

MAINAPP.EXE GETTING STARTED

Division of Medical and Biological Informatics
German Cancer Research Center, Heidelberg, Germany

15.10.2008

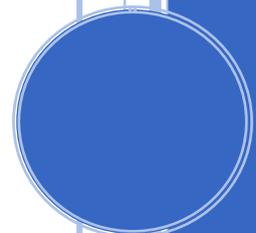


TABLE OF CONTENTS

Table of Contents	2
Preface.....	3
Welcome	3
Installation.....	4
Installer-Package.....	4
Developer-Package.....	8
Basics	10
User Interface	10
Loading Data.....	11
Visualization functions.....	13
2D and 3D planes.....	13
Visualization Buttons	14
Slicer.....	15
Level Window.....	16
Volume Visualization.....	18
Data Manager	19
First Steps.....	21
Hounsfield units and coordinates	21
IsoSurface.....	22
Crop	23
Measurement	25
MovieMaker	26
Quite Simple Region Grower.....	27
Volumetry.....	28
Interactive Segmentation	29
Troubleshooting	34
Glossary.....	35
Impressum	36

PREFACE

This document is intended for first-time users of the precompiled MITK application you can download from the homepage. Developers can find instructions on how to get started with MITK development in the [MITK tutorial](#).

WELCOME

We are happy you are interested in the Medical Imaging Interaction Toolkit (MITK).

MITK is an open-source framework that was originally developed as a common framework for Ph.D. students in the Division of Medical and Biological Informatics (MBI) at the German Cancer Research Center. MITK aims at supporting the development of leading-edge medical imaging software with a high degree of interaction.

MITK re-uses virtually anything from VTK and ITK. Thus, it is not at all a competitor to VTK or ITK, but an extension, which tries to ease the combination of both and to add features not supported by VTK or ITK.

Research institutes, medical professionals and companies alike can use MITK as a basic framework for their research and even commercial (thorough code research needed) software due to the BSD-like software license.

Research institutes will profit from the high level of integration of ITK and VTK enhanced with data management, advanced visualization and interaction functionality in a single framework that is supported by a wide variety of researchers and developers. You won't have to reinvent the wheel over and over and can concentrate on your work.

Medical Professionals will profit from MITK and the sample MainApp.Exe application by using its basic functionalities for research projects. But nonetheless they will be better off, unless they are programmers themselves, to cooperate with a research institute developing with MITK to get the functionality they need. MITK and the

presented MainApp.exe are not certified medical products and may be used in a research setting only. They must not be used in patient care.

INSTALLATION

Installer-Package

The Installer-Package is suited for medical professionals and for researchers who do like to get a first impression of MITK.

Please download the Windows-Installer-Package from the Website www.mitk.org. It is an executable file with the file extension *.exe. Please note that some email clients will deny to access or send the file. Although MITK is a cross-platform toolkit, an installer will only be supported for Windows system software.

When downloaded, please execute the file and, for Windows Vista users, allow the program to access your system and install on your computer.

The first screen will look like figure 2.



Figure 1: First Installation screen; press "Next" to proceed.

Please read the license agreement and press “I Agree” to install MITK.

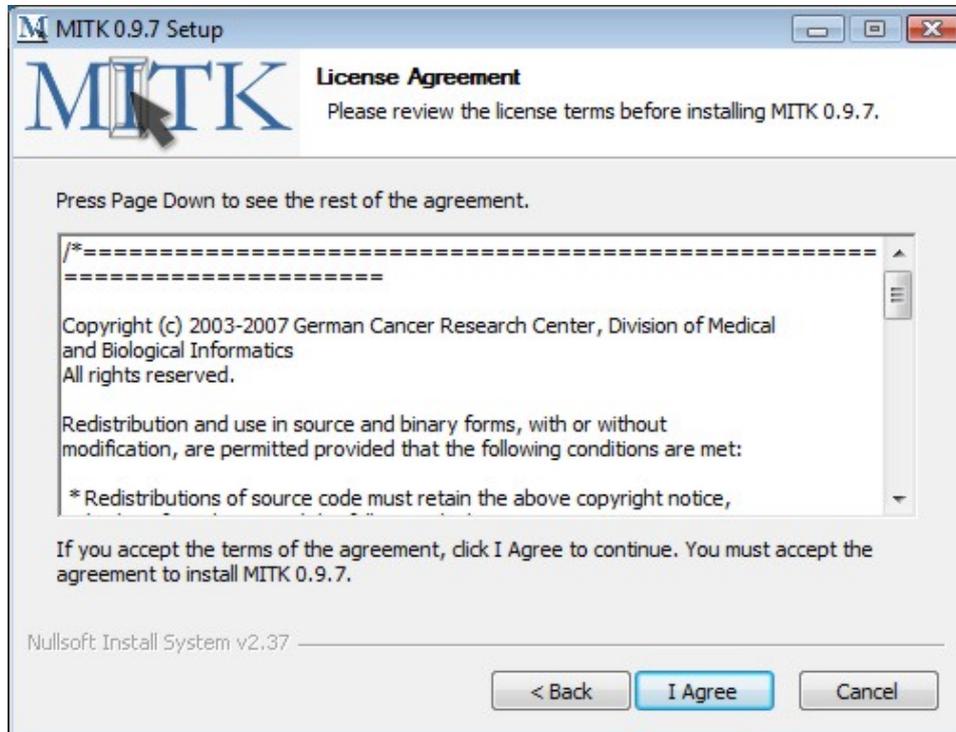


Figure 2: License Agreement; press “I Agree” to proceed.

If you want to use MITK it is not necessary to add it to the system PATH. The creation of a desktop icon however is recommended to use the drag and drop functionality of MITK for the loading of datasets.

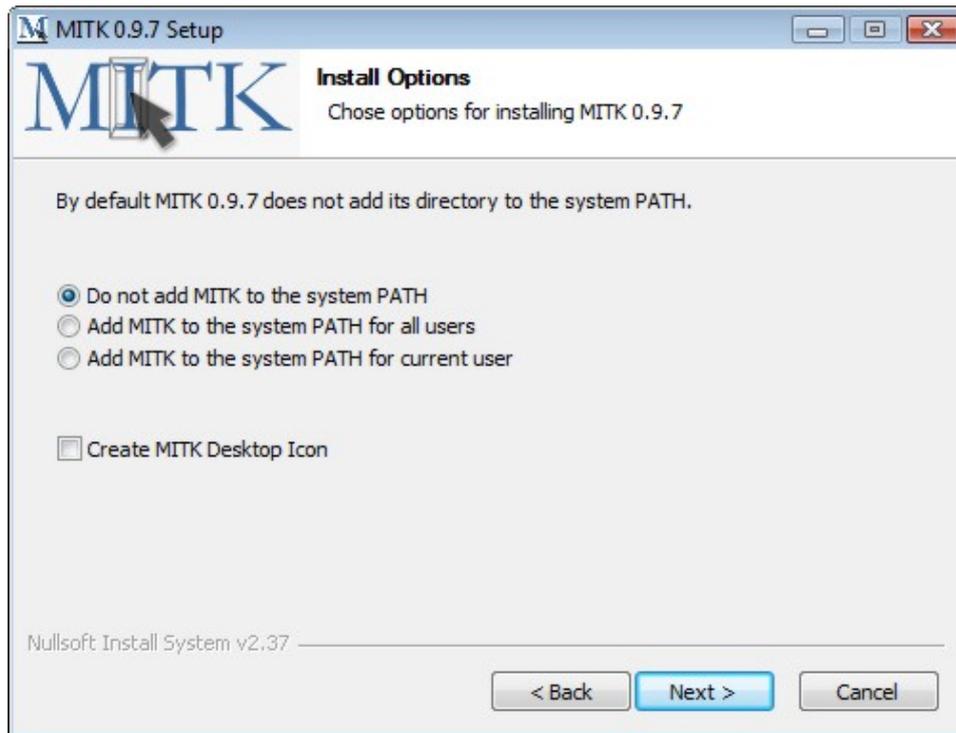


Figure 3: Install Options; press “Next” to proceed.

Use the default installation folder if you want to install MITK on the same partition as your operating system. Changing the destination folder will not affect the way MITK will be used.

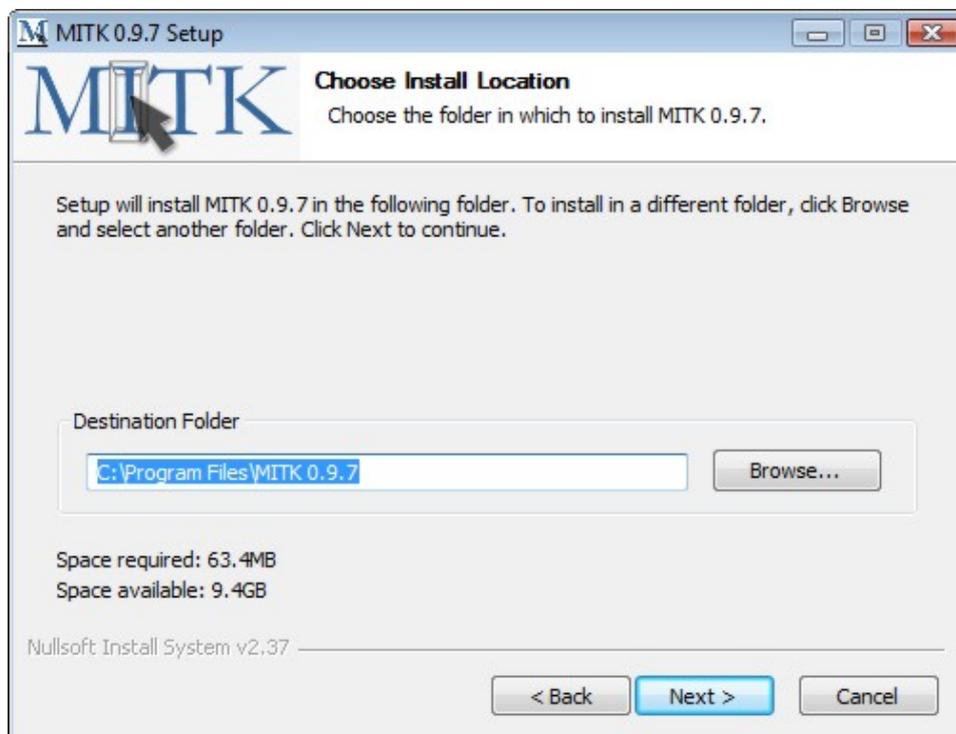


Figure 4: Destination Folder; press “Next” to proceed.

You can customize the StartMenu Folder. The mode of operation of MITK will not be affected by this.



Figure 5: Start Menu Folder; press “Install” to proceed.

Please wait until MITK was installed on your computer. This will take a few minutes. Avoid shutting the computer down during installation.



Figure 6: Installing.

The following screen will be displayed. MITK was successfully installed on your computer and is ready to be used without restarting. In case of problems during installation please refer to <http://wiki.mitk.org>.

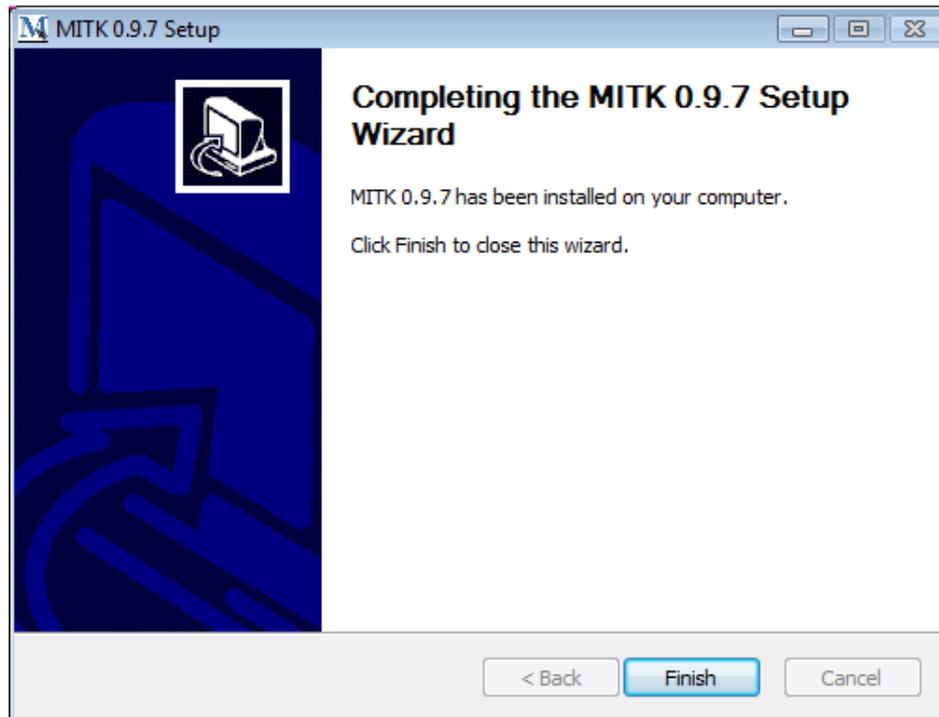


Figure 7: Setup complete.

Windows Vista might prompt you and ask whether MITK has been successfully installed. This is due to internal checks of Windows Vista. In that case accept the option that MITK has been successfully installed and is working properly.

Developer-Package

To be a part of the MITK Community and start developing MITK is really easy.

There are several binary packages of MITK, some including all program modules (functionalities), others containing only InteractiveSegmentation for basic image segmentation.

All binary packages are hosted at. <http://sourceforge.net/projects/mitk/>

Follow the up to date steps and recommendations described on the MITK Homepage to establish a developer environment for MITK.

<http://www.mitk.org>

Please remind that MITK is an open-source toolkit under active development. We appreciate every feedback from developers and users alike to improve MITK in every possible way.

15.10.2008

BASICS

User Interface

MITK starts with all available functionalities that have been compiled. A functionality is a application module with specific functions. In figure 9 you see the standard configuration and functionalities of the available Installer Package at www.mitk.org.

Double-click on the MITK desktop icon or start it from your program menu.

First a console window will open, that will show the status of the software loading process and software status. Be patient to wait for the MITK user interface window to open. Figure 9 explains the basic structure of the GUI.

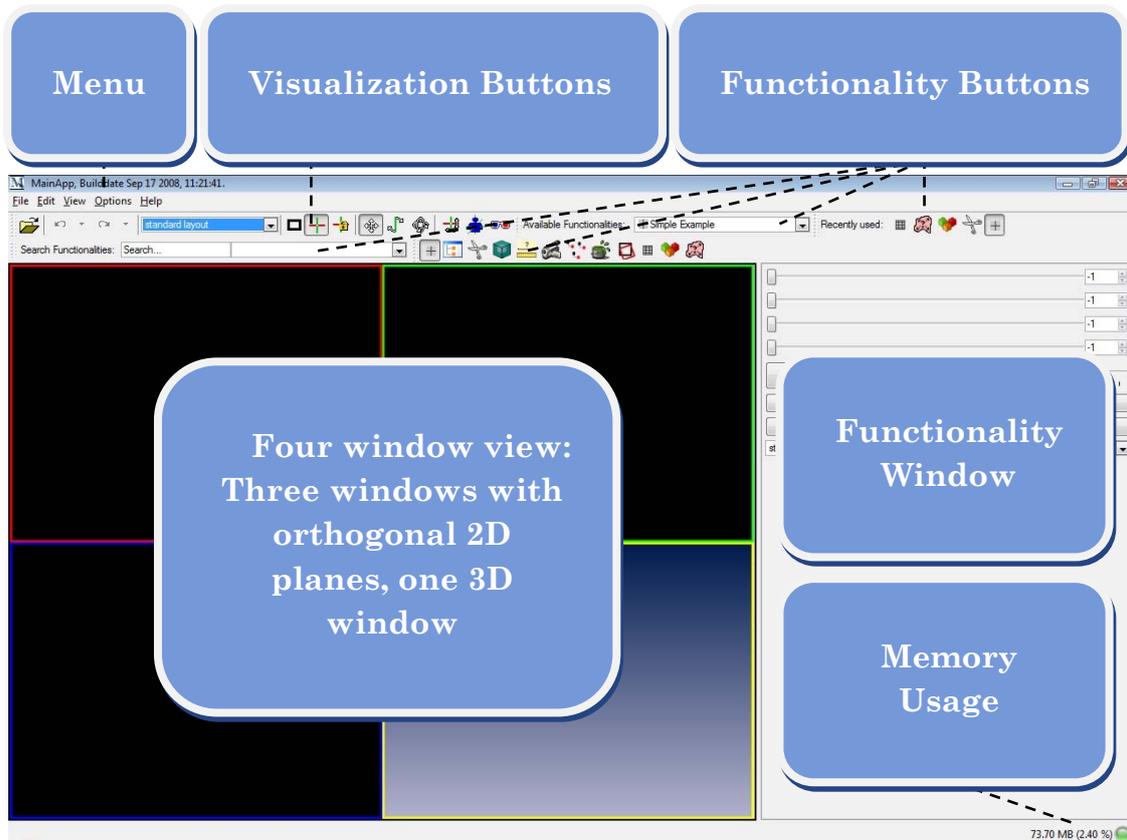


Figure 8: User interface

Loading Data

MITK is able to process different kind of 2D and 3D datasets.

Among these are DICOM files (*.dcm, *.dc3, *.gdcm), Point sets (*.mps), Sets of 2D slices (*.pic, *.pic.gz, *.png, *.tif, *.bmp, *.dcm, *.ima, *.raw) and surface files (*.stl, *.obj, *.vtk).

In this example we open a proprietary MITK data format file (Pic3D.pic) that can be downloaded on <http://svn.mitk.org/trunk/mitk/Testing/Data/>

There are four ways to open this file with MITK:

1. The most comfortable way is to simply drag and drop the file on the desktop icon of MITK or on the running application window.



Figure 9: Drag and Drop files on desktop icon

2. Inside the application click on the yellow folder button in the top left corner to open the file explorer.

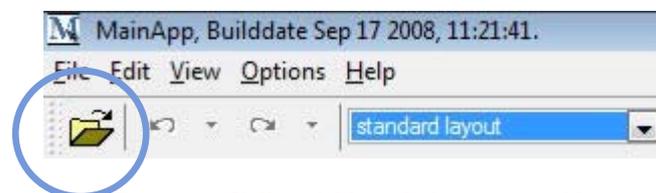


Figure 10: Yellow folder, click to open a file

- Click “File” in the menu, click “Open...” to get the open window.

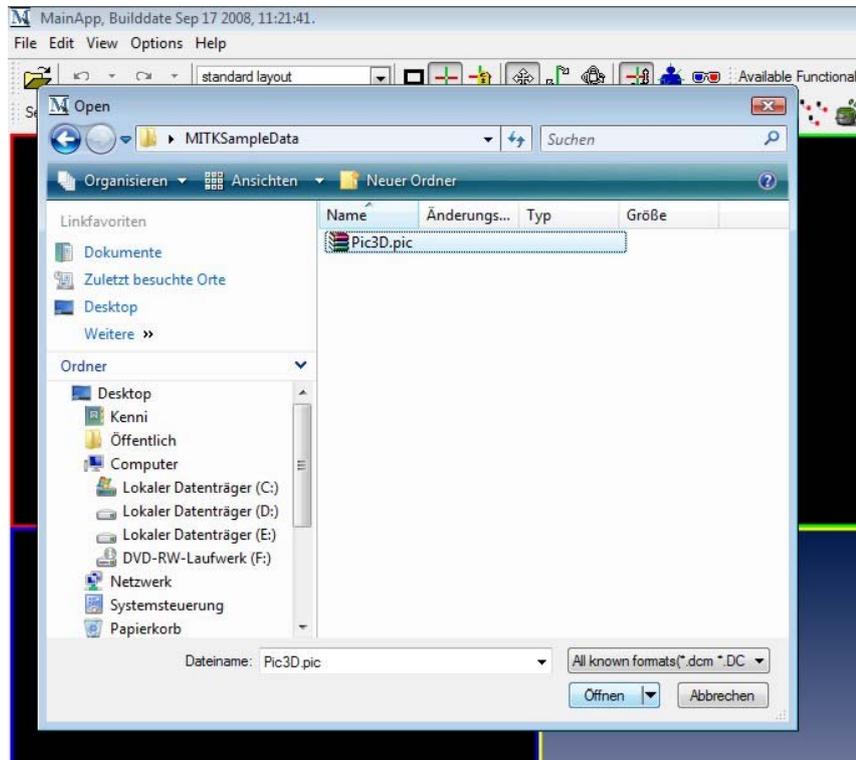


Figure 11: File Explorer

- The data manager, which will be described later.

Open the dataset Pic3D.pic. You should see the following window:

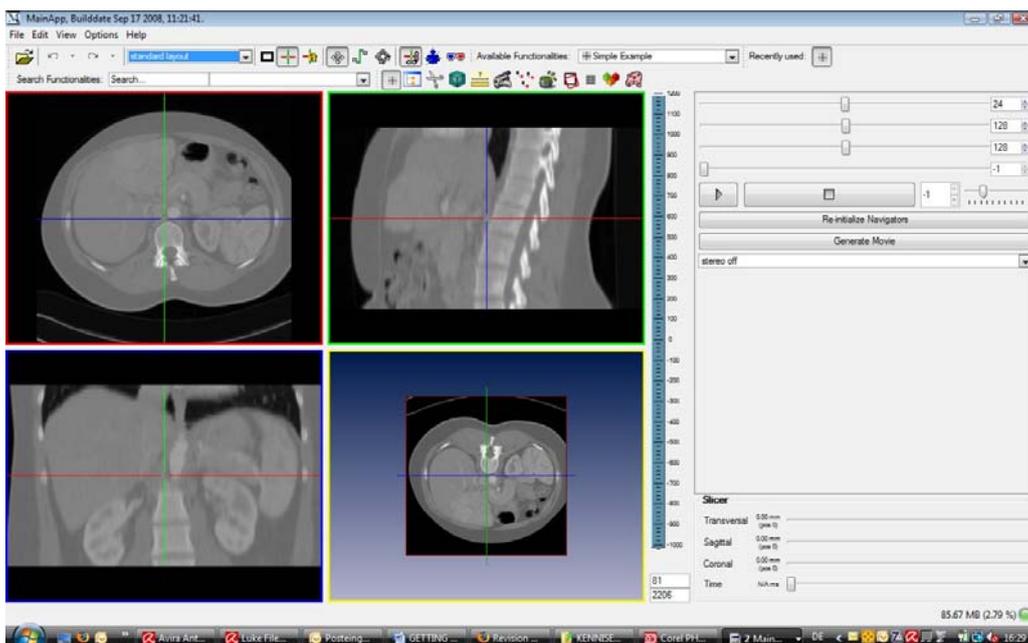


Figure 12: Successfully loaded Pic3D.pic

Visualization functions

MITK provides extensive possibilities to view datasets. A selection of them is already provided within the standard installer package and will be presented in short in the following.

2D and 3D planes

After loading the sample dataset you should see the data in the different windows.

With your mouse you can interact with the dataset. MITK recognizes the position of your mouse over a window automatically.

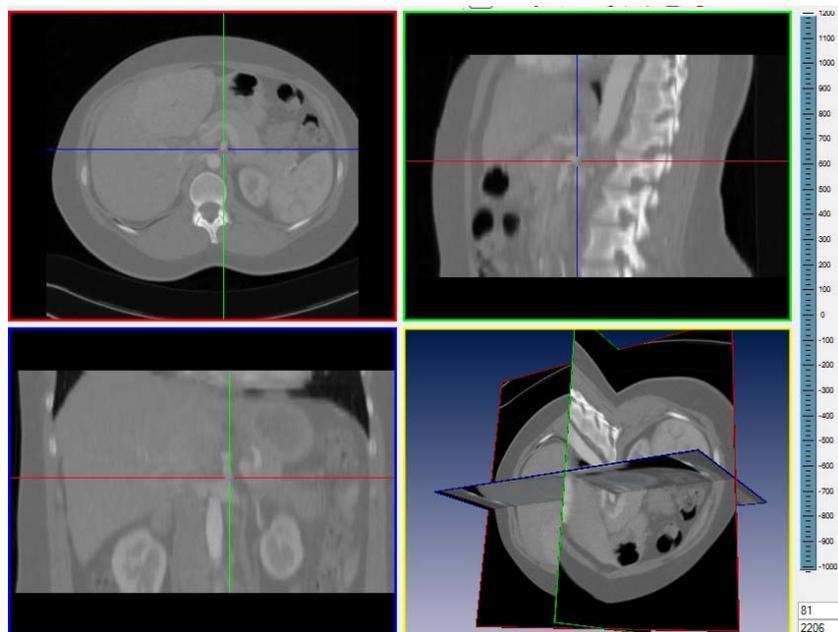


Figure 13: 2D and 3D planes; dataset: Pic3D.pic

- | | |
|------------|--|
| Left Click | Moves the position of the planes to that point and adjusts the planes in the other 2D and 3D planes to that point. In the 3D plane you can move the viewpoint to the clicked position. |
| Left Hold | In the 2D planes it moves the planes continuously.

In the 3D plane you can rotate the viewpoint around the dataset. Rotate with the mouse |

	clockwise to turn the data counter-clockwise and vice versa.
Right Hold	Move the mouse up or down to scale the dataset in this window
Right Click	No standard function
Mouse Wheel	In the 2D plane you scroll through the dataset as in a PACS system In the 3D plane you scale the dataset
Middle Hold	In all planes the dataset is panned like a sheet of paper.

Visualization Buttons

The drop-down menu on top allows you to change the layout of the data visualization. Experiment with the different settings to find the one that suits your needs best.

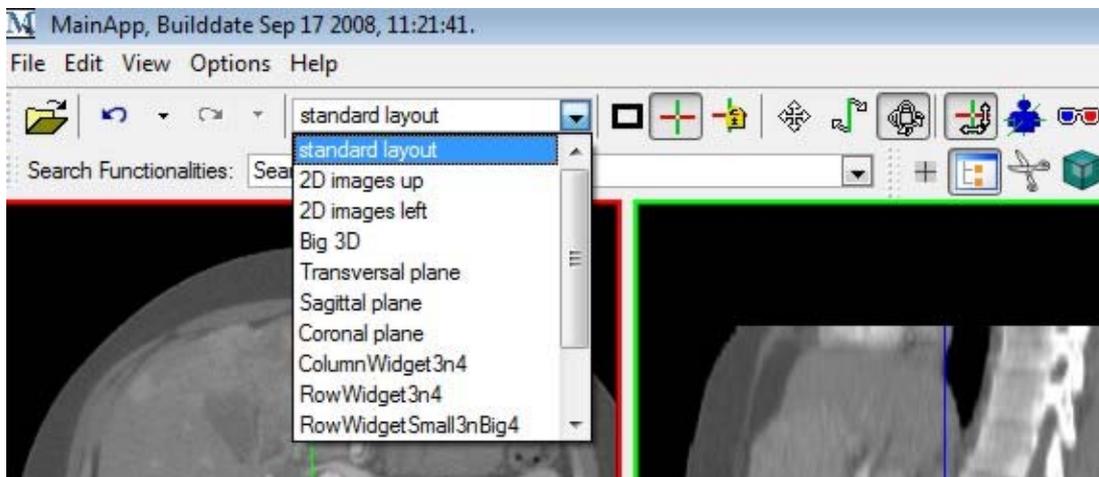


Figure 14: Visualization Buttons



Toggles fullscreen



Hide/Show 2D planes in the 3D window; important for advanced visualization of 3D models



Locks planes in their positions;



Standard plane interaction as described above



Plane Swivel mode tilts planes



Toggles Slicer function in the down right corner



Displays an orientation for the standard views in the down right corner



Toggles stereo function in the down right corner (special goggles or stereoscopic monitor needed)

Slicer

The slicer is turned on by default when you open MITK and can be activated and deactivated with this button .

With the slicer in the down right corner you can also navigate through the dataset. The time function is only available if you have loaded a 4D dataset.

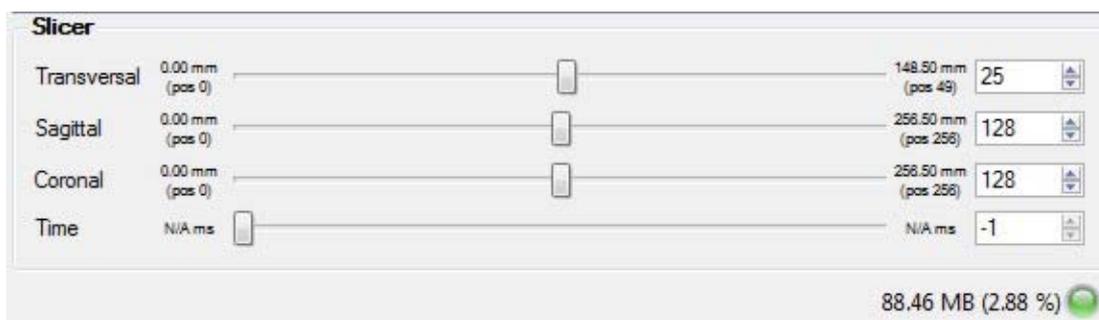


Figure 15: Slicer

If you want the dataset to be reset to the previous position you can use the blue undo arrow in the top left corner.



Figure 16: Undo and Redo - Buttons

If you want the dataset to be reset to its standard position, go to the DataManager functionality, which will be described later, and click “Global Reinit”.

Level Window

The level window scale and its bar show which part of the grayscale distribution of the dataset is shown in the 2D planes window. Our test dataset Pic3D.pic is a computed tomography. So the values you see in the scale are Hounsfield units. The level window can be changed by clicking and dragging the bar up and down and by minimizing and maximizing the bar by clicking and dragging at its ends.

The first value at the bottom indicates the mean Hounsfield unit of the bar and the second value indicates the total range of the bar in Hounsfield units.

Right Click on the menu bar and try the preset image thresholds on the sample dataset.

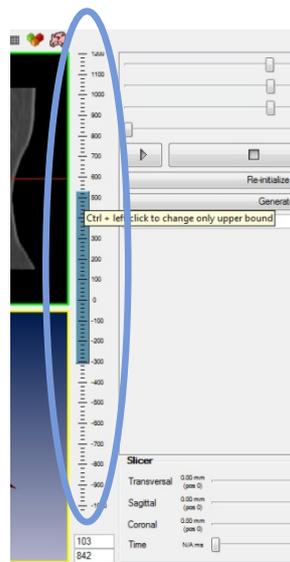


Figure 17: Level Window function

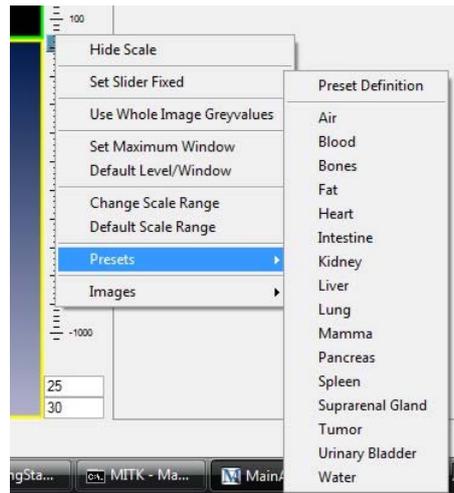


Figure 18: Right Click on Slider bar drop down menu

Volume Visualization

A basic functionality for Volume Visualization is already built in the standard MITK installer package.

It can be accessed by this button . With the loaded sample dataset the preset parameters already produce an interesting visualization.

Load Pic3D.pic from the sample datasets, activate the module  and toggle volume visualization in the upper left corner of the functionality window.

Press  to get a better view of the visualization.

Note that this is no segmentation and just a way to paint greyvalues in a 3D dataset. There is also no sharp distinction between organs or structures and the visible part does not represent the actual position exactly.

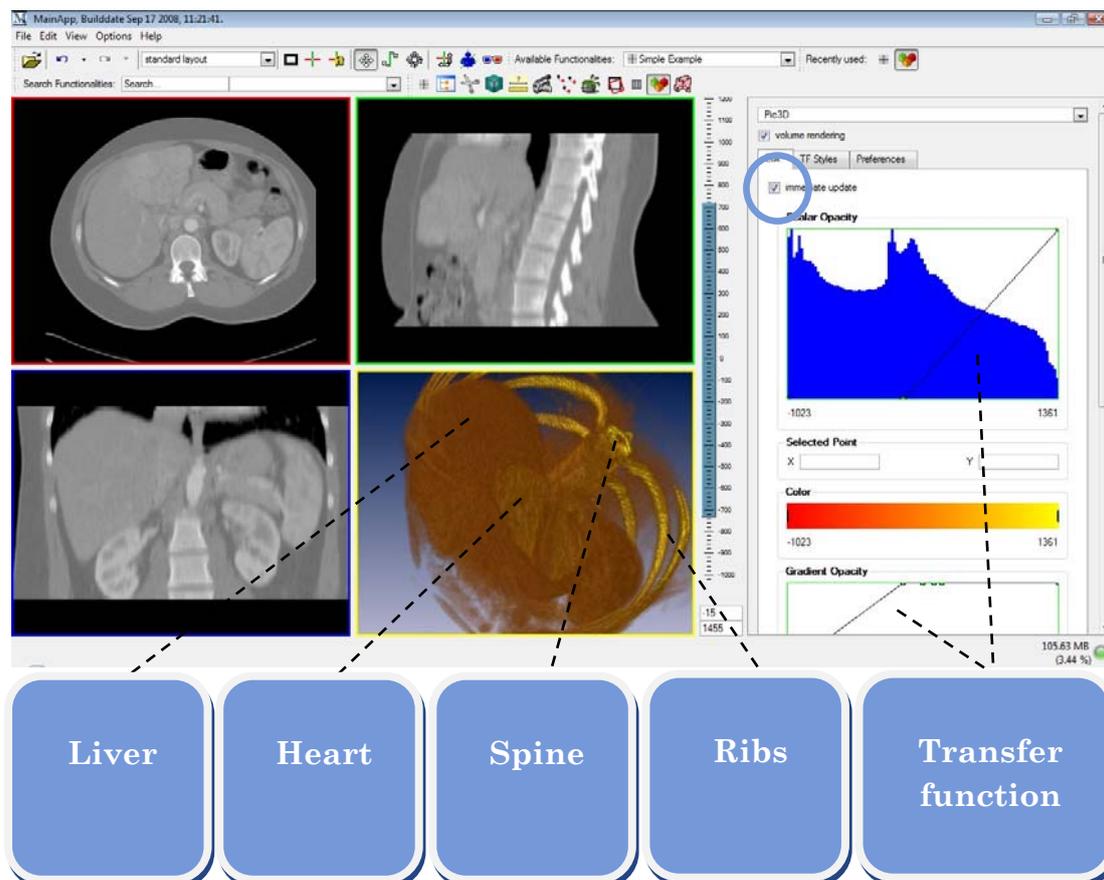


Figure 19: Volume Visualization

Data Manager

The data manager is the main access to the present data in the session and organizes it.

When several datasets are loaded, the data manager shows them in the order they were loaded in the system, following parent and child relations.

The data manager can be accessed by this button  .

The standard tab shows all loaded data and all data that is going to be produced during the session.

The MultiMode tab lets you change the standard settings for the visualization of the 2D planes.

The data manager also allows to load data directly into the data tree. In addition every highlighted data in the data tree can be saved to the harddisk. This is very important to save processed data. Any item of the data tree can also be removed to free memory and thus ameliorate stability.

The buttons “Global Reinit” and “Reinit” help you to reset the views in the program automatically and can thus solve minor problems with the visualization.

The lower window displays the properties of the highlighted data objects. Among others visibility, color and opacity can be regulated here.

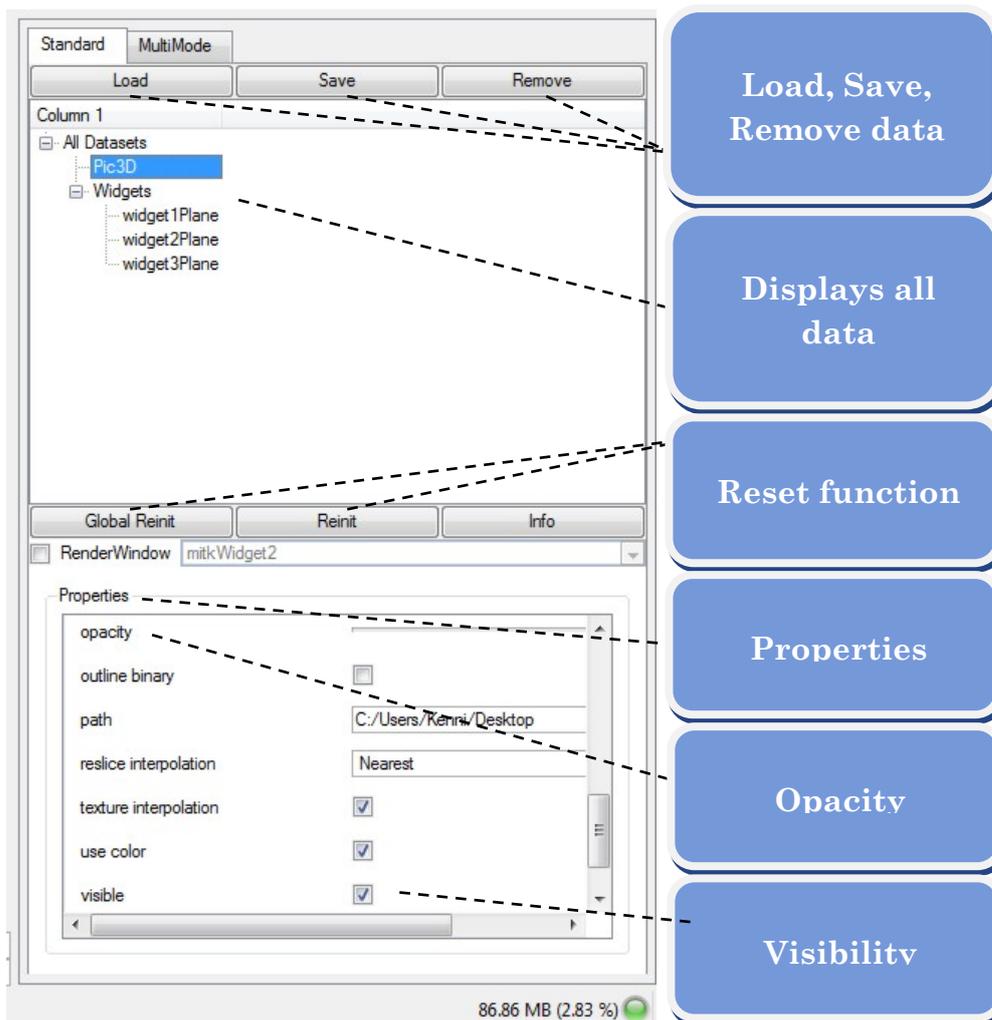


Figure 20: Data Manager Window

FIRST STEPS

Our sample dataset, as you probably already noticed, is a computer tomography of a male abdomen.

If any of the functionalities malfunction, simply restart MITK. Be sure to always save your progress.

Let's see what we can do with MITK standard functionality...

Hounsfield units and coordinates

Hounsfield units and coordinates (world and index) are shown in the left lower corner of MITK for the voxel that was clicked in the 2D plane.

Hounsfield units and coordinates are shown in the left lower corner of MITK for the voxel that was clicked in the 2D plane.

```
<188.77,143.02,75.00> mm; <188.77,143.02,25.00> pixel ; Pixelvalue: 160
```

Figure 21: Greyvalues and coordinates

IsoSurface

Imagine you would like to know what the patient looks like? What do you do?

Let's use this button  to find out.

IsoSurface will look for a certain greyvalue in the dataset and will produce a surface object connecting all these greyvalues.

The easiest way to find the surface is to look for the air surrounding it. So let us use a threshold of -400. Try it with a threshold of 300 for the bones and the blood (with contrast agent).

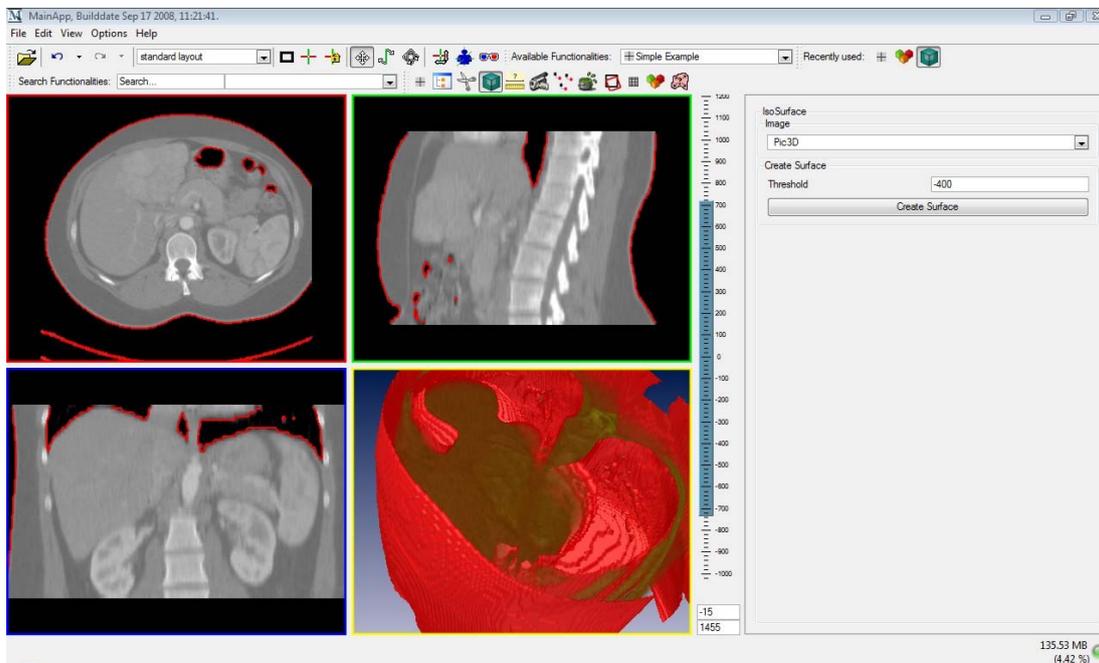


Figure 22: IsoSurface and Volume Visualization on Pic3D.pic

Crop

IsoSurface does always analyze the whole dataset. To get a better contrast and to be more flexible it might be good to define the area which will be handled; for example to avoid bone matter to be segmented together with blood vessels that have a similar Hounsfield value when a contrast agent is used.

Restart MITK, load Pic3D.pic and open the Crop functionality with this button .

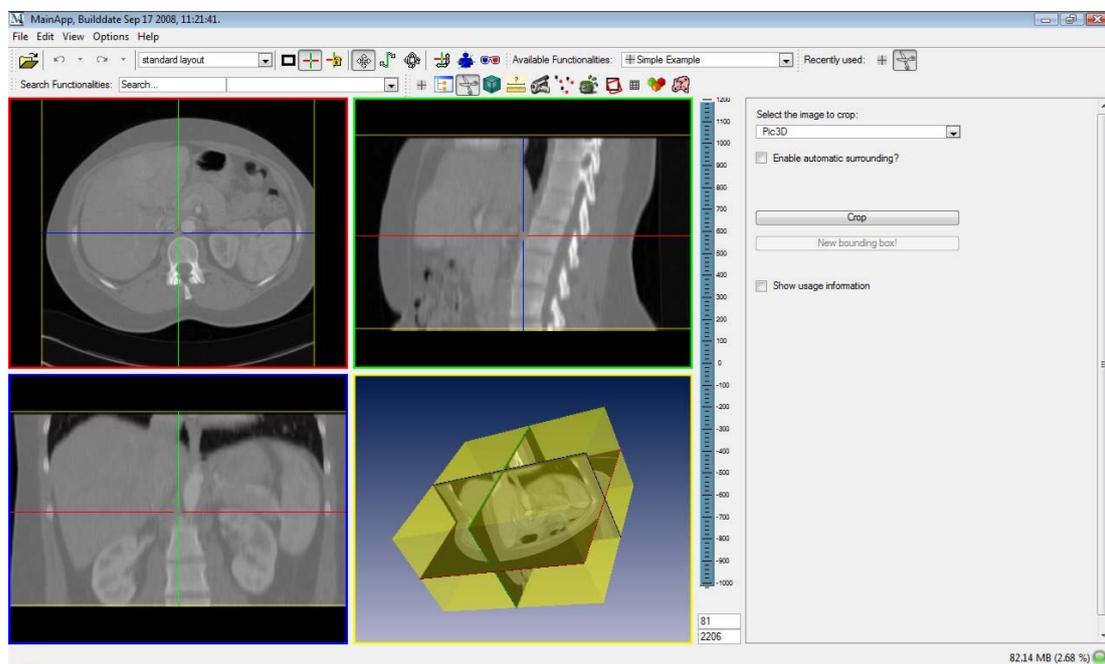


Figure 23: Crop functionality

The yellow bounding box can be manipulated by pressing “STRG” on your keyboard together with mouse actions.

- | | |
|----------------------------|-----------------------------------|
| Hold “STRG” + Left Hold | Move the bounding box on the data |
| Hold “STRG” + Right Hold | Scale the bounding box |
| Hold “STRG” + Middle Click | Rotate the bounding box |

By pressing the button “Crop” the image will be limited to the inside of the yellow box that you placed.

Although there is some training needed to be able to position the box correctly.

Try to isolate a single vertebra with a bounding box and find the right threshold for IsoSurface.

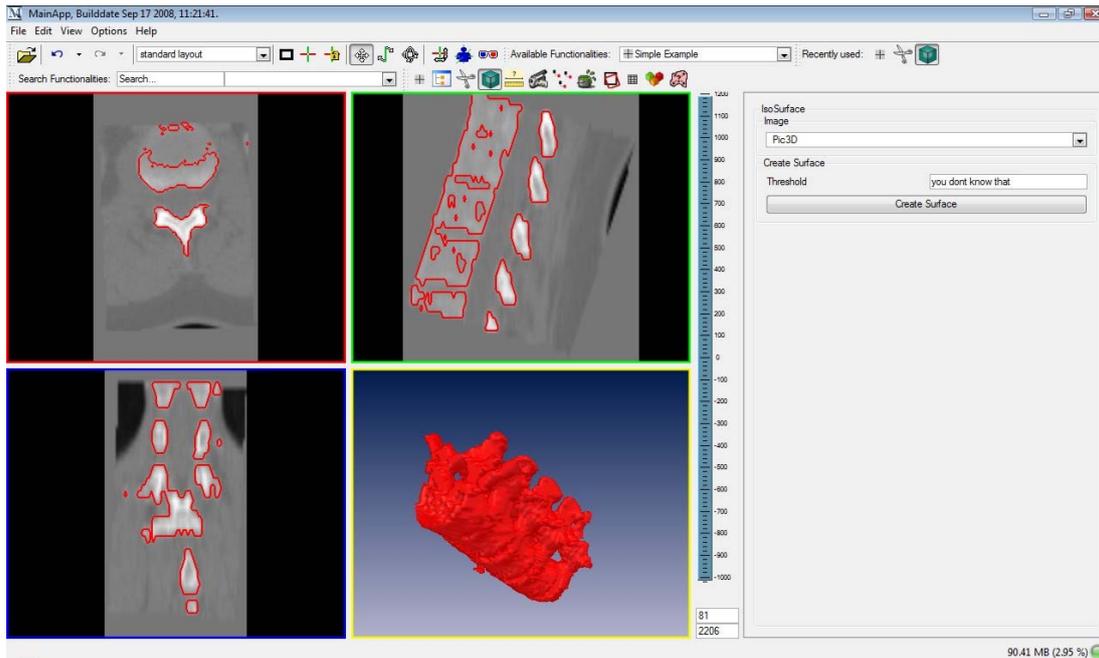


Figure 24: Combination of Crop and IsoSurface

Measurement

Speaking of vessels, in some cases it is very interesting to know the width of the aorta to decide whether to operate the aneurysm or not.

Let's measure the aorta of the sample dataset with this tool .

Restart MITK, load Pic3D.pic and open the measurement functionality.

Navigate with the planes to the aorta, change the window view to “transversal plane” and click on the button “Distance” in the functionality window. Now the measurement is activated but needs to know between which points you want to measure the distance.

In order to place the points hold down “Shift” on your keyboard and left click with your mouse on the left wall of the aorta to place the first point. Then place another point on the adjacent side.

The distance is immediately calculated and displayed. You can remove all results in the data manager and single points by pressing “Del” on your keyboard.

To measure an angle you will have to place three points. To measure a path all point distances will be calculated.

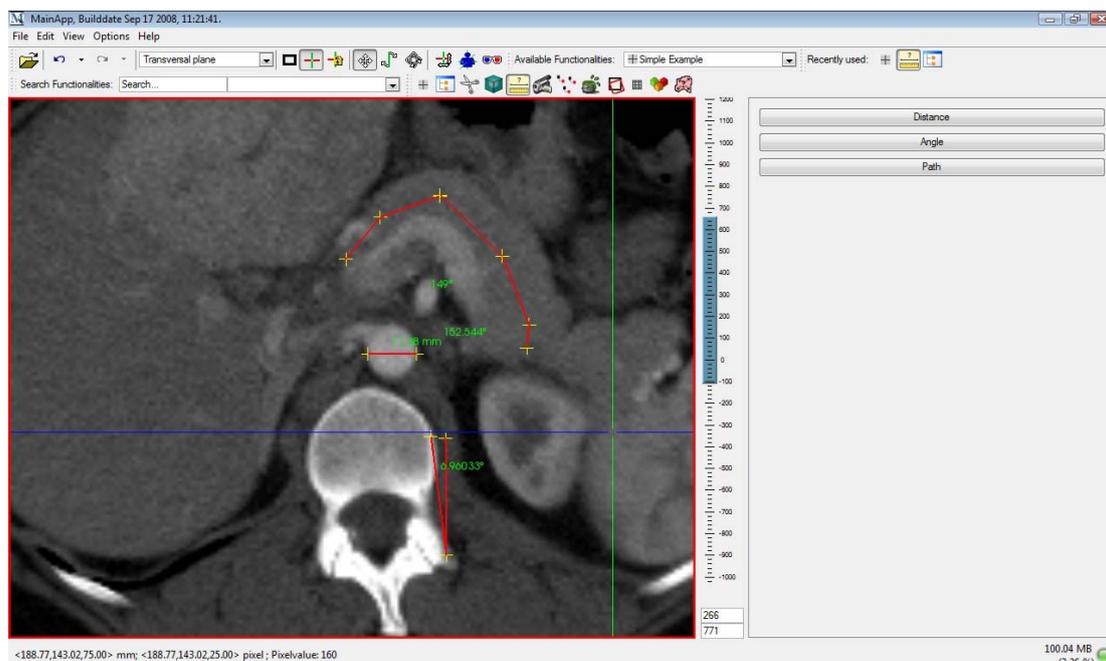


Figure 25: Measuring the width of the aorta.

MovieMaker

If you want to make a movie or a screenshot of your findings, for example for a conference, you can use the movie maker  functionality.

Open Pic3D.pic and use IsoSurface to create surfaces. Then open the movie maker functionality.

Choose the Window you want to step in and record in (usually these two are the same) and press the “Play” Button  .

In default you will see the 3D plane (mitkWidget4) rotate. Hit the “Stop” button if you are satisfied with the result and click on “Write Movie” to save the movie to your hard disk.

With the playing options you can determine how the models rotate and move and how long they will turn.

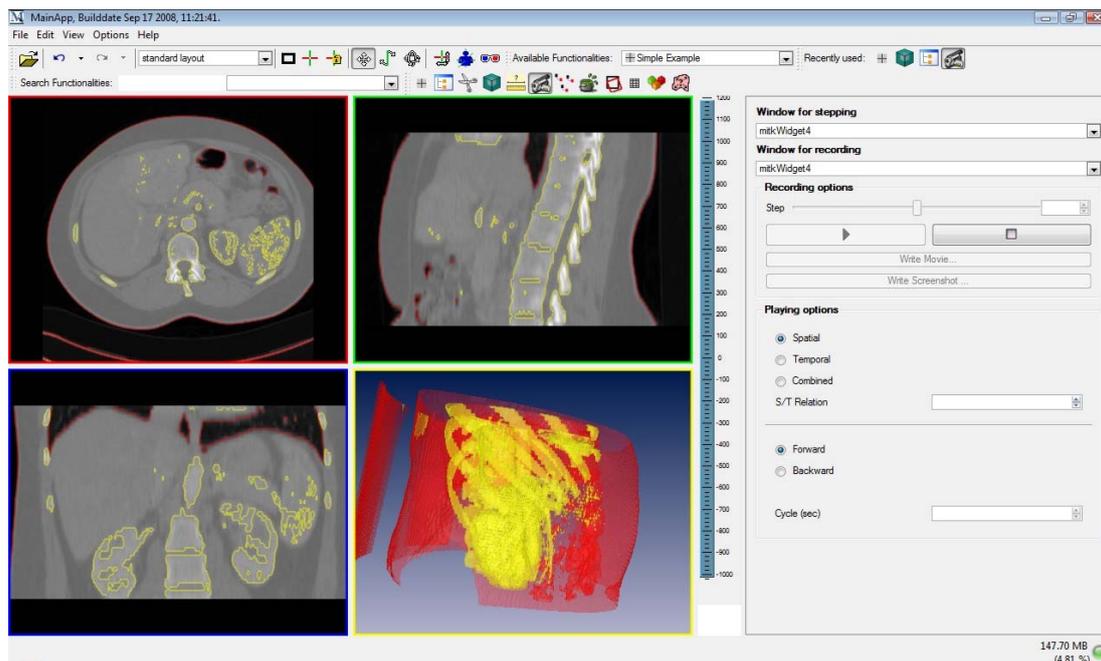


Figure 26: MovieMaker

Quite Simple Region Grower

With this functionality you can segment larger relatively homogenous structures like blood vessels with contrast agent.

The program will assess the greyvalues of several points. The maximum and the minimum value are used as thresholds. Therefore all greyvalues in between these two extremes will be selected. But the program will only take these voxel in accounts that are in the immediate neighbourhood.

Let's find out how it works by assessing how much blood is in our aorta in our sample dataset (Pic3D.pic).

Open the functionality by clicking . Then navigate to the aorta, preferably on frontal or better sagittal planes and place several points in the aorta the same way you put them in the measurement functionality by holding "SHIFT" and left clicking with your mouse. Then click on "Start region grower" in the functionality window.

This is what you should see. Note that the points are also shown in the 3D window. Check the Data Manager for the new entry "dumb segmentation". This data represents the highlighted red area. You may also rename it in the property window. Now proceed with the next chapter without closing MITK.

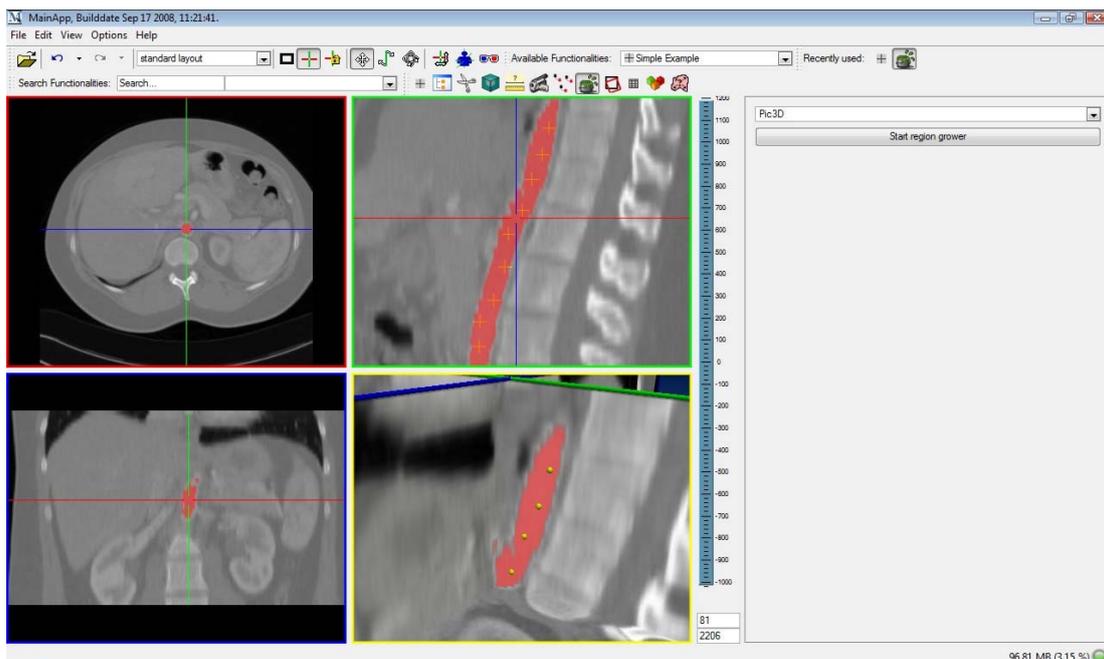


Figure 27: Quiet Simple Region Growing

Volumetry

With this functionality you can calculate volumes in a dataset.

With `QuiteSimpleRegionGrowing` you already found the aorta and segmented it. We will profit from this work now.

Open the volumetry functionality with this button .

In the upper right corner of the functionality window you can choose in a drop down menu which image you want to use the functionality on. Play around with the slider on the present pic. Then press the down arrow to see the contents of the menu and select “dumb segmentation”.

The threshold will need to be set to 1 due to the binary character of the segmentation. Press “Calc!” to calculate and display the volume in the aorta.

Hint: Go back to `IsoSurface` and select in the drop down menu of the functionality “dumb segmentation” with threshold 1 to create a surface model that will be displayed in the 3D window.

Imagine this approach for tumor, lymph nodes, lung and brain tissue...

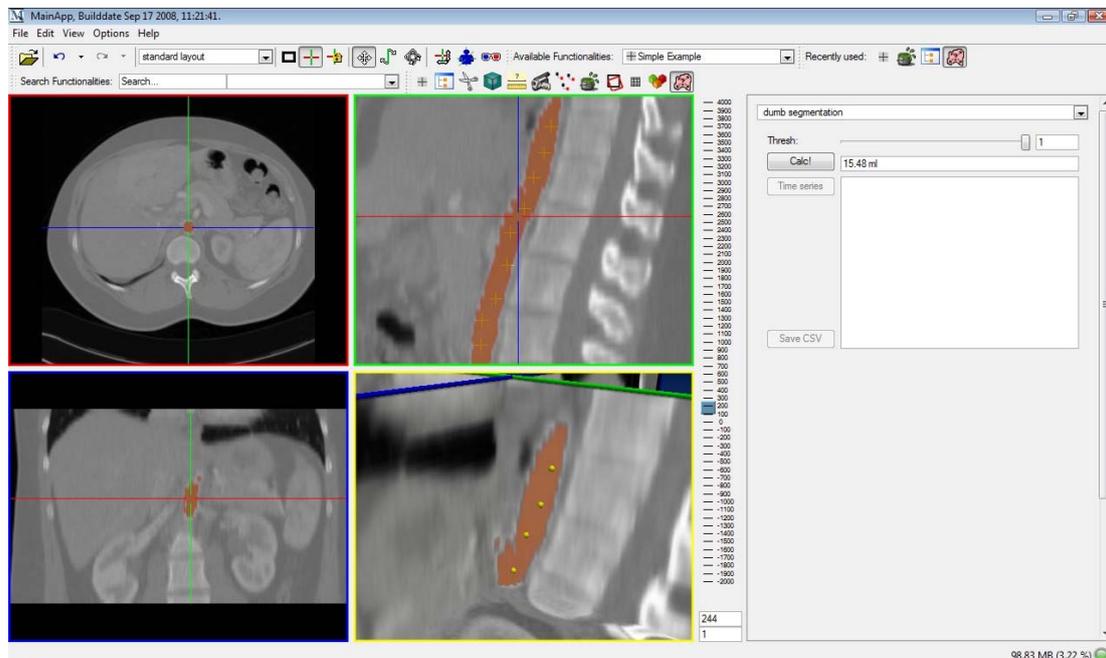


Figure 28: Volumetry based on a `QuiteSimpleSegmentation`

Interactive Segmentation

Whenever you want to process structures of the human body with a computer, you will have to cope with segmentation. Segmentation is the process of giving greyvalues meaning, i.e. Aorta, Spine, and apply a sharp distinction to other structures unlike “Volume Visualization”. Open the Interactive Segmentation with this button . First you should choose the right dataset you want to work on. This button  will reorientate the view. As soon as you open the functionality the 3D window and the planes in the 2D window will be hidden because you are going to paint in the image. If you want to show them use this button  in the upper menu.

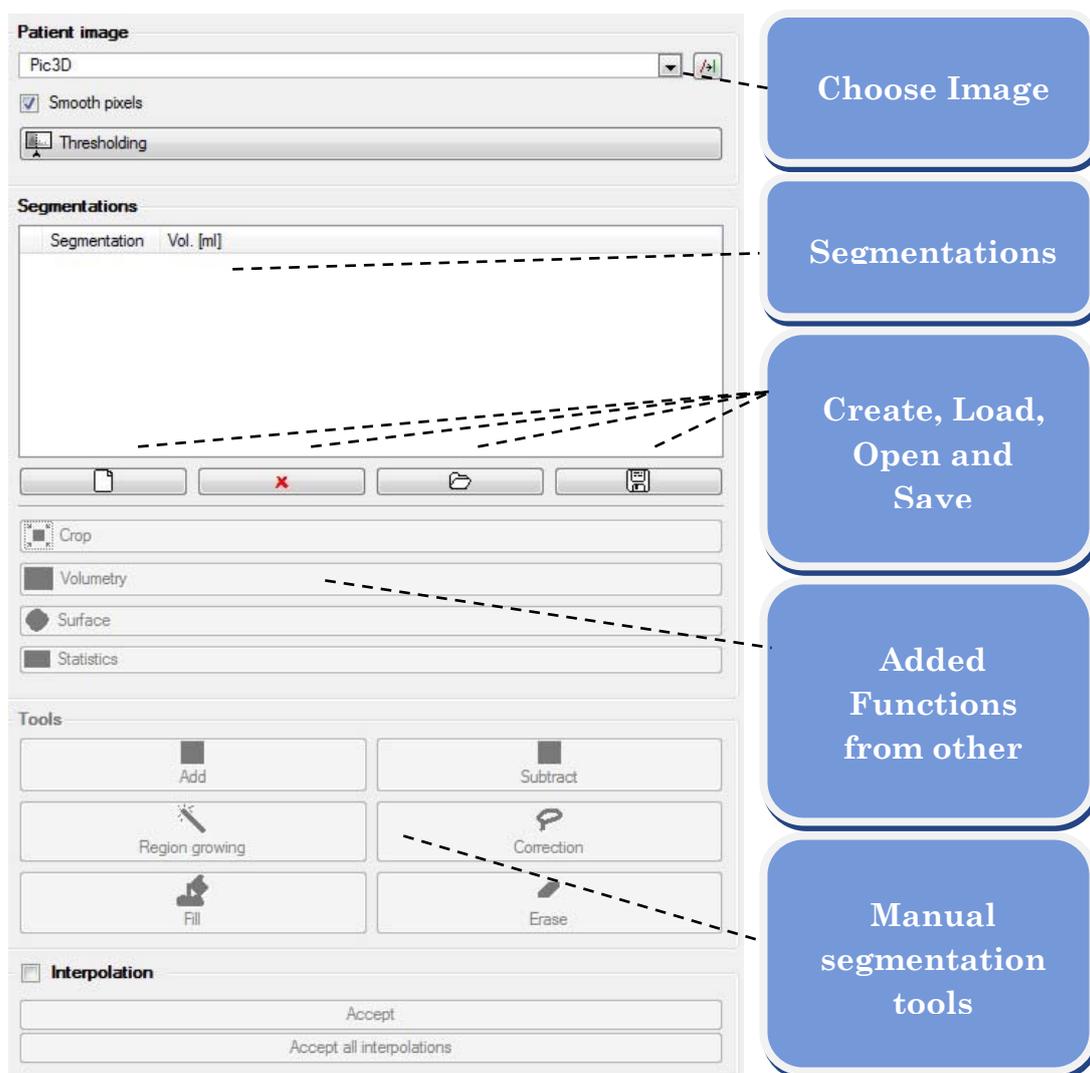


Figure 29: Interactive Segmentation Window

To get started load the dataset Pic3D.pic and open Interactive Segmentation.

First you should create a new segmentation with this button  and name it “Liver” in the opening drop down menu.

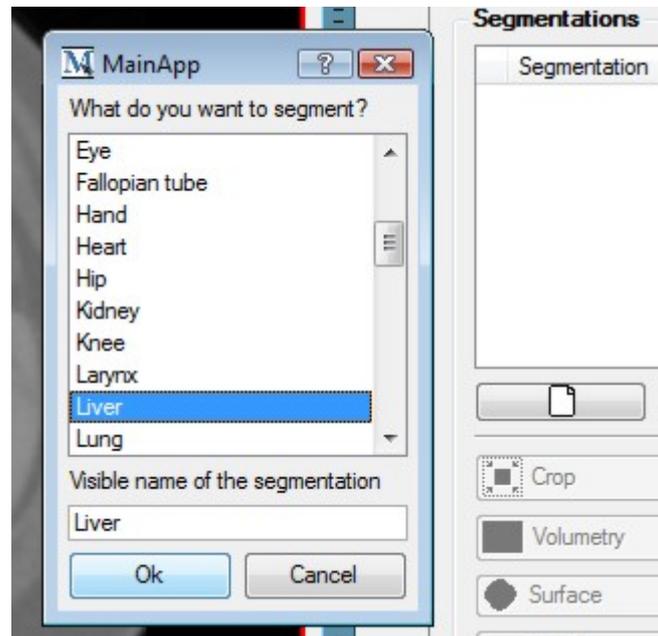
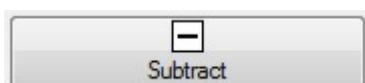


Figure 30: Drop down menu of a new segmentation

Change the view to “Transversal plane”. Then move to the liver in the dataset. With the “Tools” implemented in the functionality you are now able to literally paint a region of interest and by that creating a segmentation.



Activate this button hold the left mouse button and circle the area of interest in the transversal plane. Press STRG/CTRL to subtract as the “Subtract”-Button.



Hold the left mouse button down and subtract undesired highlighted areas. Press STRG/CTRL to add as the “Add”-Button.



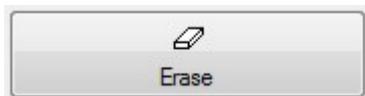
Hold the left mouse button down. By moving the mouse up and down you can shift the threshold to include more or less greyvalues.



Hold down the left mouse button and paint a cutting line through your segmentation to throw this part away.



If you used region growing in one plane several times it may happen that there happen to be some holes. Left click in them to fill them. Press STRG/CTRL and left click on your mouse to fill the whole plane.



Left click on a highlighted area and all of the connected markings in this plane will be erased. Press STRG/CTRL and left click on your mouse to erase the whole plane.

Now try to highline the liver with these tools in one plane. If you have difficulties, just remember to hold the right mouse button and magnify the plane by moving the mouse up.

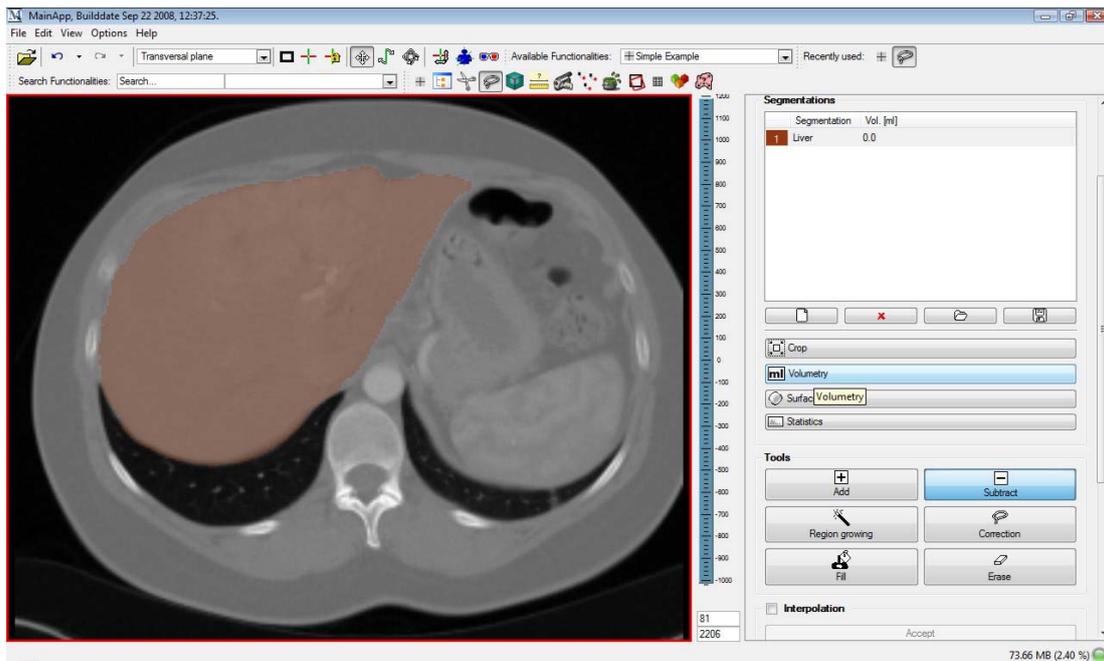


Figure 31: Segmented Liver in one plane

Once you have done this in one plane you will notice that you will need some time to segment the whole liver in every plane. To speed-up this process you can leave out a few planes and let the computer do the work by interpolating in between the remaining planes.

Segment some planes. Activate the “Interpolation” check box and check which segmentation the computer proposes on the remaining planes. You can now either refine this segmentation, accept it plane by plane or accept all segmentations.

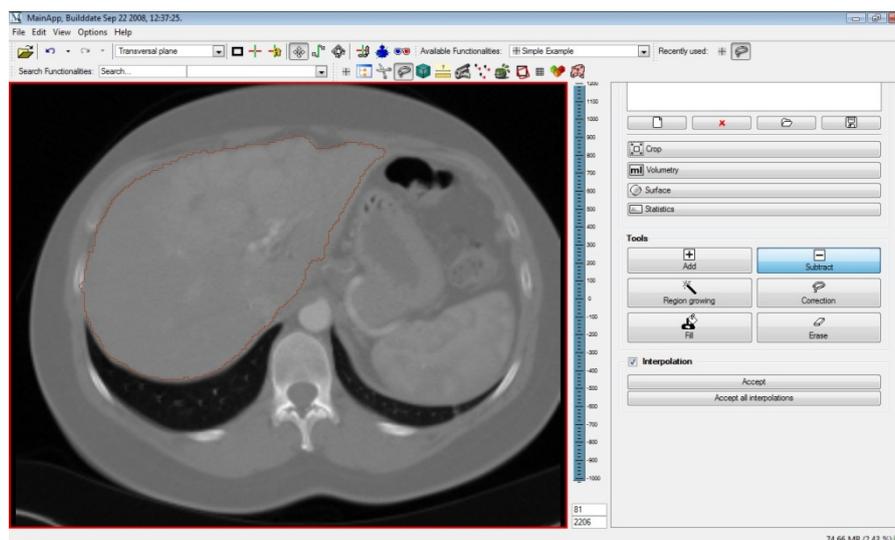


Figure 32: Interpolation of Liver segmentation

Now try the other functions that are built in. For example press  to produce a 3D model of your segmentation.

Right clicking on the segmentation list will allow you to change the names and colors for the different segmentations. To increase your segmentation speed you can also press the indicated numbers of the segmentations on your keyboard to swiftly switch between the segmentations. If you want to see the original layer without segmentation press “SPACE”.

Try to combine the different functionalities for best results...

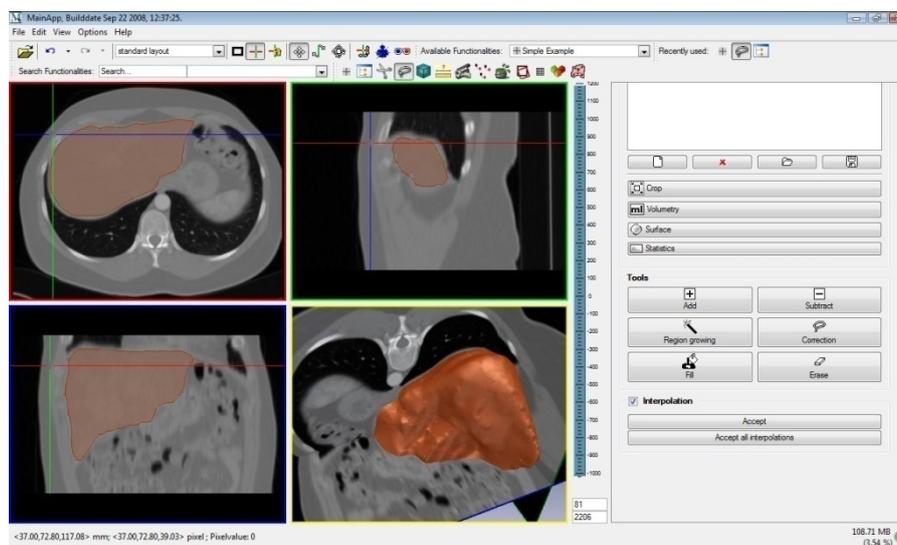


Figure 33: 3D model of the segmented liver

TROUBLESHOOTING

MITK is under active development and improvements are made to the framework every day. Please check <http://www.mitk.org> regularly for updates and troubleshooting.

Whenever you have problems with the software you should follow the following three steps:

1. Press “Global Reinit” in the Data Manager
2. Restart MITK and try again
3. Contact us on <http://www.mitk.org> and report a bug

We hope you will have great ideas and fortune based on MITK.

Let us know...

GLOSSARY

GUI	Graphical User Interface
MITK	Medical Imaging Interaction Toolkit
ITK	Insight Segmentation and Registration Toolkit, http://www.itk.org
VTK	Visualization Toolkit, http://www.vtk.org
MBI	Division of Medical and Biological Informatics, http://www.dkfz-heidelberg.de/en/mbi
DKFZ	Deutsches Krebsforschungszentrum (German Cancer Research Center), http://www.dkfz-heidelberg.de

IMPRESSUM

MITK MainApp.exe Getting Started, October 2008

Author: Hannes Kenngott

Copyright © Division of Medical and Biological Informatics, 2008

German Cancer Research Center

Im Neuenheimer Feld 280

69120 Heidelberg

Germany

To get in contact please visit <http://www.mitk.org>