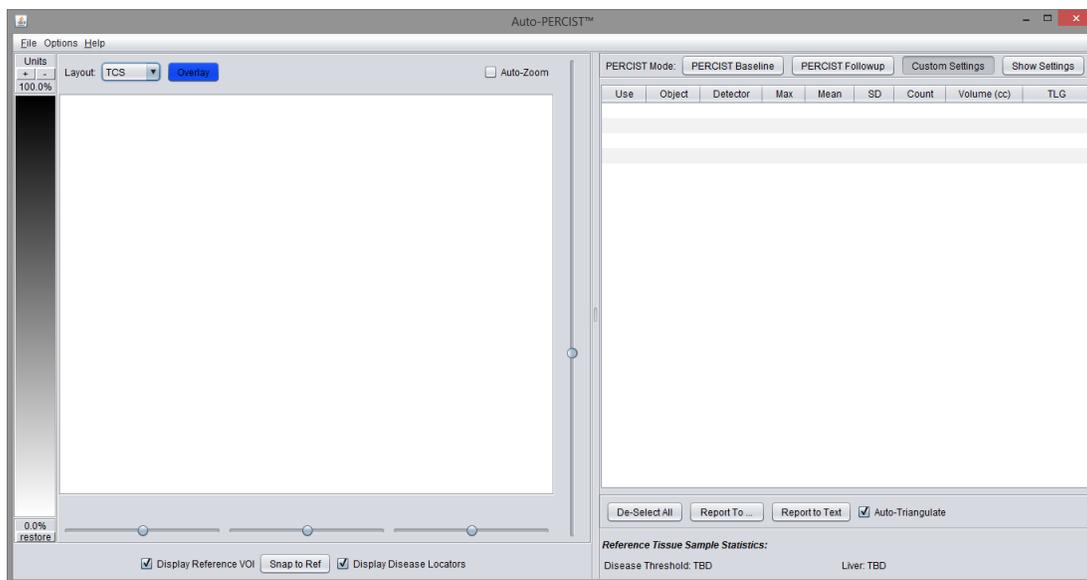


Figure 5-24 Auto-PERCIST™ Main Application Window

You are now running *Auto-PERCIST™*!

5.3.2 Configuration

While you can run *Auto-PERCIST™* directly at this point, to make the experience of loading and saving data easier, there are a few configuration options which the user may want to make at this point. The user has the option of having all user settings saved into a default properties file when the program is exited via the **File→Exit** menu (by default all settings are saved in a file named *autopercist.properties*), or via the **File→Properties** menu option, where the current property settings can be saved to - or a previously saved property file can be loaded from – a disk file.

!!! IMPORTANT: *If at any time you experience a failure of Auto-PERCIST™ to start, especially following an upgrade or re-install, please delete the autopercist.properties file and try again. There is a known issue in which a corrupted or improperly formed autopercist.properties file can prevent the application from launching.*

5.3.3 DICOM Archive Connectivity

While image data can be loaded directly from the file system, the easiest and most convenient way to access your PET data is by connecting to a locally installed DICOM archive (described in section 4.3 above). In order to connect with that system, you will need to know the *name*, *password* and SQL server *port* number of the archive’s database.

To enter these settings into *Auto-PERCIST™*, select **File→Load from DB** menu.

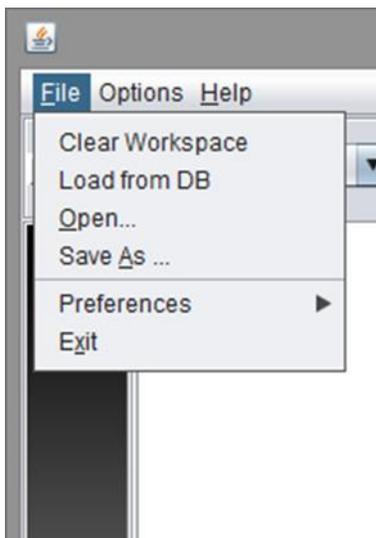


Figure 5-25 Auto-PERCIST™ File - Load from DB Menu

You will be presented with a *DICOM DB Query* dialog box (Figure 5-26). From within this dialog you can configure your connection to the archive database. It will appear empty at first.

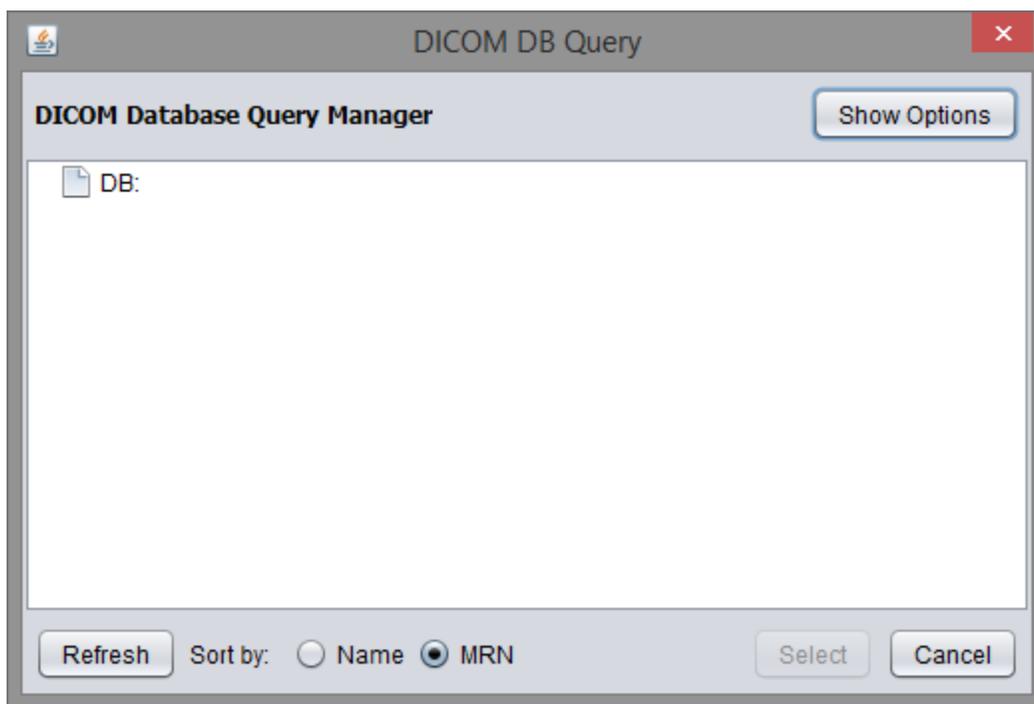


Figure 5-26 Auto-PERCIST™ DICOM DB Query Dialog

Selecting the **Show Options** button will open the configuration panel of the dialog box (Figure 5-27).

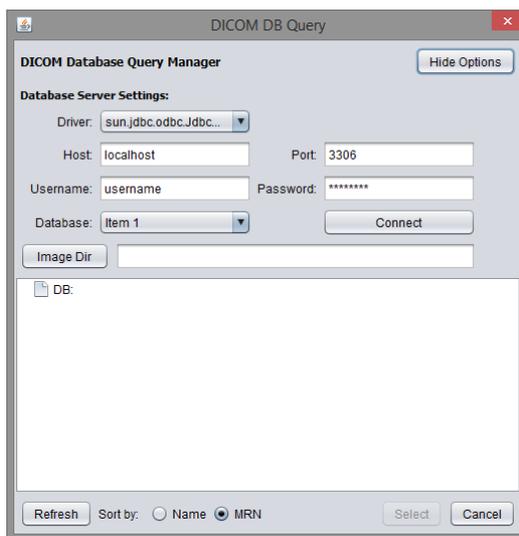


Figure 5-27 Auto-PERCIST™ DICOM DB Query Options Setup

For connectivity via the *MySQL* database (the only one currently supported), select the *com.mysql.jdbc.Driver* in the *Driver* drop down box. If the *MySQL* database is running on the same machine as *Auto-PERCIST™* leave the *host* setting as *localhost*. If you did not change the *MySQL port* setting during the configuration, leave it at the default setting of **3306**. Enter the administrator user name (*root*) and the *password* you assigned for the *MySQL* server, then press **Connect**. At this time, the *Database* dropdown will populate with the names of the databases currently installed on your database server (Figure 5-28).

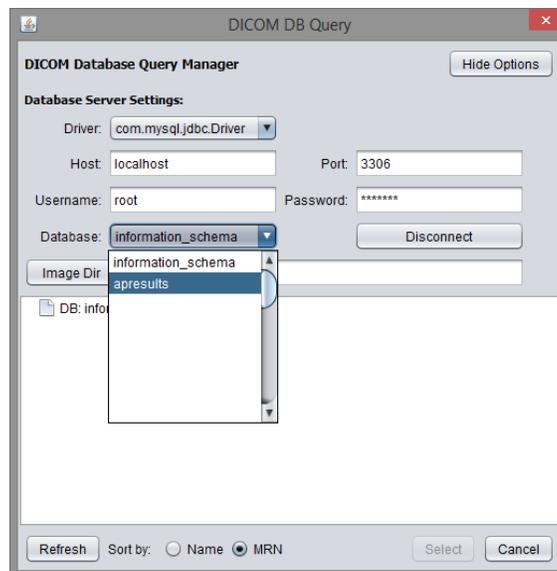


Figure 5-28 Auto-PERCIST™ DICOM DB Query Configuration

There will be multiple entries even if you just installed the database for your *Auto-PERCIST™* installation and haven't created anything beyond the DICOM archive database. Locate and select the name of the database you created as part of the DICOM archive installation. In the example presented here, the name is *apresults*. Once you have selected your database you will need to tell *Auto-PERCIST™* the directory within which the DICOM archive is storing the actual image files. Select the **Image Dir** button to open a *File Directory* dialog box (Figure 5-29) and navigate to the directory in which you installed the DICOM archive. Inside this directory you will find a subdirectory named *data*. Select that directory and press **Open**.

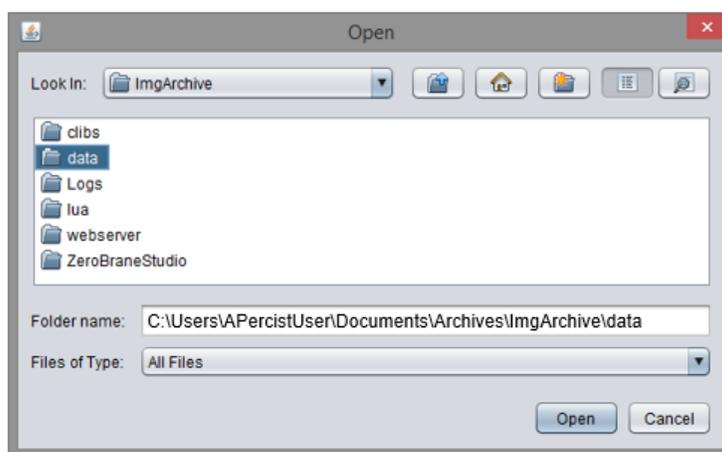


Figure 5-29 Auto-PERCIST(TM) DICOM DB File Location Setting

The *Image Dir* text box will now be populated with the directory path to the image files stored in your DICOM archive.

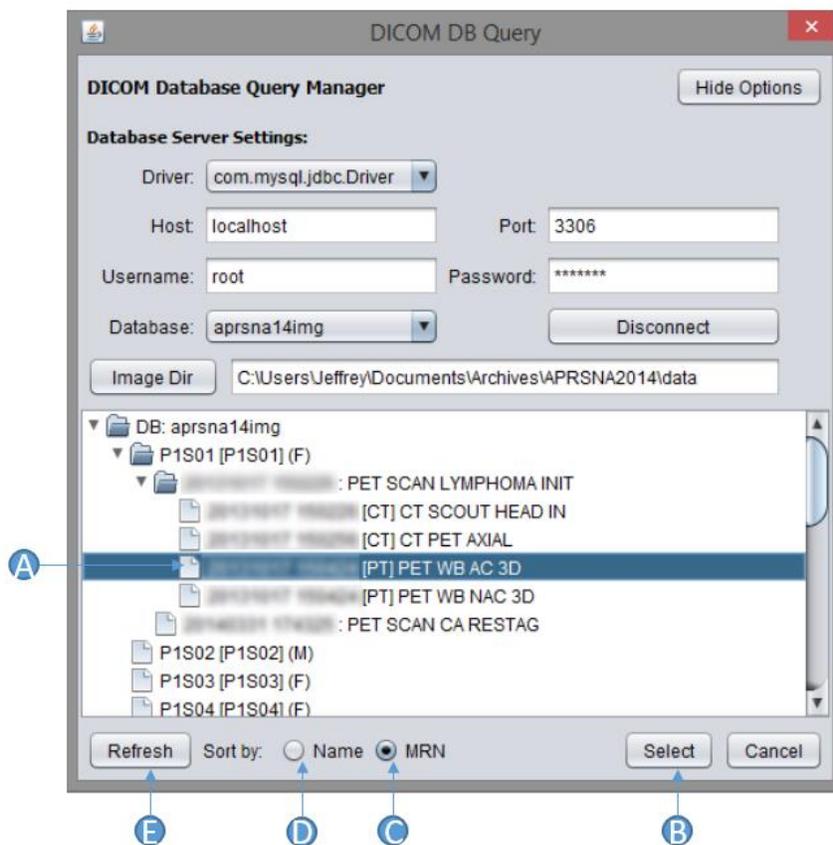


Figure 5-30 Auto-PERCIST™ DICOM DB Query Dialog

The DICOM DB Query Dialog (Figure 5-30) allows you to quickly locate the study series you wish to load by navigating the data presented in a Tree diagram (A) organized in the following hierarchy: Patient Name → Study → Series. The data can be sorted at the root level by either Medical Record Number (MRN) (C) or by the patient’s last name (D). The DICOM archive will store all valid DICOM data, though at this time *Auto-PERCIST™* can only load PET modality data. This is evidenced by the fact that the **Select** button only becomes available for selection when you select a valid PET dataset. Once a valid data set is selected, the user can proceed with loading the data by either double-clicking the entry (A) or pressing the **Select** button (B).

Update Note: As of version 0.6, *Auto-PERCIST™* will now allow loading of multiple image series of multiple modalities simultaneously. However, visualization and disease modelling (derivation of candidate disease objects) currently only uses the first series loaded which must be an FDG-PET study, and all series are assumed to be in the same ‘space’. This is currently an experimental feature to allow the transfer of the ‘disease model’ from the ‘baseline’ study to propagate to ‘follow-up’ studies, but is a

feature which is not yet fully developed. Please refer to future documentation as this feature is further developed.

At this point you can select a valid PET image set. Upon selection the dialog will close and *Auto-PERCIST™* will begin loading and processing the study.

Depending on the speed of your computer, the left side of the application (Figure 5-31) will soon present the PET image dataset in the default Transaxial-Coronal-Sagittal (TCS) display mode with the default *Monochrome* Look-up Table (LUT). After a bit more time the results of the *Auto-PERCIST™* processing will appear in the table to the right side of the application. The first thing you will probably want to do is to configure the LUT table to your particular liking, as well as the display format and candidate lesion overlay color.

Right-click on the graphic representing the LUT table and a pop-up menu will appear which will allow you to adjust the LUT settings. Clicking on the OVERLAY button will allow you to choose a color for the candidate lesion overlays.

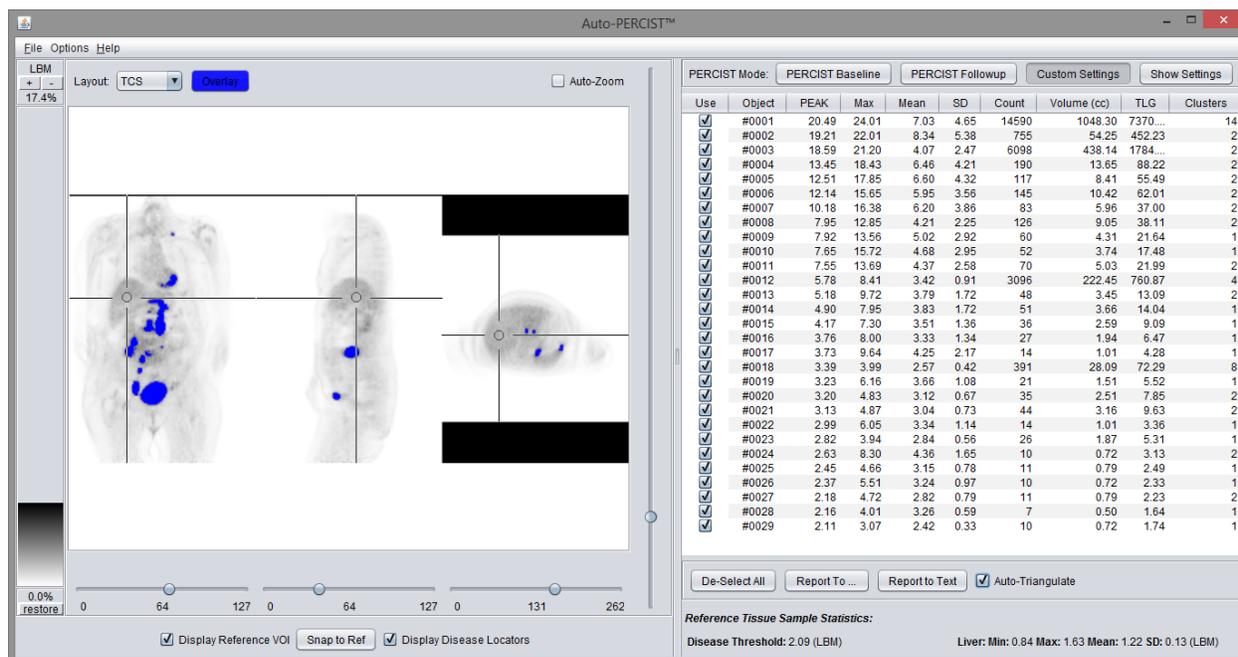


Figure 5-31 Auto-PERCIST™ Main Application Window

5.3.4 Results Database Configuration

If you wish to automatically save the results of your *Auto-PERCIST™* analysis to an external database for further analysis and reporting, you can do so quickly and easily from within *Auto-PERCIST™*. The Database Server Settings dialog is access via the **Options→Results→Database** menu (Figure 5-32).

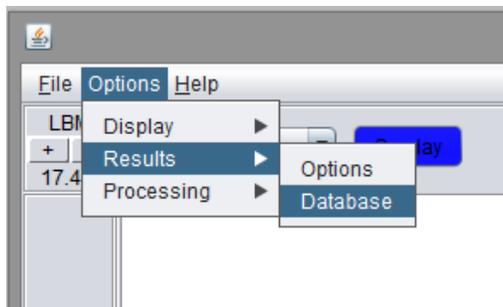


Figure 5-32 Auto-PERCIST™ File Results Database Menu

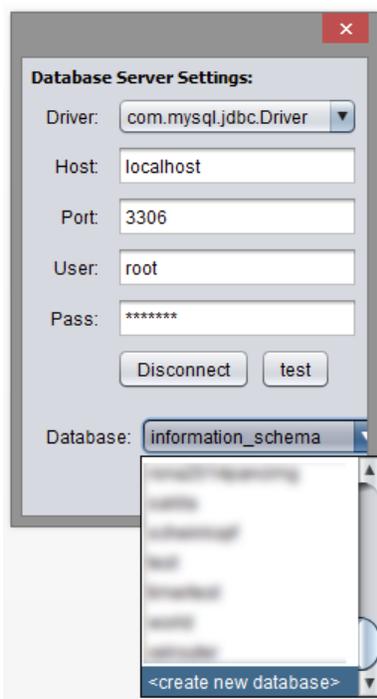


Figure 5-33 Auto-PERCIST™ Database Server Settings

This dialog (Figure 5-33) is configured in much the same way as the database configuration which connects *Auto-PERCIST™* to the DICOM Archive database. First, select the correct driver with which to connect with the database (as before, only the *com.mysql.jdbc.Driver* is currently supported). If using the default *MySQL* database server installed locally (as described in section 4.1), keep the *host* and *port* settings at their default settings and enter the *root* *username* and *password* in the correct fields. Upon clicking the **Connect** button, the *Database* combobox will populate with the names of all the existing databases currently existing on the server. At this point you will probably want to create a new database to store your results. If you are working on multiple projects you may want to consider creating a unique results database for each project. Just be sure to connect to the proper database (or load a project specific properties file) for each analysis session.

In order to create a new database, just select the *<create new database>* entry from the Database list. You will be presented with a dialog in which you can enter a name for your results database (Figure 5-34).

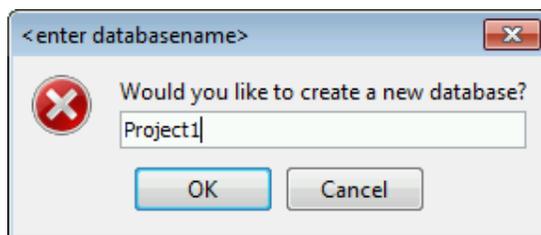


Figure 5-34 Auto-PERCIST™ Create New Results Database

After you select **OK**, you will get an error message stating that that particular database does not exist and asking if you'd like to create one with that name. Answer in the affirmative. If all goes well the main dialog will return to its prior state. You must then select your database from the Database combo-box and click the **Close** button.

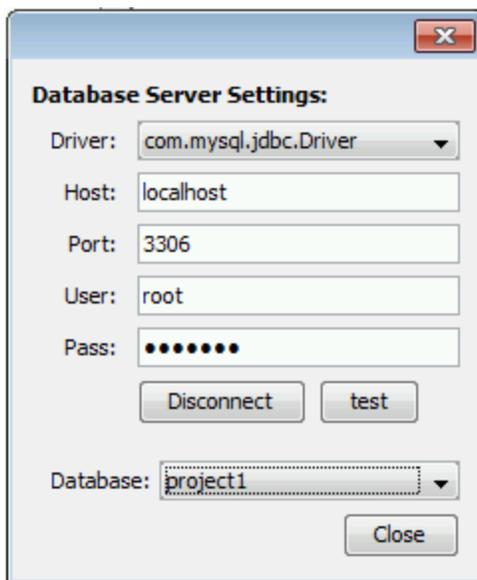


Figure 5-35 Auto-PERCIST™ Configured Database Results Dialog

As stated earlier, once this setting is in place, as long as the user exits the program via the **File→Exit** menu, or by manually saving a *properties file* via the **File→Properties** menu, these settings will be retained between program runs.

5.3.5 Results Options

To a limited extent, you can control what Results data is exported to your Results database.

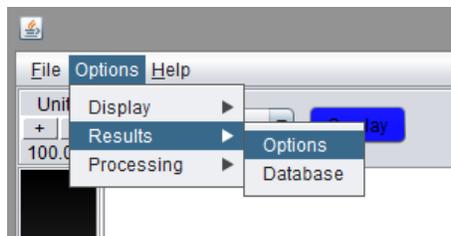


Figure 5-36 Auto-PERCIST(TM) Results Options Menu

By selection the **Options -> Results – Options** menu (Figure 5-36), the user will be presented with the Results Options dialog (Figure 5-37).

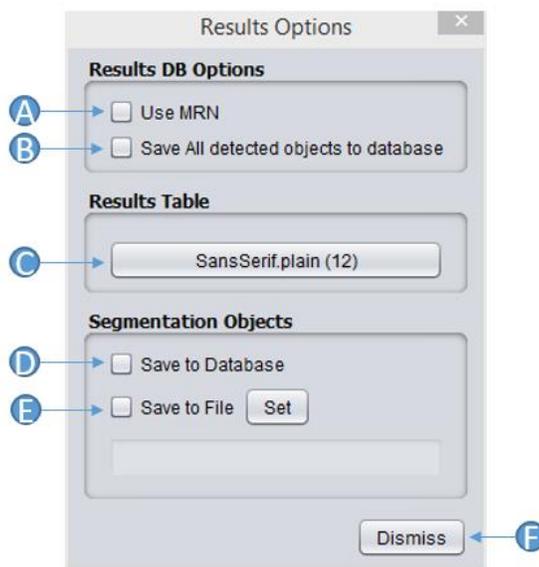


Figure 5-37 Auto-PERCIST(TM) Results Options Dialog

In this dialog, the user can set global results settings, such as whether or not to use and save the patient MRN when saving the analysis results to the database (A) and whether all candidate lesions, whether identified as disease or not, are saved to the database (B) (a flag is set for each entry indicating whether the user classified it as disease or not for that particular analysis session). The font used in the display of the results table can be changed (C). Finally, the user can select whether the lesions classified as disease be saved as DICOM Segmentation Objects. The user can decide to save them directly in the results database (D) as a binary stream in DICOM format, and/or as individual DICOM files in a directory of the user’s choosing (E).

5.3.6 User Options

The remaining user options are described in the next section. As stated before, all user options can be retained between program executions by either manually saving a *properties file* or exiting the program via the **File→Exit** menu and answering the ‘Save Properties File’ dialog in the affirmative.

6 USAGE

Now that you have completed the installation and basic configuration of *Auto-PERCIST™* it is time to start using it!

To get started, you can load a PET image data set from either your connected DICOM archive **File→Load from DB** or directly from the file system **File→Open**. If you choose to open a dataset directly from the file system, select any PET image file from the list of files in the source data directory. The program will read the file you have selected and then scan all the other files in the directory to find those with matching Series UIDs and will build the series from the resulting set of images. Once you've loaded a dataset, you should have a display similar to the one below

(

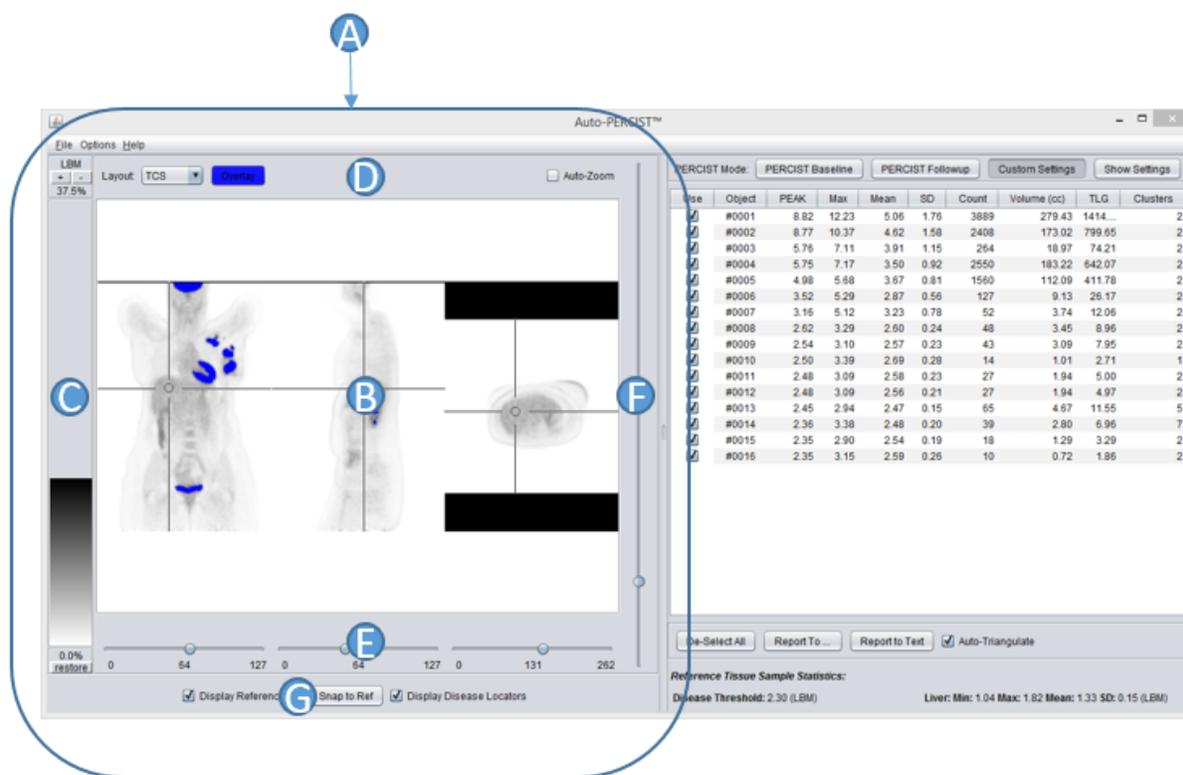


Figure 6-1).

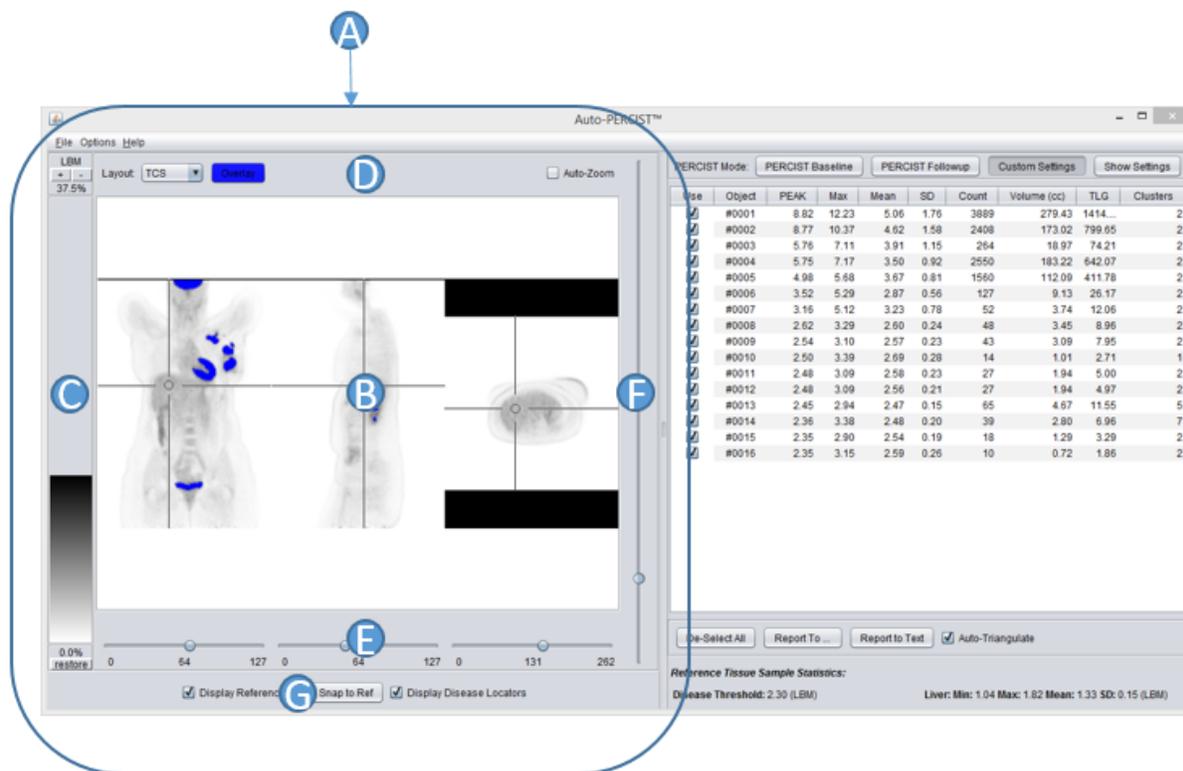


Figure 6-1 Auto-PERCIST™ Main Application Window

6.1 DISPLAY PANEL

Let's begin with a review of the left side of the application windows, the *Display Panel* (A). There are essentially four components to the *Display Panel*: the *Image Display window* (B), the *Look-Up-Table (LUT) Control* (C), and the *Image Display Controls* (D), (E), (F) and (G).

6.1.1 Look-Up-Table Slider

The *LUT slider* is a graphical representation and controller for the *window-level* settings for the display window. The system automatically calculates a preferred *window-level* setting based on the automatically derived normal *reference tissue* sample (discussed in Section 6.3.1 below). If this setting is not suitable to the user, the user can click and drag the top or bottom of the *LUT slider* to either stretch or shrink the *window* width. The LUT graphic can also be grabbed in the middle and moved up or down to adjust the Level. The key elements of the graphic control are shown here:

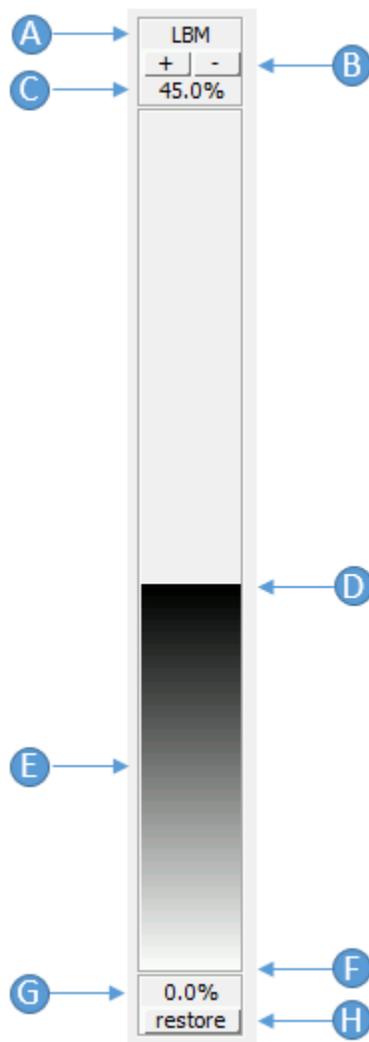


Figure 6-2 Auto-PERCIST™ LUT Control

The units in which the image data has been converted to for internal processing are identified (A). These are user selectable, depending on the system capabilities given the loaded data, and can be variants of SUV (LBM – Lean Body Mass, BSA – Body Surface Area, BW – Body Weight, or RAW). Setting the image units is described elsewhere in this manual (See section 6.3.1 below). The (+) and (-) buttons allow either expansion or contraction of the available dynamic range of the control. The default dynamic range of the control are the image data’s true minimum and maximum after conversion to the image units described by (A). Similarly, the minimum value for the window is described by element (G), represented as a percentage of the image data dynamic range. Item (C) reflects the current position of the display window’s upper value represented as a percentage of the image data’s dynamic range. The display window’s upper value can be manipulated by selecting the top of the LUT graphic, located at position (D) and moving up or down. Similarly, the lower end of the window can be manipulated in the same way

by select the graphic at position (F). The Level of the entire window can be manipulated by selecting the middle of the graphic at position (E) and translating the LUT up or down the available dynamic range. The button identified as element (H) allows the user to restore the LUT control to true image minimum and maximum.

The actual LUT can be changed by right-clicking on the control and selecting a new LUT from the popup-menu. The user can also choose to invert the current LUT from the same popup-menu.

6.1.2 Image Display Controls

The Image Display Controls available on the top of the display window include the layout manager, the overlay color selector and an Auto-Zoom toggle (

Figure 6-3 Image Display Controls - Top

).

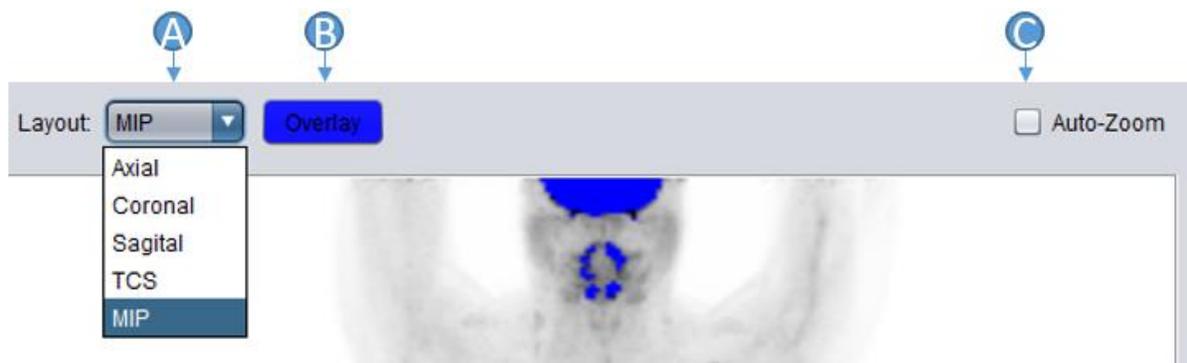


Figure 6-3 Image Display Controls - Top

The Layout dropbox (A) allows the user to control how the image data is displayed (i.e., Axial, Coronal, Sagittal, TCS or MIP). The user can select which color to render an overlay of the candidate disease objects by pressing the **Overlay** button (B) and opening a *Choose Overlay Color* dialog. The user can either select a color by which the disease candidates will be rendered in the image display, or press either **Cancel** or close the dialog via the **X** button in the upper right corner to remove the overlay color. Finally, the user can select whether the system should automatically calculate the display zoom to fill the current workspace or allow the user to manually adjust the zoom level (C).

The Far Bottom of the Image Display Panel contains controls which are independent of the current image layout. They include toggle buttons which indicate whether the Normal Reference VOI should be displayed, whether a bounding cube should be displayed to highlight the disease object currently selected on the Results Table (See 6.2 below), and if the display should be auto-triangulated to the Normal Reference VOI.

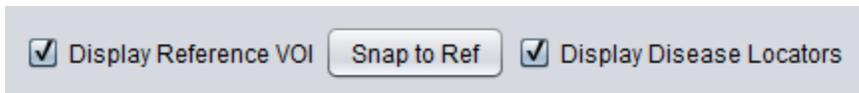


Figure 6-4 Image Display Controls - Far Bottom

The Right side of the screen contains an image zoom scroller for manual control of the display image zoom level. It is only active if the Auto-Zoom feature is unchecked.

The Bottom of the Image Display Panel contains controls which will change depending on the currently selected layout. When a single plane view is displayed (e.g. Axial, Sagittal or Coronal), it will display a single scroll control to allow you to select the displayed frame of data. When the layout is set to TCS (Transaxial-Coronal-Sagittal), each display pane will have its own scroll control. Finally, when MIP (i.e. Maximum Intensity Projection) mode is selected, the controls will change to allow free rotation (A), snap-to quadrant rotation (B), and automatic, movie-mode projection (C) with adjustable speed (D).

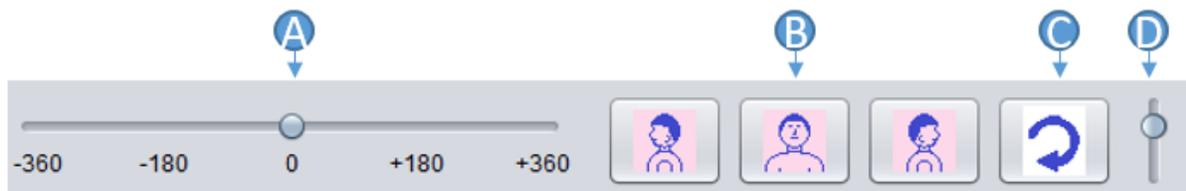


Figure 6-5 MIP Image Display Controls

6.1.3 Image Display Window

The Image Display Window, besides serving as the primary viewport to the image data, has several unique features and can be manipulated directly by the user through use of the mouse.

6.1.3.1 *Transaxial, Coronal and Sagittal Display Modes*

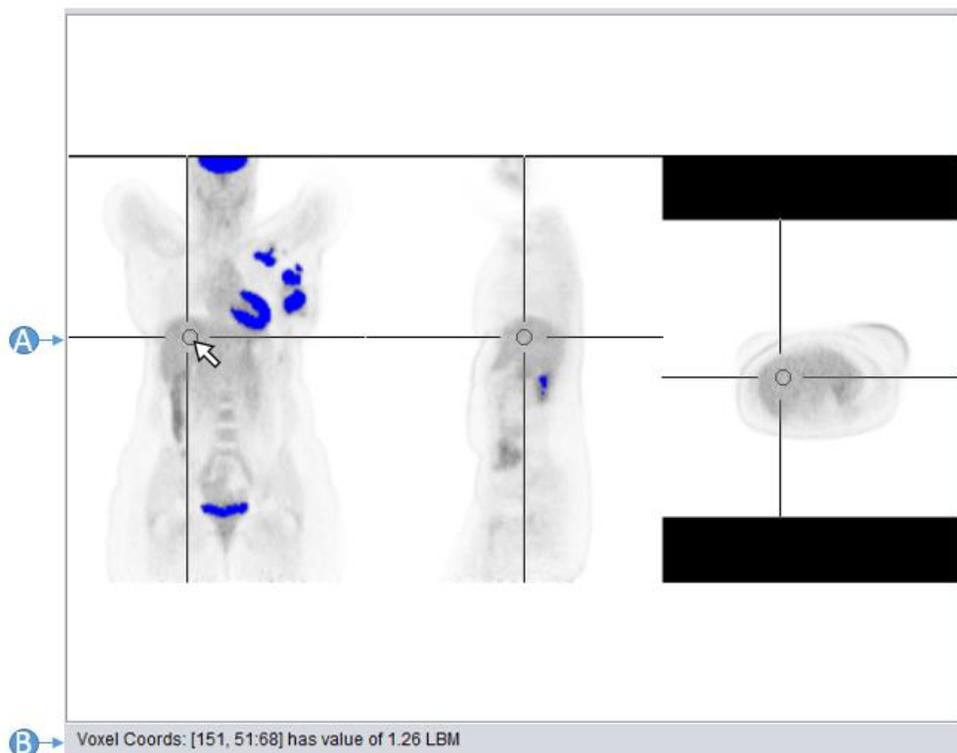


Figure 6-6 Auto-PERCIST™ TCS Display Mode

In Figure 6-6, the display is in the TCS display mode format. The display has been auto-triangulated to the center of the automatically located normal reference tissue VOI (A). Tissue objects with SUV-LBM values greater than the PERCIST threshold have been identified and are overlaid in blue. Cross-hairs indicate the current cursor position, while the voxel reporter on the bottom of the screen (B) provides the coordinates and value for that particular voxel.

By dragging the mouse the user can change the point of triangulation of the display. In addition, by rolling the mouse scroller (if one is available), the user can scroll through the stack of images which lie under the current mouse position.

As mentioned before (6.1.2 above), the display of the normal reference tissue VOI can be turned off and on through the *Display Options* panel, as well as the color of the disease candidate overlays and the overall format of the display screen.

6.1.3.2 *Maximum Intensity Projection (MIP) Display Mode*

Auto-PERCIST™ is also capable of displaying the entire volume of data in a MIP display. This is illustrated below (Figure 6-7):

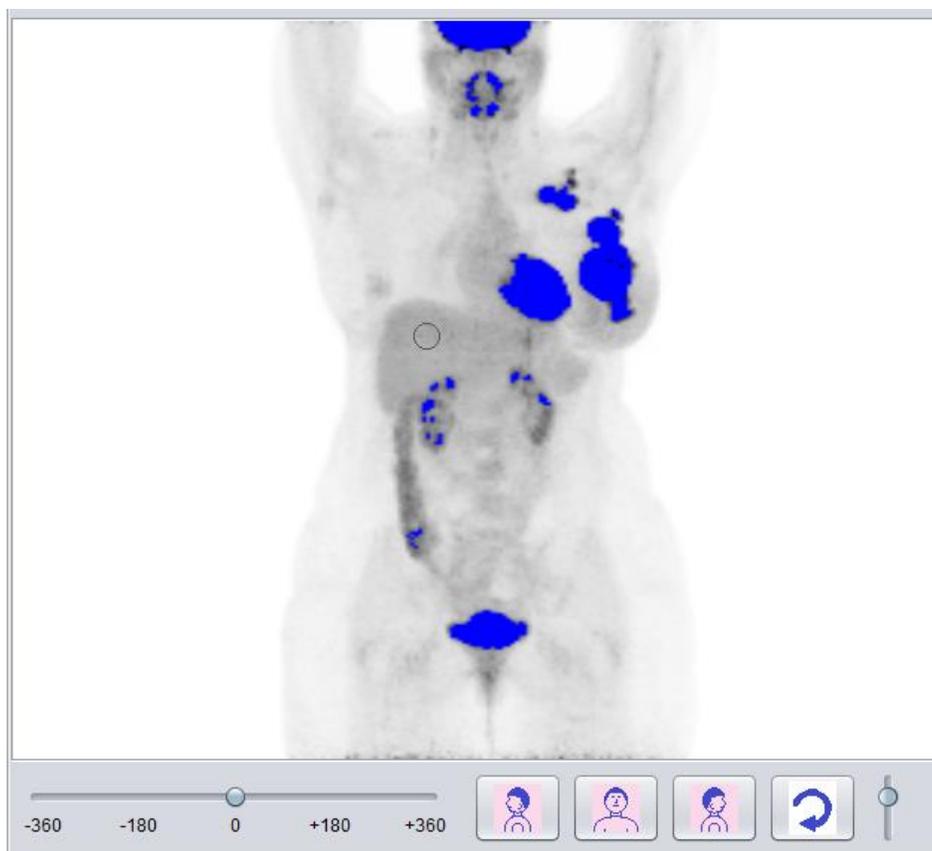


Figure 6-7 Image Display Window - MIP Layout

In this mode, many of the display options are still available, although the mouse does take on a different behavior. The user can still control the display of the normal reference tissue VOI and the colorization of the disease candidate objects through the *Display Options* panel. However, the mouse now acts solely to manipulate the scrolling of the window through the projections. This can occur by either dragging the mouse through the field of view or by rolling the mouse scroller while the image display window has the mouse focus.

6.2 RESULTS TABLE

The Results Table (Figure 6-8) (A), located on the bottom half of the right side of the application windows, is where all the action really occurs. In this table, each populated row of data represents a single candidate disease object which *Auto-PERCIST™* has automatically pre-identified based on the specified criteria (the user can manipulate these criteria in the *Options Panel* described in Section 6.3 below). This table is also connected to the *Image Display Window* on the left side of the screen to allow the use to quickly navigate through the study volume.

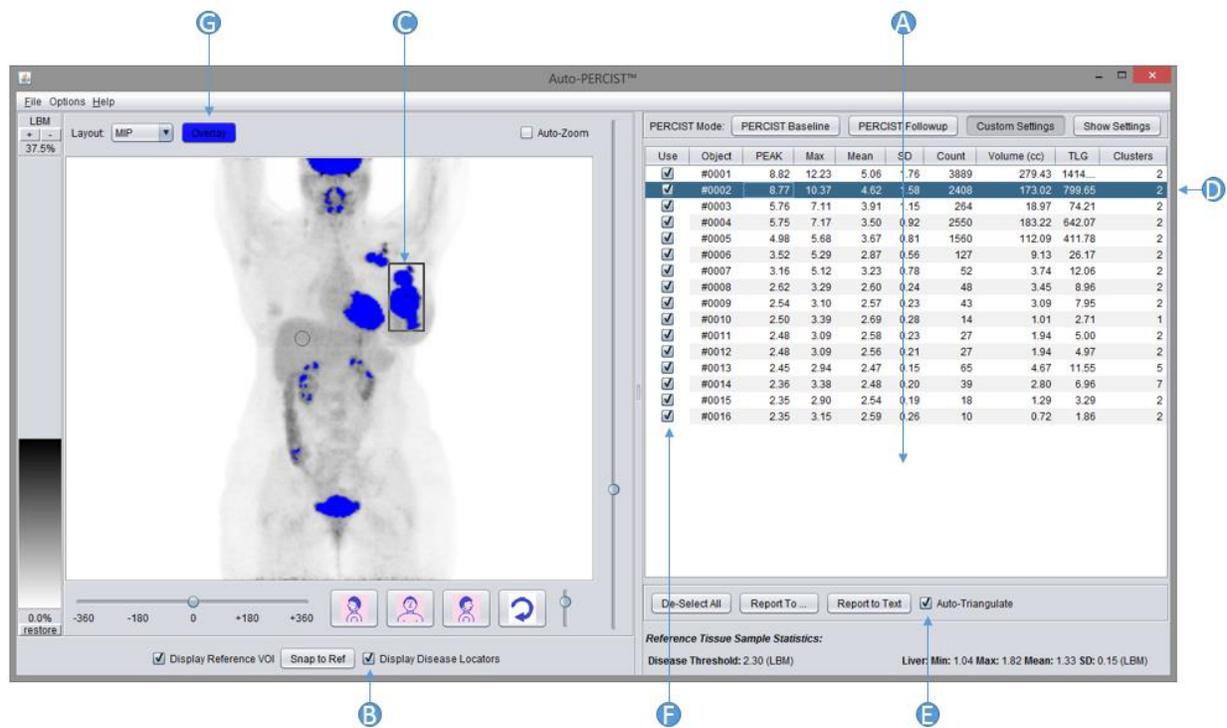


Figure 6-8 Auto-PERCIST™ Results Table

By default, all candidate disease objects are pre-selected for display. If the ‘Display Disease Locators’ option (B) is selected, then a bounding box (C) will be drawn around the target object if it is selected in the Results Table (D) by either clicking the row with the mouse, or selecting with the keyboard. Multiple objects can be simultaneously selected by manipulating the table as you would in most other programs (pressing **SHIFT** will allow a continuous range to be selected and pressing **CTRL** will allow a discontinuous range to be selected). If the *Triangulate to Selection* option is checked (E), then the image display will automatically re-triangulate to the center of the target object of the last object selected.

The user can select, or de-select, an object for display (and inclusion in any export of the results) by checking or un-checking the *Use* checkbox at the front of each table row (F). After the user reviews each candidate object and makes a determination as to whether they are disease (checked) or normal tissue (unchecked), the image display will automatically update, only displaying overlays for the selected disease objects.

6.3 OPTIONS PANEL

While in most cases the user will want to use *Auto-PERCIST™* with its default settings (auto-normal reference tissue detection, high-resolution VOI sampling, PERCIST baseline threshold, etc.), the user does have control over many aspects of the *Auto-PERCIST™* process.

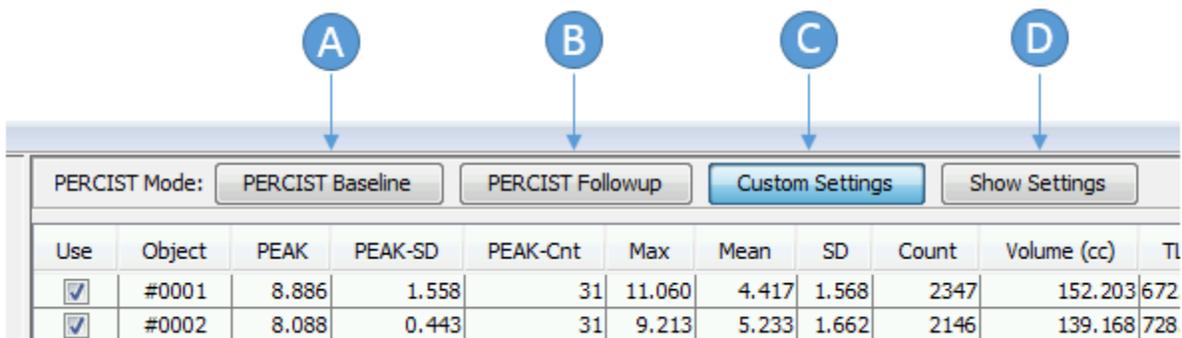


Figure 6-9 Auto-PERCIST™ Options Panel

To begin with, there are two shortcut buttons on the top of the Options Panel (Figure 6-9) which allows the user to quickly put the program into either **PERCIST Baseline** (A) or **PERCIST Followup** (B) modes. The only difference between these modes is the method by which the disease assessment threshold is calculated.

NOTE: When Auto-PERCIST™ is launched it reads a 'Properties' file (if one exists) which loads the default settings as last saved by the user (see Section 5.3.2). Thus, even if all the settings are equivalent to the default 'Baseline' or 'Followup' conditions, the application shows that 'Custom Settings' (C) are in effect. If during an analysis session the user decides to select the 'Baseline' (A) or 'Followup' (B) settings, then that button will be highlighted.

In order to view the various system options the user will press the **Show Settings** button (D), upon which a tabbed panel will open between the *Options Panel* and the *Results Table* (Figure 6-10).

6.3.1 Disease Threshold Panel

6.3.1.1 Reference Sub-Panel

PERCIST Mode: PERCIST Baseline | PERCIST Followup | Custom Settings | Hide Settings

Disease Threshold | Object Detection | VOI Styles | Demographics | Messages

Reference | Calculation

Image Units: LBM | Methodology: DICOM Vendor

Normal Tissue Activity Determination

Auto-Determined

Initial Floor: 0.9 | Terminating SD: 0.5 LBM (g/mL)

Detection Methodology: Slice Volume Mixed

Remove Data Contra-lateral to Liver

Smooth with 5 mm Radius spherical filter
(volume = 523.599 mm³)

VOI Radius 15 mm (volume = 14137.167 mm³)

Manually Positioned

Forced Value

Re-Detect

Use	Object	PEAK	PEAK-Cnt	Max	Mean	SD	Count	Volume (cc)	TLG	Clusters
<input checked="" type="checkbox"/>	#0001	8.886	31	11.060	4.417	1.568	2347	152.203	672.222	2
<input checked="" type="checkbox"/>	#0002	8.088	31	9.213	5.233	1.662	2146	139.168	728.196	2
<input checked="" type="checkbox"/>	#0003	6.455	22	8.679	4.396	1.175	2405	155.964	685.683	2
<input checked="" type="checkbox"/>	#0004	5.250	31	6.590	3.714	0.819	814	52.788	196.036	2

Figure 6-10 Auto-PERCIST™ Options Panel - Disease Threshold Tab

By default, the first option panel to appear is the *Disease Threshold* Panel (A). This panel contains two sub-panels: *Reference* and *Calculation*, accessible via the tabs (B) on the left. The *Reference* panel allows the user to set the *image units* (C) in which the PET data should be converted into before processing takes place, as well as the algorithm used to calculate these values (D). If *DICOM* is selected, then only basic information is used to derive the requested SUV values. If *Vendor* is selected, then the software will probe vendor specific fields in the file header to extract information such as residual dose, etc., allowing a more refined calculation of SUV to take place.

The *Normal Tissue Activity Determination* section is where the user can select the method by which the reference tissue VOI is placed within the image volume. The default option, *Auto-Determined* (E) uses a method proprietary to *Auto-PERCIST™* for locating and placing the normal reference tissue VOI within the liver.

The *Manually Positioned* setting (Figure 6-11) (F) allows the user to refine the placement of a VOI which had previously been placed using the *Auto-Determined* method. When selected, the user can drag the reference VOI in any of the planar display modes (Axial, Sagittal, Coronal or TCS) with the mouse. Once the final positioning is selected, selection of the *Lock Liver VOI Placement* button (I) will fix its position, preventing accidental re-positioning while navigating the display window with the mouse.

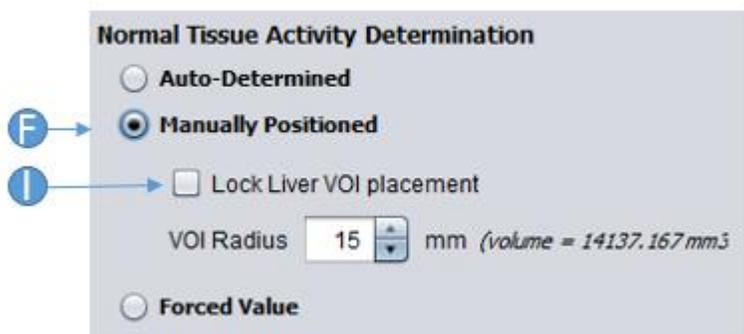


Figure 6-11 *Auto-PERCIST™* Normal Tissue VOI - Manual Positioning

The user can also force the program to use a user provided value by selecting the *Forced Value* option (Figure 6-12) (G). Doing so will instruct *Auto-PERCIST™* to use the user-specified value as the disease threshold without further manipulation.

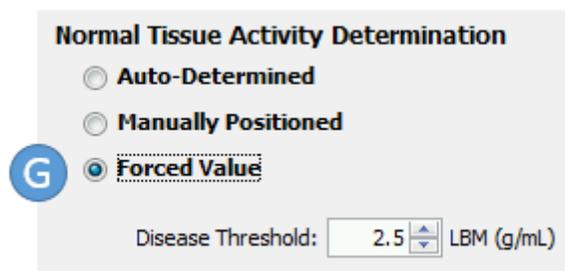


Figure 6-12 *Auto-PERCIST™* Normal Tissue Activity Determination - Forced Value

Once the user has made adjustments to how the normal reference tissue values are determined, they must press the **Re-Detect** (H) button to instruct the program to re-analyze the image and re-identify disease candidate objects using the new normal reference tissue sample values.

6.3.1.2 Calculation Sub-Panel

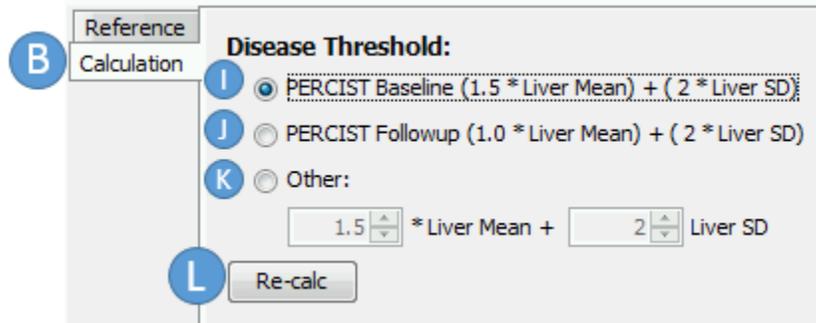


Figure 6-13 Auto-PERCIST™ Disease Threshold Calculation

The disease assessment threshold, often referred to as the *PERCIST Threshold*, is defined as a derivative of the mean and standard deviation as measured by a 3cm diameter spherical VOI placed in the liver. PERCIST 1.0 (Wahl RL, et al., 2009) defines that derivative for baseline studies as:

$$PERCIST_{Baseline} = 1.5 * Mean_{Liver} + 2.0 * St. Dev_{Liver}$$

This is sometimes referred to as the *Baseline PERCIST Threshold*. There are instances where an alternative method is used for calculating this assessment threshold. By selecting the *Calculation* tab (Figure 6-13) (B) on the *Disease Threshold* option page, the user can select auto-calculation of either the *PERCIST Baseline threshold* (I), the *PERCIST Followup Threshold* (J), or their own manual linear derivation of the threshold based on the mean and standard deviation of the measured VOI (K).

If the user makes any change to the method by which the threshold is calculated, they must then press the **Re-calc** button (L) for those changes to be reflected in the 'Results Table' and the image display.

6.3.2 Object Detection Panel

The *Object Detection* panel (Figure 6-14) contains the user-accessible controls which drive the candidate disease object detection and delineation.

Object Detection:
 Method: PEAK PAX MAX Cluster
 Detector Volume: mm3 (radius = 6.204 mm)

Object Delineation:
 Terrain: Image Detector Map
 Grow Method: Faces + Edges + Corners
 Delineator: Disease Threshold, or
 Detector % of Max Detector

Criteria for Objects:
 Number of Objects to Detect: All, or top
 Required Object Minimums:
 Size: (in voxels)
 Volume: (cc)
 Connections: (faces only)

Re-Detect

Use	Object	PEAK	PEAK-Cnt	Max	Mean	SD	Count
<input checked="" type="checkbox"/>	#0001	8.886	31	11.060	4.417	1.568	2347
<input checked="" type="checkbox"/>	#0002	8.088	31	9.213	5.233	1.662	2146

Figure 6-14 Auto-PERCIST™ Object Detection Options Panel

The first option defines the statistic which is used to identify the seed coordinates for the growth of the disease objects within the image volume (A). The PERCIST criteria call for the default value of *PEAK* to be used. *PEAK* is defined as the local average of a 1cc spherical VOI centered over a given voxel. The other options include *PAX* (a derivative of *PEAK* and *MAX*), *MAX* (the hottest single voxel measurement), and *Cluster* (an experimental statistic which uses the mean of a user specified cluster of connected voxels).

Once the seed coordinate is determined, the object is grown from that coordinate according to the options set forth in the *Object Delineation* section (B). These include the *Terrain* – either *image* or *detector map* (default is *image*), the definition of 3-dimensional connectedness between voxels (either

6, 14, or 26 voxel connectivity), and the terminating condition for growth (the default is the *PERCIST threshold* as defined in the Calculation Sub-Panel (Section 6.3.1.1), though a user-specified percentage of the maximum detector is also allowed).

The user can also select to tighten the criteria by which a detected object is deemed valid, and how many of these valid objects to detect (C). By default, all objects are detected and reported. The user can also specify a minimum size (in voxels or real world volumetric measurement), and/or the minimum number of connections between the voxels within the object.

As with other option settings, if the user changes the settings in this panel, they must force a re-detection of disease candidate objects by pressing the **Re-Detect** button (D).

6.3.3 VOI Styles

The VOI Styles options panel (Figure 6-15) allows the user to control the algorithm by which *Auto-PERCIST™* calculates the statistics it derives from spherical VOIs (e.g. *PEAK*, normal reference tissue sample, etc).

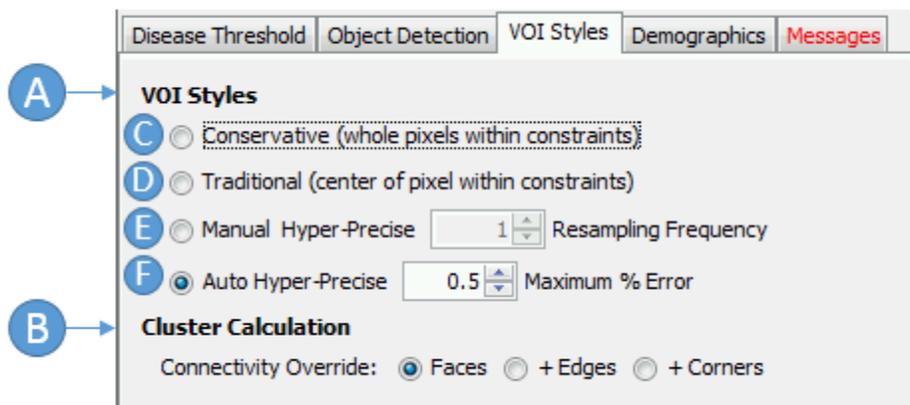


Figure 6-15 Auto-PERCIST™ VOI Styles

The primary section of this panel, ‘VOI Styles’ (A) contains the four (4) algorithms available to *Auto-PERCIST™* for calculating spherical objects. The default method – *Auto Hyper-Precise* (F) – is unique to the *Auto-PERCIST™* program and allows the user to specify a spherical VOI by volume and a maximum percent error tolerance for that volume. For example, if the user were to specify that they wanted a 5cc sphere to be used with a 0.5% maximum error in measurement, then the program would sub-sample the voxel data until it was able to generate a measurable sphere with a volume between 4.995cc and 5.005cc. The *Manual Hyper-Precise* (E) option is similar, but allows the user to define the maximum sub-sampling frequency to use. The *Traditional* method (D) calculates spherical VOIs by including those voxels in the calculation whose centers-of-energy lie on or within the bounding surface of the designated spherical VOI. The *Conservative* method (C) only uses those voxels which are entirely within the constraints of the bounding surface of the VOI.

The *Cluster Calculation* (B) is experimental at this time, but allows the user to manipulate the connectivity algorithm used when determining the number of sub-objects which a candidate object may contain, and where the boundaries between these subjects may lie.

6.3.4 Demographics

The ‘Demographics’ panel displays key demographic data which might be useful to the user. This panel is for information purposes only.

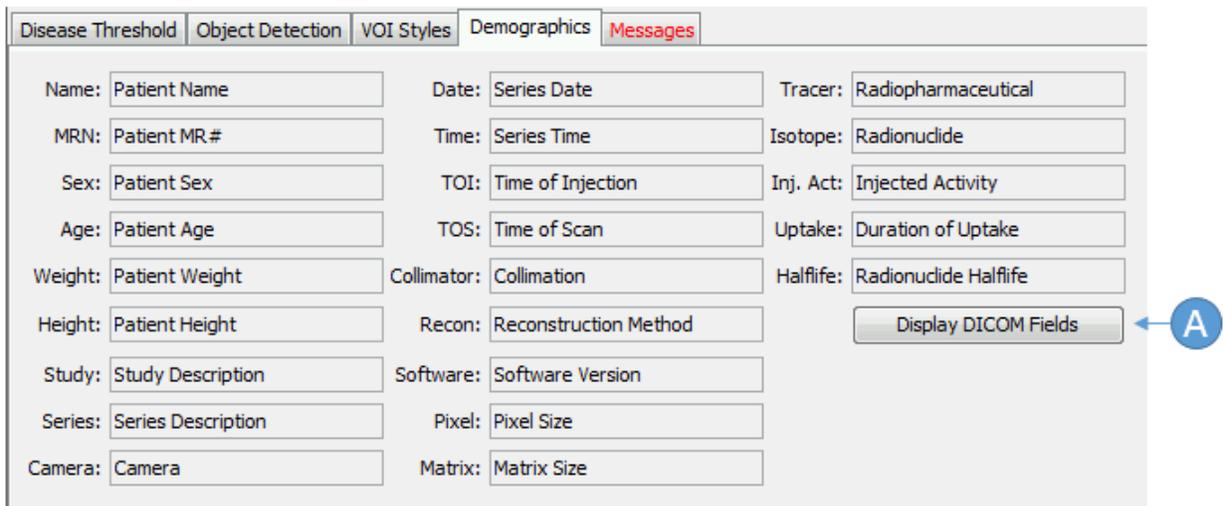


Figure 6-16 Auto-PERCIST™ Demographics Panel

The only option available to the user on this panel is the button entitled **Display DICOM Fields** (A). By selecting this button, a new windows will pop-up which will provide the user the ability to peruse all the DICOM fields contained within the dataset. This is primarily provided for testing and debugging purposes.

6.3.5 Messages

The right-most panel is the ‘Messages’ panel (Figure 6-17). Within this panel, all informational and error messages are logged.

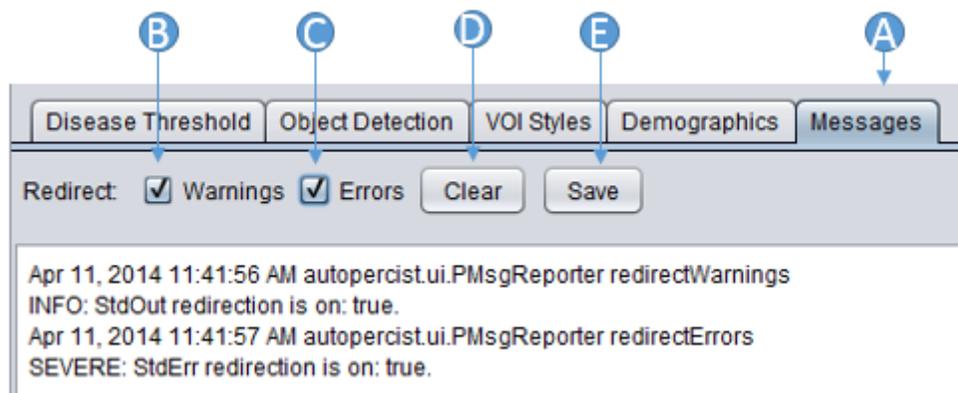


Figure 6-17 Auto-PERCIST™ Message Panel

The title tab for the panel (A) will turn red if unread messages exist in the panel. Selecting the tab which brings focus to the panel will clear the color of the tab title. The *Warning* (B) and *Errors* (C) settings determine which categories of errors are displayed in the text area of the panel. The **Clear** button (D) will erase all current entries in the panel, while the **Save** button (E) will allow the user to save the text within the panel to a text file. This is useful for debugging purposes. If the user encounters an unexplained error it would be useful to save the messages and send a copy of the data and error messages to the *Auto-PERCIST™* authors for analysis.

7 ADVANCED AND EXPERIMENTAL FEATURES

There are currently two features available to the user which are only available through the keyboard, and therefore don't present themselves obviously through the user interface. The ability to either erode a candidate disease object into multiple objects using an algorithm unique and proprietary to *Auto-PERCIST™*, or the inverse where multiple separate and distinct objects can be combined into a single object for consolidated quantitative purposes. An example case is described below:

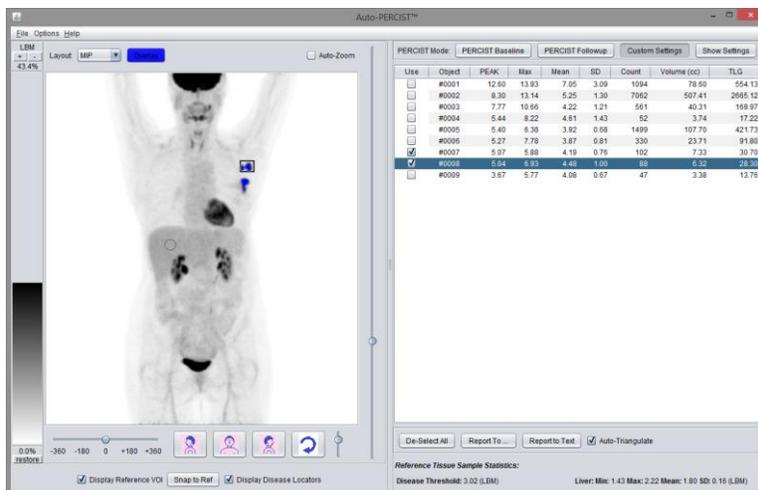


Figure 7-1 Auto-PERCIST™ Candidate Lesion Selection

In this example case, two candidate lesions have been selected by the user as valid disease objects (Figure 7-1). The second object (#0008) is currently selected by the user. If the user were to press the **E** key on the keyboard, the program will perform its proprietary *erosion* operation which will separate the object into two or more discrete objects (Figure 7-2).

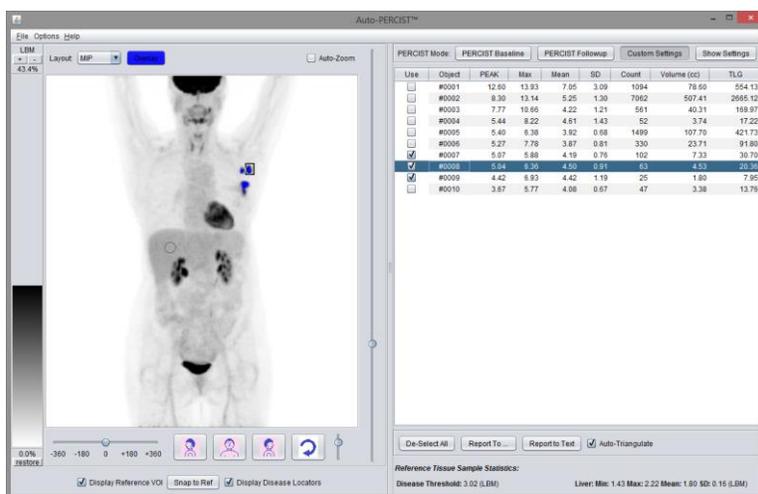


Figure 7-2 Auto-PERCIST™ Candidate Lesion Erosion

Object #008 from **Error! Reference source not found.** has now been eroded into two separate objects (#008 and #009) in **Error! Reference source not found.**, each separately characterized and selectable by the user.

*NOTE: The ‘separately’ of an object can be pre-calculated by activating the “Pre-calc Sub-Clusters” option in the **Options → Processing → Pre-Calc Sub-clusters** menu. Once enabled, a ‘Clusters’ column will appear to the far right of the ‘Results Table’ after a re-processing of the data has occurred, and provides a preview*

of the number of sub-objects a given object can be separated into by this algorithm. This feature is experimental and can significantly increase the computation time required for object identification and characterization. It is disabled by default.

The inverse capability exists by selecting multiple objects and pressing the **C** key on the keyboard to combine multiple objects. For example, the user can select multiple objects simultaneously by holding the **CTRL** key while clicking on the rows of the individual objects they wish to combine in the *Results Table* (Figure 7-3).

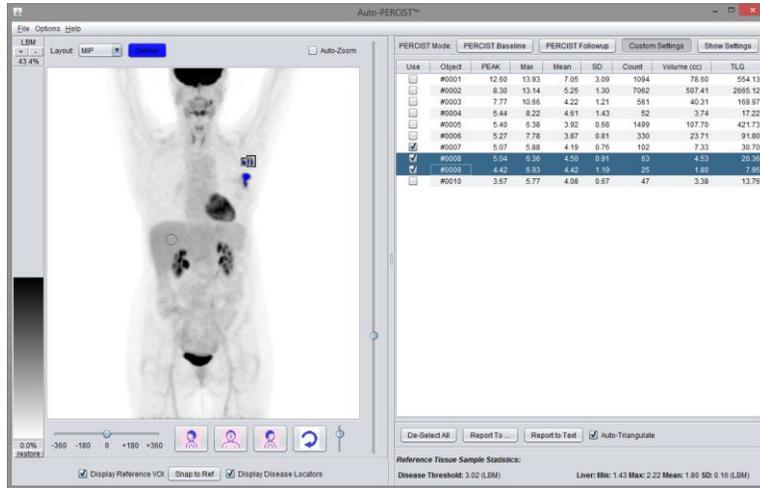


Figure 7-3 Auto-PERCIST™ Candidate Lesion Multi-Select

Pressing the **C** key on the keyboard will *combine* the different object into a single object (#0008) with no loss of data (Figure 7-4).

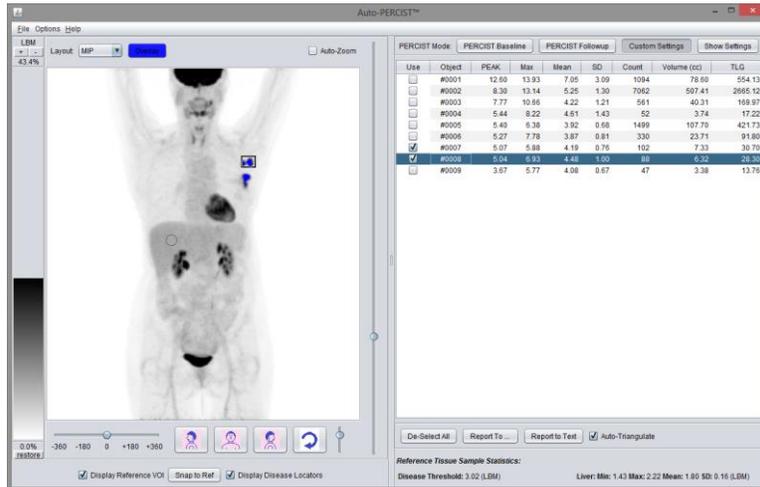


Figure 7-4 Auto-PERCIST™ Candidate Lesion Consolidation

8 RESULTS REPORTING

8.1 EXPORTING OF RESULTS

As described elsewhere (Section 5.3.4 above), the summary information contained in the *Results Table*, as well as much more detailed information can be exported for further analysis.

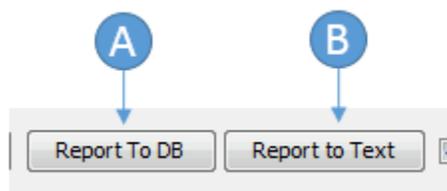


Figure 8-1 Auto-PERCIST™ Exporting Results

To export the data to an external database, the user can click the **Report to DB** button (Figure 8-1) (A) which will transfer the displayed summary data as well as a much more extensive selection of data to a pre-configured SQL database. A similar exportation of the Auto-PERCIST™ processing results can be exported into a text file, suitable for importing into a spreadsheet, by clicking the **Report to Text** button (Figure 8-1) (B).

Use	Object	PEAK	PEAK-Cnt	Max	Mean	SD	Count	Volume (cc)	TLG	Clusters
<input type="checkbox"/>	#0001	12.602	37	13.932	7.050	3.093	1094	78.605	554.129	2
<input type="checkbox"/>	#0002	8.304	23	13.145	5.252	1.302	7062	507.409	2665...	3
<input type="checkbox"/>	#0003	7.771	37	10.657	4.217	1.210	561	40.308	169.970	2
<input type="checkbox"/>	#0004	5.445	37	8.216	4.609	1.435	52	3.736	17.221	2
<input type="checkbox"/>	#0005	5.401	37	6.382	3.916	0.677	1499	107.704	421.734	2
<input type="checkbox"/>	#0006	5.272	37	7.776	3.872	0.814	330	23.711	91.803	3
<input checked="" type="checkbox"/>	#0007	5.070	37	5.878	4.189	0.756	102	7.329	30.698	2
<input checked="" type="checkbox"/>	#0008	5.045	37	6.932	4.476	0.997	88	6.323	28.300	2
<input type="checkbox"/>	#0009	3.673	37	5.767	4.076	0.670	47	3.377	13.764	2

Figure 8-2 Auto-PERCIST™ Results Table Selection via <Ctrl><A>

Finally, the contents of the *Results Table* can be selected by clicking anywhere within the *Results Table* and pressing the **Ctrl** **A** keyboard combination (Figure 8-2). The user can then press **Ctrl** **C** to copy the contents to the clipboard, and **Ctrl** **V** to paste the data into another program, such as a spreadsheet or other analysis package.

!!!Note: Keyboard combinations for copy-and-paste represented here are specific for the Windows platform! If you are running Auto-PERCIST™ on a different platform, use the keyboard combinations specific for your system.

!!!Note: When copying the Results Table using the copy-and-paste methods, ONLY the data shown on screen is copied, and not the extensive array of data which is available to you through the database and/or text file export methods.

8.2 EXAMPLE MICROSOFT ACCESS RESULTS DATABASE

Provided with the beta-release of Auto-PERCIST™ is an example Microsoft Access database with which you can generate some basic summary and analysis reports of your Auto-PERCIST™ results which have been transferred to a previously defined database. In order to fully enable this capability, a few configuration steps need to be performed.

!!!Note: These examples use Microsoft Access 2007. If you are using a more current version your screen display may appear different. The basic functionality is the same.

!!!Note: It is recommended that you use this example reporting database as an example of what you can do with your Auto-PERCIST™ results, but not necessarily as your final reporting tool. It is provided solely as an example.

8.2.1 Create ODBC Connector to MySQL Server

!!!Note: Depending on your system settings, you may require 'Administrative' privileges to perform the following actions.

!!!Note: Misconfiguration of your system may disable or severely impair the functioning of your computer. If you are not comfortable with making these settings it is recommended that you ask an IT administrator for assistance. In particular, driver mismatches between your version of Windows and your version of Microsoft Office may require special configuration settings which are not described here.

The first step is to create a connector so that the Microsoft Access database can “speak” to the MySQL database you already created (Section 5.3.4) as a repository for your Auto-PERCIST™ results. On Microsoft Windows systems, this is achieved by running the “Data Sources (ODBC)” applet which can be found in the “Administrative Tools” section of the “Control Panel”.

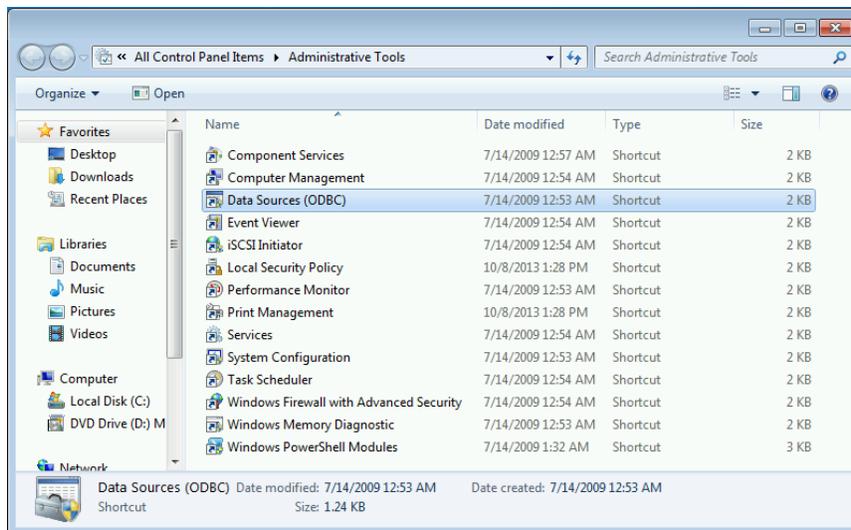


Figure 8-3 Windows Administrative Tools

Upon running the “Data Sources (ODBC)” configuration tool (Figure 8-3), you will be presented with an ODBC configurator dialog box (Figure 8-4).

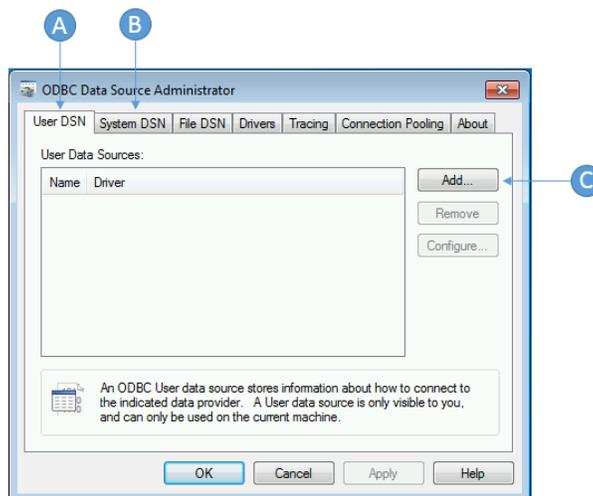


Figure 8-4 Windows ODBC Data Source Administrator

!!!Note: The system dialog boxes used in this example may not appear the same as on your system, depending on the version and service pack of your system.

You will create your connector here. If you want your database connection to be limited to your user account you will create your connector in the *User DSN* tab (A). If you want your connection to be shared across all users of the computer, you will create it in the *System DSN* tab (B).

To create the database, select the appropriate environment – *User DSN* or *System DSN* and press the **Add** button (C). This opens the *Create New Data Source* dialog (Figure 8-5).

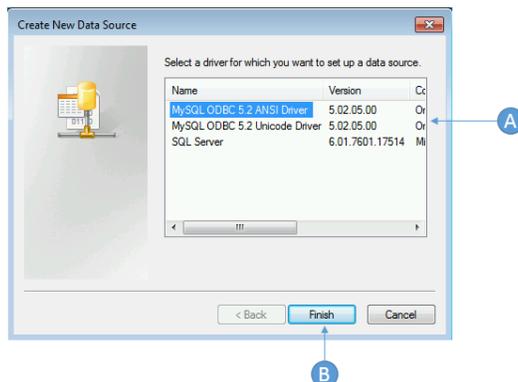


Figure 8-5 Windows Create New Data Source

!!!Note: The contents of your dialog may appear very different than the contents of the examples presented here. However, the functionality should be the same.

One or more suitable connector drivers were already installed on your systems when you originally installed the *MySQL* database (Section 5.1 above). You may find multiple ‘MySQL ODBC’ drivers (A). Select one with the highest version number and in the appropriate language for you (if multiple language versions exist in your installation). Once you have selected the appropriate driver, click **Finish** (B) to configure your connection.

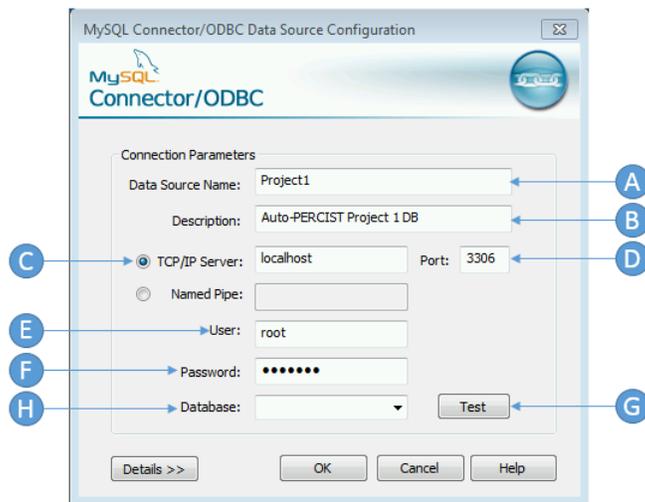


Figure 8-6 MySQL Connector/ODBC Data Source Configuration

The *MySQL Connector* dialog will present itself (Figure 8-6) and will initially be empty. You will need to provide a name for your connection (A), and you can also provide a more elaborate description of your

database if so you desire (B). If the *MySQL* server is installed on this same machine, you can enter the phrase *localhost* in the TCP/IP Server address box (C). If the *MySQL* server is on another machine, you would need to enter that machine’s TCP/IP address. The network Port address should already be configured with the default setting for *MySQL* – 3306 (D). If you or your Database administrator have configured your system with an alternative setting, please enter it here. You will need to enter a *user name* (E) and *user password* (F) for an account on the *MySQL* server which has the appropriate privileges to access the database. This is most often the same account as was used when the database was created, but it does not need to be. Once these fields are populated you can connect with the server by pressing the **Test** button (G).

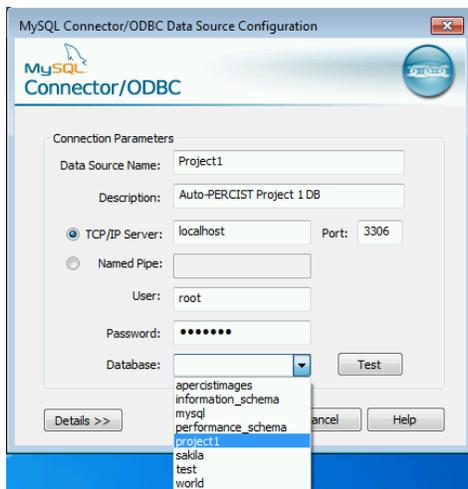


Figure 8-7 MySQL Connector/ODBC Data Source Configuration

If you were able to successfully connect with the *MySQL* server, the *Database* combobox will populate with a list of the databases available to you on the server (Figure 8-7). Select the database you created earlier which contains your Auto-PERCIST™ results and press **OK**.

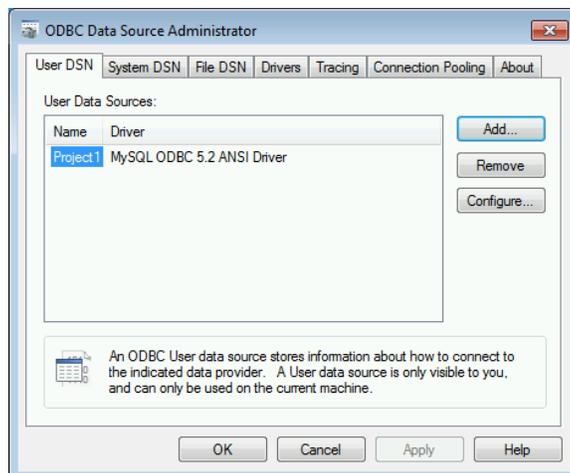


Figure 8-8 ODBC Data Source Administrator

You have now created an ODBC connection to your *MySQL* database (Figure 8-8). This will allow you to connect the example *Microsoft Access* report tool to your database!

8.2.2 Attach the Example Microsoft Access Report tool to ODBC Connector

You will need to connect the example *Microsoft Access* Report tool to the ODBC connector. To do so, you must already have *Microsoft Access* installed on your computer and have it properly configured to allow the macros and code built-in to the tool to execute. If you are not familiar with how to do this you may need to contact your local IT support.

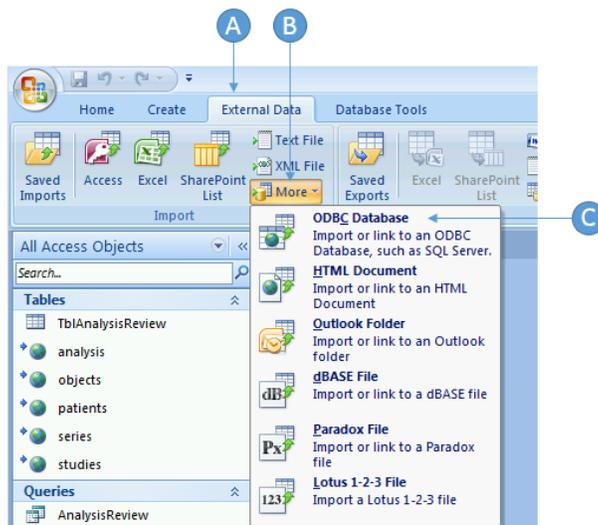


Figure 8-9 Microsoft Access External Data Import Menu

Once you have open the Report tool, you will select the **External Data** main menu item (Figure 8-9) (A). From that item, in the **Import** section, you will find a drop-down button named **More** (B). Select this button and select **ODBC Database** from its options (C).

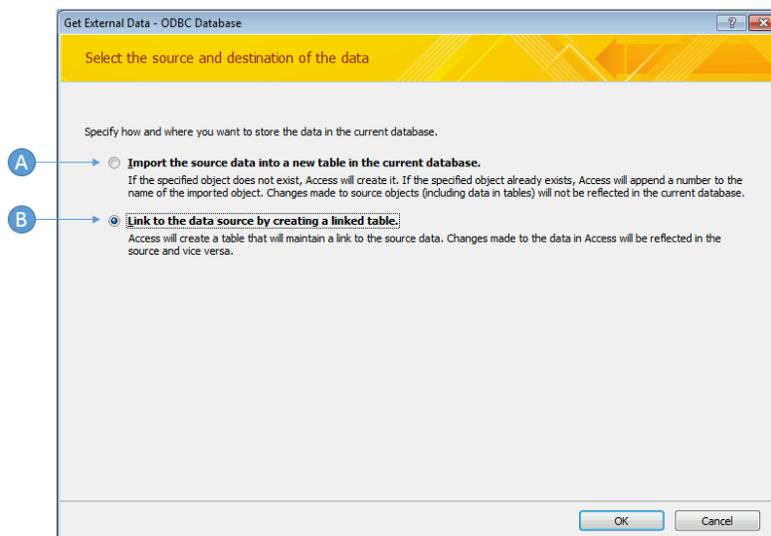


Figure 8-10 MS-Access Get External Data - ODBC Database

You will now be asked how you wish to import the data (Figure 8-10). You can either copy the data directly into the report tool (A), or create an active link to the data (B). If you are still acquiring data in this database, it would be best to create the active link (B). However, if you are done acquiring data and want to copy the report tool populated with your data to another system, you will need to use the copy option (A). Once you have made your selection, press the **OK** button to proceed.

You will now be asked to select the data source with which you want to connect (Figure 8-11).

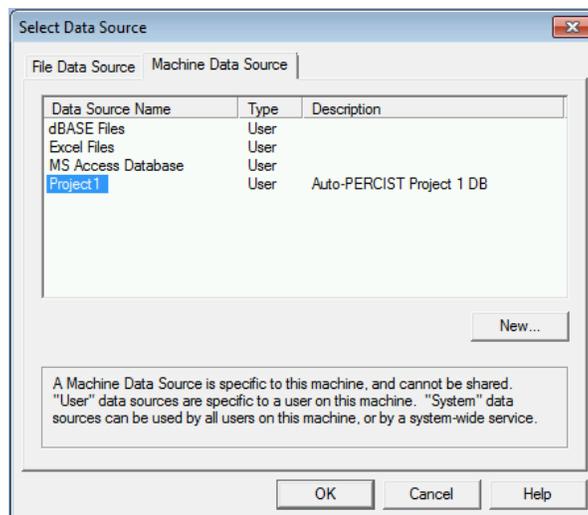


Figure 8-11 MS-Access Select Data Source

You will want to select the *Machine Data Source* tab and the ODBC database connection which we created earlier (Section 8.2.1 above). Once you have selected, you should see the following *Link Tables* dialog (if you are performing a link operation, otherwise the dialog will be named *Import Objects*, though it will appear and function in a similar fashion) (Figure 8-12):

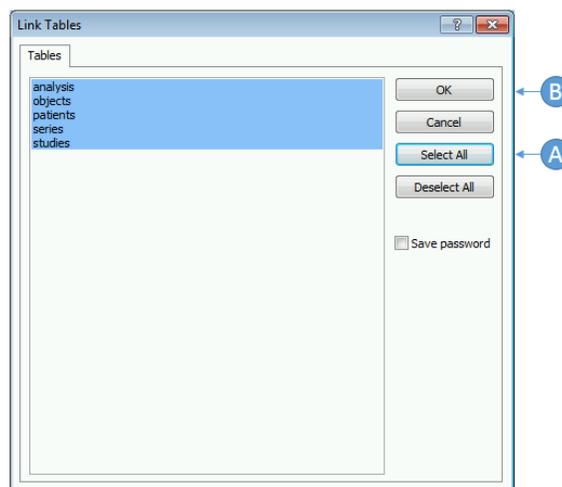


Figure 8-12 Link Tables

The only information you will want to either link or copy into the report tool is the table data, so you will first **Select All** table data (A) and then accept the selection by pressing the **OK** button (B).

You have now either copied or linked your report tool to your Auto-PERCIST™ results database!

There are two primary reports and one informational report available to you in this example report tool. You can access all three by opening the *Switchboard* form (Figure 8-13).

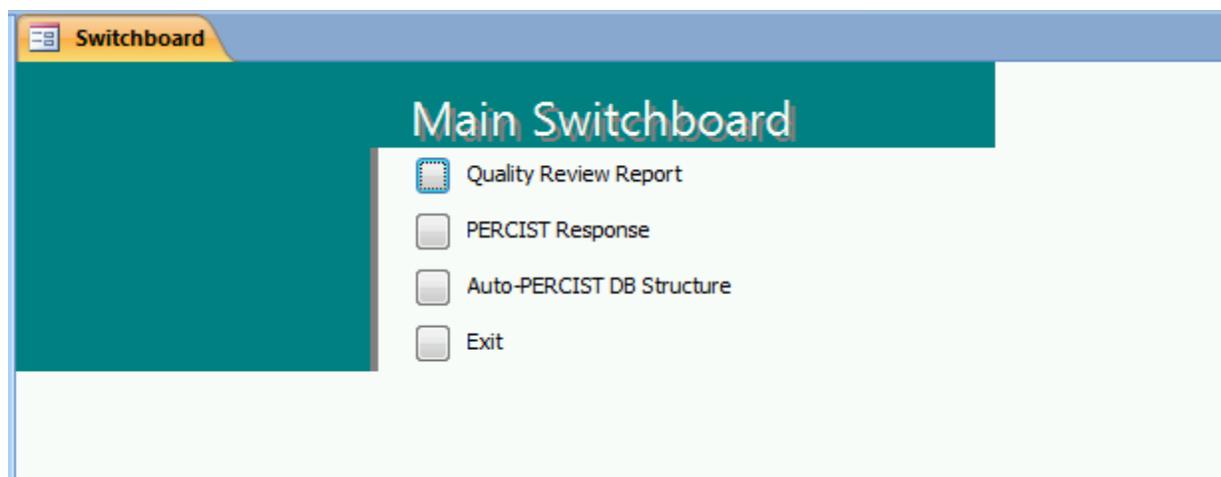


Figure 8-13 Example Report Tool Switchboard

From this interface, you can review an example **Quality Review** report, a **PERCIST Response** report, and an informational summary of the available database fields.

The report tool provided is just an example of the type of reporting you can do with the data generated by *Auto-PERCIST™*. You will most likely want to develop your own reporting tools to suit your individual, or project, needs.

9 TROUBLESHOOTING

9.1 FAILURE OF THE MAIN APPLICATION WINDOW TO APPEAR

If the main application fails to appear after attempting to run the program, the application properties file (usually named *autopercist.properties*) may have been corrupted. This file should be deleted and execution of *Auto-PERCIST™* re-attempted. The default directory for this file is the user's home directory.

9.2 MEMORY ERRORS

Auto-PERCIST™ works best in a 64-bit environment with access to plenty of RAM memory. Memory is usually not a concern when running on a 64-bit environment, but if you have deployed *Auto-PERCIST™* on a 32-bit environment with limited RAM memory, you may benefit by modifying the startup configuration to guarantee a suitable amount of memory is available to the application.

There are two types of memory which *Auto-PERCIST™* requires to successfully execute, *HEAP* and *STACK*. The *HEAP* is the global memory pool for data objects (like images, bitmaps, etc.). The *STACK* is a separate section of memory which is used by the application for temporary use as it performs its various processes.

By default, *Auto-PERCIST™* is configured to request 4MB of RAM for its *STACK* space. If you get memory errors – specifically *OUT OF STACK* errors - you can change the default configuration of *Auto-PERCIST™* by editing the file *Auto-PERCIST.lax* which is found in the installation directory for *Auto-PERCIST™* (on Windows computers this is usually *C:\Program Files\AutoPERCIST*).

WARNING!!! Editing the '*.lax*' configuration files of your *Auto-PERCIST™* installation could disable your installation altogether. Only do so if you are comfortable with advanced Java Virtual Machine settings!!!

Within the *Auto-PERCIST.lax* file, there is a variable named '*lax.nl.java.option.additional=*' which specifies the default memory options for the Java Virtual Machine used by *Auto-PERCIST™*. The default *stack* size is specified as 4MB (via an option string which looks like '*-Xss4m*'). Increasing the *STACK* size will allow more complex objects to be detected by increasing the system's ability to perform recursive operations.

If you are running *Auto-PERCIST™* on a 32-bit virtual machine and are running out of *HEAP* memory, as evidenced by any other type of *OUT OF MEMORY* error, you can increase the *HEAP* memory pool available to *Auto-PERCIST* up to the maximum allowed by your specific Java™ Virtual Machine implementation, by adding a line such as '*-Xms2G*' to the '*lax.nl.java.option.additional=*' setting in the *Auto-PERCIST.lax* file as described for the *STACK* memory setting. The '*2G*' indicates that 2 GB of RAM memory should be reserved for the application at startup and, if that amount of memory is not available, then the application will fail to launch.

9.3 OTHER ERRORS

Other errors should be documented by saving the message log to a text file (described in Section 6.3.5) and sending them, along with the appropriate data to replicate the problem (if possible) to the authors at iratlab@jhmi.edu. If the amount of data is too large to transmit via e-mail, arrangements can be made for an FTP transfer.

10 BIBLIOGRAPHY

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