

sliceOmatic

User's Manual

Version 4.3
Rev: 11 August 2011



division of
VIRTUAL MAGIC INC.
MONTREAL, CANADA

sliceOmatic USER'S MANUAL
Version 4.3

sliceOmatic
Copyright © 1997-2008 by Yves Martel
Distribution rights by TomoVision
ALL RIGHTS RESERVED

TomoVision
3280 Ch. Milletta
Magog, Qc
Canada, J1X 0R4

For questions regarding sliceOmatic, call (819) 843-1999 or FAX (819) 843-1999 during Eastern standard time business hours, or e-mail (support@tomovision.com)

Information in this document is subject to change without notice and does not represent a commitment on the part of TomoVision, Virtual Magic Inc. It is against the law to copy this software in any fashion or any medium.

Intel and Pentium are registered trademarks of Intel Corp.

Windows and Microsoft are registered trademarks of Microsoft Corp.

TomoVision is a division of Virtual Magic Inc.

DISCLAIMER:

Good data processing procedure dictates that any program be thoroughly tested with non-critical data before relying on it. The user must assume the entire risk of using the program.

Virtual Magic Inc. makes no representation or warranty with respect to the adequacy of sliceOmatic for any particular purpose or with respect to its adequacy to produce any particular results. In no events shall Virtual Magic Inc. or its employees be liable for special, direct, indirect or consequential damages, losses, costs, changes, demands, or claim for lost profits, fees, or expenses of any nature.

Table of Contents

Introduction

1 History	3
2 The Interface Tools and their Usage	3
3 File Extensions	5
4 Who to Contact in Case of Problems	7
5 About this manual	7

Installation Guide

1 System Requirements	11
2 Installing the Software	11
Step-by-Step Installation Part 1:	11
Installing TomoVision's sliceOmatic from the CD-ROM	11
Installing TomoVision's sliceOmatic from the Web	12
Installing the Dongle	13
Email TomoVision	14
Step-by-Step Installation Part 2	14
3 Uninstalling the Software	15
5 Upgrading the Software	15
6 Starting the Program	15
7 Using command line arguments	17
7.1 Starting from a DOS Prompt	17
7.2 Starting from a shortcut	17
7.3 Starting from the "Run" window	17
8 The sliceOmatic.ini file	18
9 The Licenses	19
9.1 The HASP Dongle	19
9.2 The NetHASP Dongle	19
9.3 The 30 days Licenses	20
9.4 The Permanent Licenses	20
9.5 The Upgrade License	20
10 The Network Dongle	21
10.1 The hardware Dongle	21
10.2 The License Manager	21
10.3 The Dongle's device drivers	22
10.4 Starting the programs	22
11 The TomoVision_License Program	22
11.1 Generating the Registration Form	23
11.2 Activating the Licenses	23
12 Program Crash	24

User's Guide

1 Program Overview	27
--------------------	----

1.1	The Modules	27
1.1.1	The BASIC Module	27
1.1.2	The TAG Module	27
1.1.3	The 3D Module	28
1.2	The Files	28
1.2.1	The GLI Files	28
1.2.2	The TAG Files	32
1.2.3	The Geom Files	32
1.2.4	The Script Files	33
1.3	The sliceOmatic Screen	34
1.4	Image Selection and Image Groups	35
1.4.1	Image Groups	35
1.4.2	Image Selection	35
2	The Main Menu	37
2.1	The File Menu	37
2.1.1	The “Medi Browser” button	38
2.1.2	The “File Open” button	38
2.1.3	The “Save GLI Files” button	39
2.1.4	The “Save TAG Files” button	39
2.1.5	The “Script Browser” button	40
2.1.6	The “Script Open” button	40
2.1.7	The “Save Script as ...” button	40
2.1.8	The “Geometry Open” button	41
2.1.9	The “Save Geometry as ...” button	41
2.1.10	The “Raw Image Support” button	42
2.1.11	The “Preferences” button	42
2.1.12	The “Register” button	43
2.1.13	The “Quit” button	43
2.2	The Undo/Redo Menu	44
2.2.1	the Undo and the Memory	44
2.2.2	The Undo/Redo and the Load/Restore operations	45
2.3	The Tools Menu	47
2.4	The Modes Menu	48
3	The Display Area	51
3.1	Mode All and Mode One	52
3.1.1	From the Graphic Interface	53
3.1.2	From the Keyboard	53
3.1.3	From the Command Line	54
3.2	Image Graphic States	55
3.2.1	From the Graphical Interface	56
3.2.3	From the Keyboard	56
3.2.3	From the Command Line	57
3.3	Image Selection	59
3.3.1	From the Graphical Interface	59
3.3.3	From the Keyboard	59
3.3.3	From the Command Line	60

4	The BASIC Module	61
4.1	The BASIC Tools	61
4.1.1	The Blow-Up Tool	63
4.1.2	The Color Scheme Tool	64
4.1.3	The Gamma Correction Tool	67
4.1.4	The GLI Color Map Tool	69
4.1.5	The Image Info Tool	70
4.1.6	The Memory Manager Tool	73
4.1.7	The Text Overlay Tool	76
4.1.8	The Pixel Info Tool	79
4.1.9	The Point Tool	81
4.1.10	The Display Area Snapshot Tool	85
4.1.11	The Units Tool	87
4.1.12	The Windows Tool	89
4.2	The BASIC Modes	92
4.2.1	The Admin Mode	93
4.2.2	The Filter Mode	97
4.2.3	The Measurements Mode	105
4.2.4	The 2D Registration Mode	110
4.2.5	The ROI + Re-Slice Mode	115
5	The TAG Module	119
5.1	The TAG Tools	119
5.1.1	The Tag Color Tool	120
5.1.2	The Tag Lock Tool	122
5.1.3	The Tag Surfaces and Volumes Tool	124
5.2	The TAG Modes	131
5.2.1	The Edit Mode	135
5.2.2	The Geometric Mask Mode	137
5.2.3	The Morpho Mode	142
5.2.4	The Region Growing / Painting Mode	148
5.2.5	The Snake Mode	153
5.2.6	The Thresholding Mode	158
6	The 3D Module	163
6.1	The 3D Tools	164
6.1.1	The Background Color Tool	165
6.1.2	The Clip Plane Tool	166
6.1.3	Display 2D Slices	168
6.1.4	The Light Tool	171
6.1.5	The Matrix Tool	173
6.1.6	The Measurement Tool	176
6.1.7	The Geometry Overlay Tool	177
6.1.8	The Stereo Tool	180
6.1.9	The Surface Shading Tool	182
6.1.10	The Surface Smoothing Tool	185
6.2	The 3D Modes	187
6.2.1	The Shell Mode	189

6.2.2	The Contour Mode	194
6.2.3	The Volume Mode	198
6.2.4	The MIP Mode	202
7	The Medi_Browser Program	207
8	The Script_Browser Program	211
9	The sliceOconfig Program	213
9.1	The Basic Module Preferences	214
9.2	The TAG Module Preferences	216
9.3	The 3D Module Preferences	218
9.4	The Drivers Selection	221
10	The Raw Header Program	223
10.1	The File Format tab	225
10.2	The Image Format tab	227
10.3	The Image Geometry tab	229
10.4	The Patient Info	231

Appendices

Appendix A:	Keyboard Shortcuts	235
A.1	The available key names	235
A.2	The available keyboard shortcuts	236
A.3	The default keyboard shortcuts	238
Appendix B:	The TAG File Format	243
Appendix C:	The Command line Syntax	247
C.1	The syntax of the command line is:	247
C.2	The variables	248
C.3	The macros	249
C.4	The commands statements	249
C.5	The control statements	249
C.6	Keyboard mapping	250
C.7	The system variables	252
C.8	The templates	257
C.9	The commands statements list	259
C.9.1	General commands, File and Image manipulations	259
C.9.2	Interface commands	262
C.9.3	Set commands	263
C.9.4	BASIC Mode commands	265
C.9.5	TAG Mode commands	268
C.9.6	3D Mode commands	270
C.9.7	BASIC & TAG Tools commands	271
C.9.8	3D Tools commands	273

Introduction

1 History

SliceOmatic is a medical imaging software designed to assist in the computation of anatomical volumes from CT and MRI scans.

SliceOmatic was developed as an in-house research tool. It was considered such a powerful tool that its fame grew by word of mouth, and soon it was used extensively by researchers around the world. Those who had the opportunity to use it were unanimous: sliceOmatic is the best tool for both Body Composition research and 3D modeling of anatomical structures. After many years of continual improvement, it is now available to the public.

The first version of sliceOmatic was developed for SGI's UNIX computers. But the advent of Pentium processors and powerful OpenGL graphic cards made it possible to port the application on PCs. Starting with version 4.1, sliceOmatic became a Windows application.

2 The Interface Tools and their Usage

SliceOmatic uses its own set of graphical interface tools. Here is a brief description of the different tools you will encounter.

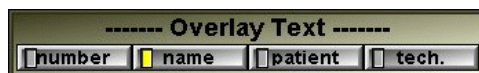
Buttons

Buttons can be activated by clicking the left mouse button. A button will change color when the mouse pointer is over it. Once activated, a button will look depressed and its text will be white.

If a button appears as only a red outline, it cannot be activated.



Some buttons have yellow indicator light to indicate their state. The state can be toggled ON or OFF by clicking the button.



Introduction

Button Lists Button lists are used to group many buttons together. If there are more buttons than can be displayed at one time, a slider will appear on the left side of the list. This slider can be used to scroll the list.



Sliders Parameters controlled by a slider can be modified either by clicking the left mouse button when the mouse pointer is over the desired portion of the slider, or by clicking and dragging the cursor of the slider with the mouse pointer. A slider will change color when the mouse pointer is over it.



Some sliders will also display their current values numerically.



When the mouse pointer is over the slider, you can also increase or decrease the slider's value with the keyboard.

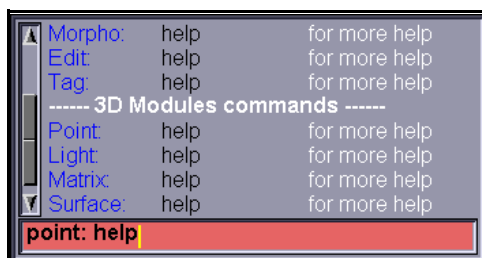
<i>Keys</i>	<i>Function</i>
Page Down	+1 to the current value
Home	-1 to the current value
End	+10 to the current value
Page Up	-10 to the current value
Insert	+100 to the current value
Delete	-100 to the current value

In many instances, the width of the cursor is proportional to the range of values represented by the slider. Thus, for the Slice Selection slider, if the total number of slices is four, the cursor will be one fourth the length of the slider.

Text Input These windows are used to prompt the user for textual information. You must place the mouse pointer over the window and type the information on the keyboard. Pressing the "Enter" key will signal the window that the text has been entered. You can use the arrow keys to move inside the text and the backspace and delete keys to edit the text. The vertical arrows are used to recall previously entered text strings.



Text Windows These windows are used to display textual information. If a slider appears to the left of the window, it can be used to scroll through the text.



Command Line At the bottom of the main text window, there is a text input line where you can enter command lines for the program.

3 File Extensions

In Windows, there is practically no restriction to the length of a file name or its extension. However, since it is sometimes desirable to transfer files to DOS, we recommend that you limit your file names to 8 characters and your file extensions to 3 characters. File extensions are not necessary but are useful for identifying files. The file extensions used by **sliceOmatic** are:

<i>Extension</i>	<i>Identification</i>
.scp:	A script file. Script files are used to group a sequence of GLI ¹ files and their "z" values in one read operation. They are also used to specify a number of operating parameters for the program.

¹ GLI images are defined in the **Section 1.2.1: The GLI Files** of the User's Guide

.tag: A TAG file.
These files are the tagged images produced by the program. The program will produce one TAG file for each GLI file.

Body composition result files:

.res: A surface area and volume results file.
These files contain the results of the surface and volume computations done by the program.

.srf: A surface results file in database compatible format.
These files contain the surface area results in a format that can easily be imported into a database program.

.vol: A volume results file in database compatible format.
These files contain the volume results in a format that can easily be imported into a database program.

3D polygon files:

.dxf: An Autocad's DXF file.
These files contain the results of a 3D shell reconstruction.

.mov: A MOVIE.BYU polygon file.
These files contain the results of a 3D shell reconstruction. They can be viewed with the 3D option.

.obj: An Wavefront OBJ polygon file.
These files contain the results of a 3D shell reconstruction.

.stl: A STL polygon file.
These files contain the results of a 3D shell reconstruction. They can be viewed with the 3D option. STL files are used by stereo lithographic -systems to create 3D models.

.wrl: A VRML polygon file.
These files contain the results of a 3D shell reconstruction. They can be viewed with the 3D option.

4 Who to Contact in Case of Problems

TomoVision

4559 Pontiac,
Montreal (Quebec)
CANADA H2J 2T2
tel: (877) 522-3559
fax: (877) 522-3559
e-mail: support@tomovision.com

If outside of Continental US or Canada:
tel: (514) 522-3559
fax: (514) 522-3559

5 About this manual

This manual is divided into 3 main sections:

- "Installation Guide"
- "User's Guide"
- "Appendices".

Installation Guide

The installation guide will give you the system requirements of the software and will walk you through the installation steps. It will also show you the different ways to start the program.

User's Guide

Section 1: Program Overview gives a description of the program, its main screen areas, its different modules and its operating modes. In this section, you will also find a description of the GLI, TAG and Script files used by the program.

Section 2: The Main Menu describes the main menu and how it is used to change the operating mode of the program. A short description of each of these modes is also included.

- Section 3: The DISPLAY Area** describes what you see in this window, how to toggle between the two display modes, how to scroll through the images, and the keyboard commands associated with this window.
- Section 4: The BASIC Module** describes the tools available in sliceOmatic to visualize and take measurements on 2D images.
- Section 5: The TAG Module** describes the tools available in sliceOmatic to segment and label tissues and to do anatomical volume computations.
- Section 6: The 3D Module** describes the tools available in sliceOmatic to generate and manipulate 3D images and surfaces.
- Section 7: The Medi_Browser Program** describes the Explorer-like browser used to select images.
- Section 8: The Script Browser Program** describes the Explorer-like browser used to select script files.
- Section 9: The sliceOconfig Program** explains how to configure sliceOmatic with your preferences.
- Section 10: The Raw Header Program** explains how to read a raw image in sliceOmatic.

Appendices

- Appendix A: Keyboard Shortcuts**
- Appendix B: The TAG File Format** describes the format used for the TAG files.
- Appendix C: The Command Line Syntax** describes the syntax used by sliceOmatic's command line and the script files.

Installation Guide

1 System Requirements

Minimum requirements:

- Pentium3, 500 MHz IBM PC or compatible
- 256 MB of RAM
- Windows 95, 98, NT, 2000 or XP
- A 100% Windows compatible mouse
- An OpenGL graphic card

Recommended configuration:

- Pentium4, 1GHz IBM PC or compatible
- 1GB to 2GB of RAM
- Windows NT, 2000 or XP
- A wheeled 3 buttons 100% Windows compatible mouse
- A graphic card with a recent Ge Force chip-set
- a 21" screen using a resolution of 1280x1024 or better

2 Installing the Software

Step-by-Step Installation Part 1:

Installing TomoVision's sliceOmatic from the CD-ROM

What to have on hand:

- TomoVision's sliceOmatic CD
- License Dongle

1. Log in as an administrator if you are running Windows NT, 2000 or XP.
2. Insert TomoVision's sliceOmatic CD into the computer's CD-ROM drive. If your Autorun is not enabled, click on the icon representing your CD-ROM drive under "My Computer". This will bring up a listing of the files on the sliceOmatic disk. Find SETUP.EXE and double click to launch the Install application.
3. In the Setup dialog box that contains the **Software License Agreement**, read the agreement and click **Yes** if you agree with the statement: "Do you accept all the terms of the preceding License Agreement".
4. In the **Destination Location** dialog box, click **Next** to accept the default installation directory: "C:\Program Files\Tomovision".
5. Select the component(s) you wish to install and click **Next**. The choices are:

Component	Notes
Program Files	All the files necessary to run the program
Documentation Files	The User's manual in PDF format
Tutorial Files	The segmentation tutorial and the associated demo images

6. In the **Information** dialog box, read the "readme" file and click **Next**.
7. In the **Setup Complete** dialog box, you can check the "Run sliceOmatic in Anonymous Mode" if you want to prevent the program from displaying patients' name or ID information (this option may come in handy if you are doing a blind study), then click **Finished**.

Installing TomoVision's sliceOmatic from the Web

What to have on hand:

- License Dongle
- Winzip or an application able to read ".zip" files. If you do not have Winzip on your computer, follow the appropriate link from sliceOmatic's download page to get the latest version.

Download sliceOmatic.zip

Login the TomoVision's Web site at: www.TomoVision.com, go to the download page and select sliceOmatic's download.

Download the latest version of the sliceOmatic.zip file.

Note

Lately, some paranoid firewall programs will block ".zip" programs from downloading, or even worse, they will alter the ".zip" file content. If you have problems downloading the software or are unable to run the installation program from the ".zip" file, please make sure that the problem is not caused by your firewall.

Installing TomoVision's sliceOmatic

1. Log in as an administrator if you are running Windows NT, 2000 or XP.
2. Double click on the sliceOmatic.zip file to start the winzip application. From winzip select "install" to start the installation program (alternatively, you can decompress the ".zip" file to a temporary directory and run the "setup.exe" program from that directory.)

3. In the Setup dialog box that contains the **Software License Agreement**, read the agreement and click **Yes** if you agree with the statement: “Do you accept all the terms of the preceding License Agreement”.
4. In the **Destination Location** dialog box, click **Next** to accept the default installation directory: “C:\Program Files\Tomovision”.
5. Select the component(s) you wish to install and click **Next**. The choices are:

Component	Notes
Program Files	All the files necessary to run the program

Note

The User’s manual and Tutorial files that are present on the CD are not included in the Web version of sliceOmatic’s installation. You can download them separately from the Web site.

6. In the **Information** dialog box, read the “readme” file and click **Next**.
7. In the **Setup Complete** dialog box, you can check the “Run sliceOmatic in Anonymous Mode” if you want to prevent the program from displaying patients’ name or ID information (this option may come in handy if you are doing a blind study), then click **Finished**.

Installing the Dongle

For more information on what is a dongle and why it is needed by the software, please refer to appendix A “The Dongle”.

Optionally, you can have a network dongle that can control multiple licenses. If you have a network dongle, please refer to **section 10** of this Installation Guide for a more detailed installation procedure.

Installing the dongle’s device drivers

1. Log in as an administrator if you are running Windows NT, 2000, XP or Vista.
2. Run the HASP_User_Setup.exe installation application. This program can be found in the TomoVision’s installation directory (by default: c:\Program Files\Tomovision)
3. Restart your computer

Plugging the hardware dongle

The dongles are available either for your USB or printer port. Unless you specifically asked for a printer port dongle, you received an USB dongle with the software.

4. Plug to dongle in the port. When the dongle is firmly in place, its indicator light will turn on.

Email TomoVision

The dongle you received only contains license codes valid for 30 days. TomoVision will send your permanent license codes by email when the 2 following conditions are met:

- TomoVision has had confirmation that you received the dongle
- TomoVision has received your payment

At this point you need to advise TomoVision that you have received the dongle.

1. Send an email to sales@TomoVision.com stating that you have received the dongle and that it is working properly. Unless you specify otherwise, the return address of this email will be used to send you your permanent license codes.

Once you have received TomoVision's email with the permanent license codes, you are ready to proceed to part 2 of the installation.

Step-by-Step Installation Part 2

What to have on hand:

- TomoVision's permanent license codes email.

The permanent license codes are in a file attached to the TomoVision's permanent license codes email.

1. While viewing the email, click on the attached file icon's (a paper clip in most email programs) and follow the instructions to save the attachment to a file. Save this file in the TomoVision's installation directory (c:\Program Files\Tomovision by default).

To transfer the licenses codes from the license file to the dongle's memory, we use the TomoVision_License program. For more information on this program and its uses, please refer to **Section 11** of this Installation Guide.

2. Start the TomoVision_License program from the start\program\Tomovision menu.

You can view the current state of your licenses by clicking on the "step-2" tab.

3. Open your window browser so that you can see the icon of the license file you saved from the TomoVision's email.
4. Drag and drop this icon on the TomoVision_License's program window.

Your licenses should now be updated. If any problem occurred during the license transfer, a detailed message will be displayed in the text window of the TomoVision_License program.

3 Uninstalling the Software

From the Windows Start Button, select Control Panel in the Settings menu. In the Control Panel, select Add/Remove Programs, left-click on SliceOmatic, and click on the Add/Remove button. The software and all its components are then removed from your hard drive.

4 Moving sliceOmatic to a new computer

If you wish to transfer the software from one computer to another, you can do it. The licenses are contained in the dongle and are not tied to the computer. Just follow Part-1 of the installation to install the software on the new computer and transfer the dongle to that computer. You do not need to repeat Part 2, your dongle already has the permanent licenses.

5 Upgrading the Software

If you have a valid upgrade license (See **Section 9** of this Installation Guide) , you can download and install the latest version of sliceOmatic from the Web.

To upgrade the software, simply install the latest version over your old version.

6 Starting the Program

You can find all the installed sliceOmatic programs on the Windows **Start** menu under **Program / Tomovision**. You can also start the program by selecting image files with the mouse, drag them to the program icon and drop them there, or you can start the program without arguments, simply by clicking on its icon. By default the program resides in C:\Program Files\TomoVision.

When sliceOmatic starts, it first parses its command line arguments for special instructions, then it look in its “.ini” files for its default parameters.

SliceOmatic can accept the following command line arguments:

```
sliceOmatic [-d dir] [-p pipe] [-t level] [-v] [-z] [-x pos dim] [-y pos dim]
```

General operation arguments (shared by all TomoVision's programs)

- t *level* Trace level (0 <= level <= 5)
- v Display the program's version and creation date
- z Use the NetHASP network dongle
- x *pos dim* Horizontal position and dimension of the program's window (in pixels)
- y *pos dim* Vertical position and dimension of the program's window (in pixels)

SliceOmatic specific arguments

- d *path* Starting directory. All File Open and Save dialogs will be rooted in this directory. (By default: path = the current directory)
- p *name* Pipe name. The program communicates with other programs through this file. If you wish to open more than one instance of the program, you have to specify a different pipe for each instance. (By default: C:\temp\sliceO.dat).

Note

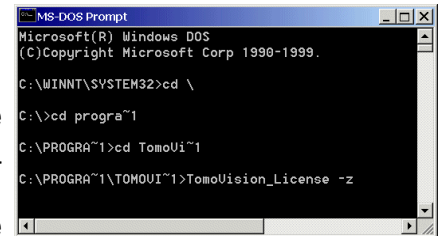
If you want to start more than 1 instance of sliceOmatic at the same time, you will need to assign a different pipe to each instance of sliceOmatic.

7 Using command line arguments

You may need to use command line arguments to enable some of the options of a program. There are 3 ways to start program with command line arguments:

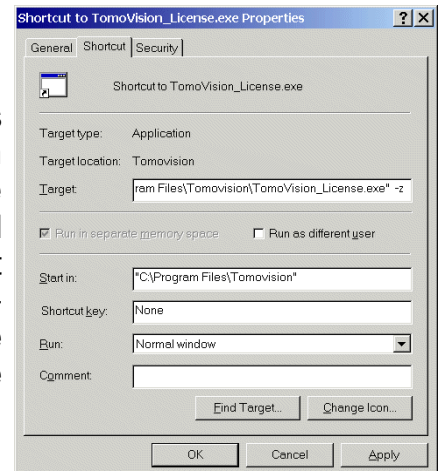
7.1 Starting from a DOS Prompt

You can type in directly the filename of the executable program, followed by the options, in a DOS Prompt window. In the following examples, the TomoVision_License program is started with the “-z” command line argument.



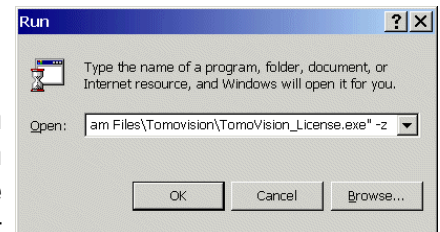
7.2 Starting from a shortcut

With this technique, the command line arguments will be present each time you start the program from the shortcut. First, create a shortcut to the executable program by right-clicking on its icon and selecting the “Create Shortcut” option. Then, edit the “Target” field of the shortcut properties by right-clicking on the shortcut and selecting the “Properties” option. Under the “Shortcut” tab add the arguments after the quotes in the Target field.



7.3 Starting from the “Run” window

From Windows “Start” menu, select the “Run” option to open the “Run” window. In this window, you can use the “Browse...” button to browse the file structure until you find the program (by default TomoVision’s programs are installed in C:\Program Files\TomoVision). The program’s path and name will be placed in the “Open” field. You can then add the arguments you wish to use after the quotes in the “Open:” field (-z in this example).



8 The sliceOmatic.ini file

There are 2 copies of sliceOmatic.ini. One in the directory of the sliceOmatic program, the second in the user's private directory (usually C:\Documents and Settings\user name\Application Data\TomoVision\).

At startup, the program reads both files, starting with the one with the sliceOmatic program. This enables you to have preferences defined for all users (from the copy in the program's directory) and preferences tailored for each user (from the copy in the user's directory).

The copy in the user's directory is generated and modified with the sliceOconfig program. If you want to apply the same preferences to all users, overwrite the copy in the program's directory with the one generated by the sliceOconfig program. The sliceOconfig program is started from the "File Preferences" menu in sliceOmatic.

The ".ini" file contains a series of "set:" command statements using the script file syntax. A detailed description of these commands can be found in Appendix C of the User's manual. The commands found in the ".ini" file are:

BASIC Module:

```
set: interface_size value           (value=0,1 or 2)
set: undo_nb value                   (0 <= value <= MAX_UNDO)
set: undo_size size                   (size in MBytes)
set: scratch_dir path                 (def: "c:\temp\"
set: start_script path                 (def: "")
set: start_2D_tools flag               (def: 11)
set: start_2D_overlays flag           (def: 2)
```

TAG Module:

```
set: TAG_placement_mode flag         (def: 5)
set: TAG_repository path              (def="C:\TAG_Repository\")
set: TAG_autosave delay                (delay in min. from 0 to 240)
set: TAG_nb value                     (16<=value<=256)
set: DB_surf_export flag               (def=1)
set: DB_vol_export flag                (def=1)
set: units_surf flag                  (def=0)
set: units_vol flag                   (def=0)
```

3D Module:

```
set: graphic_speed value              (def=710)
set: start_3D_tools flag                (def=3)
set: start_3D_overlays flag            (def=3)
set: mouse_control value               (def=0)
```

Drivers Module:

```
set: graphic_context value
```

9 The Licenses

TomoVision products use 2 layers of protections:

- a hardware layer, provided by the HASP (Hardware Against Software Piracy) dongles from Aladdin
- a software layer consisting of encrypted license activation codes stored in the dongle's memory.

9.1 The HASP Dongle

A dongle is a hardware device connected to either the USB or the printer port. The dongle used by TomoVision has its own timer and memory. All the information needed to license your products is included in the dongle, so it's easy to move your application to a new computer.



USB port dongle



Printer port dongle

If the dongle is not present on your computer, the software will run in “demo” mode and some functions will not be available.

9.2 The NetHASP Dongle

As an option, you can have all your licenses stored in a single network dongle. With this option, all the computers on a local network can share the licenses administrated by the network dongle.

9.3 The 30 days Licenses

Each module of each product can be issued a 30 days license. These licenses will unlock the desired module for a period of 30 days starting from the moment the licenses are written in the dongle at our office. The 30 days are controlled by an internal clock in the dongle and are independent of your computer's clock. While the 30 days licenses are active, you can download the latest version of the software from our Web site and it will be covered by the licenses.

The dongles are always shipped with 30 days licenses. The reasons for this are twofold:

- As soon as we get a P.O., we ship the dongle with the 30 days licenses. This enables you to start working with the product immediately while the payment is handled by the accounting department of your institution.
- If the dongle gets lost in transit, we can replace it without worrying about multiple licenses being issued, since the licenses in the lost dongle will expire in 30 days anyway.

9.4 The Permanent Licenses

Each module of each product can be issued a permanent license. These licenses will unlock the desired modules. As the name implies, the permanent licenses do not expire. The permanent licenses are written to the dongle with the help of the TomoVision_License.

9.5 The Upgrade License

The upgrade license is issued by product. Each license contains 2 informations: the modules that are covered by the license and the last allowed upgrade date. Until that date, you can download the latest version of the software from our Web pages and it will work with your license dongle. And since your permanent licenses are permanent, it will keep on working for... well, forever!

But, after that date you can no longer download a new version of the software. Any version of the software that is younger then the upgrade expiration date will not be recognized by the licenses. In this case you can either:

- Renew your upgrade contract. Upgrades contracts are available from TomoVision for a yearly fee.
- Re-install a previous version of the product. If you do not have the previous version anymore, contact TomoVision.

If you wish to keep on upgrading your software, you can purchase an additional year of support & upgrade from our Web site at www.TomoVision.com.

Please note that support & upgrade contracts are uninterrupted. This means that the starting date of your next contract is the finishing date of this one, regardless of the date of purchase. If you fail to renew your contract for more than 6 months, it will be terminated. Following this, if you wish to get the latest version of the product, you will have to purchase a new license.

10 The Network Dongle

As an option, you can have all your licenses stored in a single network dongle. With this option, all the computers on a local network can share the licenses administrated by the network dongle.

10.1 The hardware Dongle

One of the computers on your network will act as the License Manager. Only a brief description of the installation procedure will be presented here. For more information on the usage and installation of the License Manager, please consult HASP Web site at www.ealaddin.com

Plug the USB NetHASP dongle on the computer that will run the License Manager. When the dongle is firmly in place, its indicator light will turn on.

10.2 The License Manager

To install the License Manager on the computer with the dongle, you need to:

- Log in as an administrator if you are running Windows NT, 2000 or XP.
- Open the LM_Setup_Win32.zip file from TomoVision's download site. This file contains the lmsetup.exe installation application.
- Run the lmsetup.exe installation application (this can be done directly inside WinZIP, or you can extract the file to a temporary directory and run it from there).
- Accept the typical installation option unless you have reason to do otherwise.
- Restart your computer when prompted.

10.3 The Dongle's device drivers

All the other computers using TomoVision's programs will need to access the License Manager. For this, you need to install the device drivers on each of these systems.

Installing the dongle's device drivers

1. Log in as an administrator if you are running Windows NT, 2000 or XP.
2. Run the HASP_UserSetup.exe installation application. This program can be found in the TomoVision's installation directory (by default: c:\Program Files\Tomovision)
3. Restart your computer

10.4 Starting the programs

By default, TomoVision's products do not test for the presence of the network licenses. You have to tell each program that it should look for the network licenses. This is done by starting the programs with the "-z" option in their command line arguments. See **section 7** of this Installation Guide for a discussion on how to start the program with command line arguments.

11 The TomoVision_License Program

The TomoVision_License program is used to read and write license activation codes on the HASP dongle and to generate a registration form if needed. Each dongle has an unique ID number. This unique ID is used by TomoVision when the license codes are generated, so the licenses are only valid for a specific dongle.

The TomoVision_License program is installed automatically along with your TomoVision application. But you can also download it directly from the "Tools and drivers for the license dongle" page in the Download section of TomoVision's Web site.

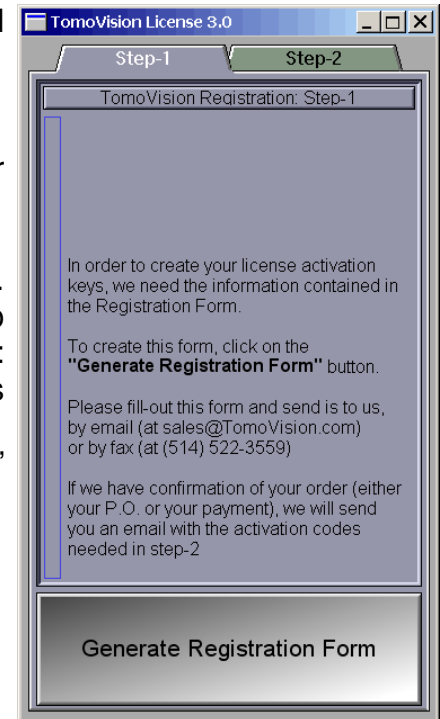
Start the TomoVision_License program from the **start\program\TomoVision** menu, or by selecting the "Register" option in the "File" menu of sliceOmatic.

11.1 Generating the Registration Form

Unless asked for by TomoVision, you do not need to generate a registration form.

If TomoVision asks for it, you should:

- Make sure the HASP dongle is connected to your computer.
- Start the TomoVision_License program.
- Click on the “Generate Registration Form” button. This will create a registration file in the c:\temp directory. This file will be named: “TomoVision_xyyyyzz_reg.dat”, where xyyyyzz is the current date in the form day/month/year.
- Fill out this form (you can use Windows “Notepad” or any other editor to edit the form).
- Email the form to “sales@TomoVision.com”

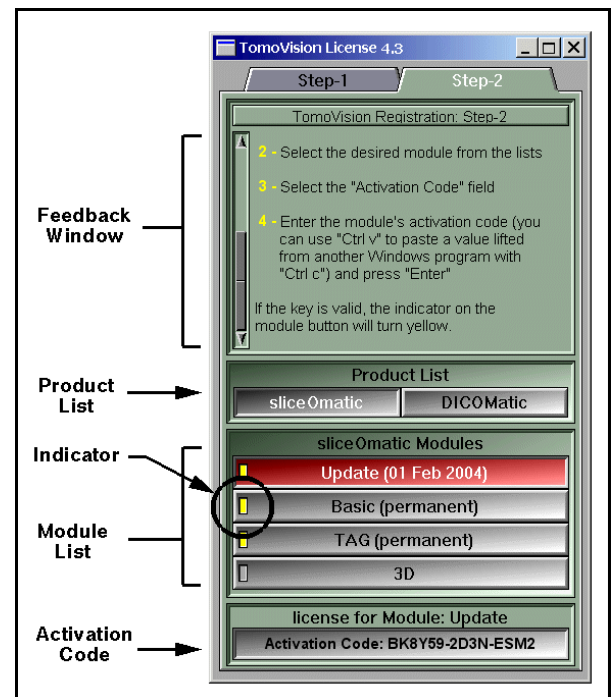


11.2 Activating the Licenses

The program “TomoVision_License” is used to transfer the license activation codes to the dongle. These can be written either automatically or manually.

Automatic

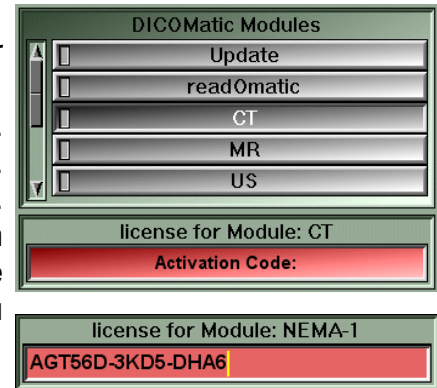
Just drag & drop the activation codes file, sent to you by TomoVision, on the License program. All the activation codes present in the file will be entered. The indicators on the corresponding buttons in the module list should turn yellow.



Manual

You can also enter the activation code manually for each module.

- Select the desired product from the “Product List”.
- Select the desired module from the “Module List”.
- Select the “Activation Code” field by clicking on it.
- Type in the activation code. Alternatively, you can “copy” (Ctrl-c) the code from the license codes file and “paste” (Ctrl-v) it in the field. Make sure you press the “Enter” key to accept the value.



If the code is valid, the indicator on the “Module List” button will turn yellow. If the code is invalid or a problem has occurred, a text message will state so in the text feedback window.

12 Program Crash

In the event of a program crash there will be an error log file called *TomoVision.err* in the Scratch Directory ("C:\Temp" by default). SliceOmatic also saves a list of all the images opened during your last session in "sliceO.dat" in the Scratch Directory. Upon startup, sliceOmatic will ask you if you want to automatically attempt to reload all these files.

User's Guide

1 Program Overview

This software is designed to help in the visualization and computation of anatomical volumes from tomographic scanners. To achieve this goal, this software helps the user to perform the following steps:

- Load and visualize the scanner images
- Reorder the images (usually according to their "depth" values)
- Filter the images to increase contrast or reduce noise if necessary
- Segment the images
- Edit and tag the segmented images
- Compute the surface area and volume of the tagged pixels
- Visualize the segmented volumes
- Extract the surface and volume information of the segmented images

1.1 The Modules

SliceOmatic functions are grouped in 3 modules.

License

Each of these modules has a separate registration code to unlock their full functionality. All the functions are available in the unlicensed version of sliceOmatic, but some restrictions on their behavior are applied: without the module License, sliceOmatic cannot save any of its results and a "demo" watermark will be displayed on the screen.

1.1.1 The BASIC Module

The BASIC Module regroups the functions that are necessary to import, visualize and make measurements on medical images. A detailed description of the tools and modes associated with the BASIC Module can be found in **Section 4: The BASIC Module** of this manual.

1.1.2 The TAG Module

The TAG Module regroups the functions that are necessary to segment and label tissues in the images and compute anatomical volumes. A detailed description of

the tools and modes associated with the TAG Module can be found in **Section 5: The TAG Module** of this manual.

1.1.3 The 3D Module

The 3D Module regroups the functions that are used to create and manipulate 3D surfaces from the Tag data. A detailed description of the tools and modes associated with the 3D Module can be found in **Section 6: The 3D Module** of this manual.

1.2 The Files

There are 4 different file types you will encounter in this manual: the GLI files, the TAG files, the GEOM files and the Script files.

1.2.1 The GLI Files

GLI stands for **Grey Level Image**. It is a generic term used to describe the input images you read in sliceOmatic. The pixel values of these images represent the physical properties of the scanned tissue (CT number, photon emission...) expressed in a numerical form by an 8, 16 or even 32 bit integer. They have a range of values that is usually in the thousands (potentially from -32,768 to 32,767 for a 16 bit image). These images will be displayed in shades of grey, hence the term Grey Level Images or GLI.

Note

Since version 4.0, sliceOmatic can also read and manipulate color images, the term GLI (although not really appropriate) will still be used for these images.

This program can work with any type of images (CT, MRI, US, SPECT, PET...). But since there are a variety of file formats, some image formats may not be recognized by sliceOmatic.

Presently, sliceOmatic is able to read the following standard formats:

DICOM, NEMA-1, NEMA-2, TIFF, JPEG, Interfile 3.0.

Also, sliceOmatic is able to read the following proprietary file formats:

CT Formats		
Manufacturer	Format	Notes
Elscint*	Elscint	This propriatery format was used by all pre-DICOM Elscint scanners Used by their 2400 and Twin scanners
	Lossless Rice	In this DICOM variation, Elscint store the images in private tags using a Lossless Rice compression algorithm Used by their Mx8000 and MxTwin scanners
GE	CT9800	Used by their CT9800 scanners
	PACE CT	Developped for GE by Yokogawa Medical Systems. Used by their ProSpeed scanners
	Signa 5.x	This format is also used by their MR scanner. Used by their HiSpeed CT/i, Jupiter and Zeus scanners
	SYTEC	Used by their Sytec scanners
Imatron	Imatron	This format support one pilot and multiple images per files Used in their Electron Beam Tomography systems
Philips*	CT HDL1	Based on the Hitachi MR HDL1 format Used by their AVE1 scanners
	JUSTFF	Used by their Tomoscan scanners
	SPI	Based on the Siemens SPI format Used by: AVE1, Gyroscan and the EasyVision stations
Picker*	IQ/PQ	Used by their IQ and PQ scanners
Shimadzu**	IS&C	(Image Save and Carry) The images of this NEMA based format are usually split in 2 parts: the header (.INF) and the pixel data (.IMG) Used by their SCT scanners
	SCT	Used by their older SCT scanners
Siemens	SPI	Based on NEMA-1 and NEMA-2. The pixel data can be compressed Used by all their pre-DICOM scanners
	Somatom DR	Used by their Somatom DR scanners
	Somatom Plus	Used by their Somatom Plus scanners
	Somatom Plus-4	Used by their Somatom Plus-4 scanners
	Somatom AR	This format is also used by their Vision MR scanner. Used by their Somatom AR scanners
Toshiba	NEMA-1	The images are offset 1Kb from the beginning of the file. Used by their Auklet scanners
	IS&C	Image Save and Carry Used by their Aquilion, Asteion, Xpress, Xpeed, Xvigor and Xvision scanners

MR Formats		
Manufacturer	Format	Notes
Bruker	Paravision	This format support multiple images per files, 32 bits images are scaled to 16 bits. The image information is spread over several files and directory levels including: "..\..\..\subject", "..\..\acqp", "..\..\imnd", "reco", "procs" and "d3proc"
Elscent [†]	Esteem	The image information is spread over several files: "m1log.txt", "scan.pv", "scan.acq", "xxx_disp", "xxx.rot" and "xxx.vff" Used by their Esteem scanners
Fonar	Fonar	The images are split in 2 components: a ".SI" file and the associated pixel data in a file without extension. This format support multiple images and 1 pilot per files
GE	PACE MR	Developed for GE by Yokogawa Medical Systems. Used by their Vectra scanners
	Signa 3	Used by their Signa scanners
	Signa 4	Used by their Signa scanners
	Signa 5.x	Used by their Signa scanners
Hitachi	MR HDL1	Used by their MPR and AIRIS scanners
Marconi [†]	IIF	Slight variation on the Picker IIF format Used by their Outlook scanners
MRRS	SMIS	Slight variation on the SMIS format
Philips [†]	SPI	Based on the Siemens SPI format Used by their Gyroscan scanners
Picker	IIF	This format support one pilot and multiple images per files Used by their Nordstar scanners
Siemens	SPI	Based on NEMA-1 and NEMA-2. There is no compressed version of the MR images Used by all their pre-DICOM scanners
	Numaris 1	Used by their old Magnetom scanners
	Numaris 2	Used by their Magnetom GBS scanners
	Vision	Used by their Impact, Magnetom Vision, Magnetom Symphony and Magnetom P8 scanners
SMIS	SMIS	(Surrey Medical Imaging System)
Toshiba	PD	This format is composed of a ".PD" header information file and a sequence of ".Pxx" (xx from 01 to n) image files. Used by their MRT35 scanners
	NEMA-1	Used by their MRT50 scanners
	VF	This format support multiple images per files. Additional information can be extracted from the "..\patient_database" or "..\patientDatabase" files if they are present. Used by their Exelart, Flexart, Opert and Visart scanners
Varian	Varian	This format support multiple images per files, 32 bits images are scaled to 16 bits Additional information can be extracted from the "procpa" file if it is present.

* Historical notes:

- in 1998 GE acquire Nuclear Medicine and MRI divisions of Elscint and the CT division is acquired by Picker.
- in 1999 Picker is renamed Marconi Medical Systems.
- in 2001 Marconi Medical System is acquired by Philips.

** Shimadzu has stopped manufacturing MR scanners around 1994-95 and CT around 2000.

Ultrasound Formats		
Manufacturer	Format	Notes
Agilent*	DSR	(Digital Storage and Retrieval), a TIFF based format with added private tags
ATL*	DEFF	(Data Exchange File Format), a TIFF based format with added private tags
GE*	KretzFile	This format support 3D volumes
HP*	DSR	
Medison*	Kartesian	
Philips*	DSR	

* Historical notes:

- in 1996, Medison acquired Kretztechnik AG.
- in 1998, ATL is acquired by Philips.
- in 1999, all of the businesses not related to computers, storage, and imaging were spun off from HP to form Agilent
- in 2000, Agilent Healthcare is acquired by Philips.
- In 2001, GE Medical Systems acquired a major shareholding in Kretztechnik AG from Medison, and Kretztechnik AG became a wholly owned subsidiary of GE Medical Systems.

Other Proprietary Formats
Analyze, iScan, Materialise, Papyrus, JPEG, TIFF...

In some of these formats, the images are split in 2 or more files: A pixel file and a header file. To open such images in sliceOmatic, you must open the header part of the image. The program will automatically read the associated image pixel file. If you try to open the image pixel file, sliceOmatic will be unable to associate it with the header file and you will be missing critical information.

Other image formats and raw images can also be read using the "Raw Image" program. **Section 10: The Raw Header Program** explains how to use this program.

(If you are using another format, please contact us at: support@TomoVision.com)

1.2.2 The TAG Files

The program will help you create a new set of images called **TAG** images. There will be one TAG image for each GLI image. They contain pixels whose values can range from 0 to 255. These values are tags that are used to identify the anatomical structures of the corresponding pixel in the GLI images. (ex: all pixels whose tag is 1 are bone, 2 are fat, 3 are muscle ... Or, 1 are kidney, 2 are liver, 3 are bone...).

The program will display these TAG images as color images superimposed on the GLI images. Depending on the color scheme selected:

- only the TAG images will be displayed
- only the GLI images will be displayed
- the TAG images will be opaque and displayed over the GLI images
- the TAG images will be translucent and displayed over the GLI images.

These new TAG images can be saved in files. The created files will have the same name as the corresponding GLI file but with a ".tag" extension. The format of these files is given in **Appendix B: The TAG File Format**. These files will be placed either with the GLI images or in a central repository (c.f. **section 9: The sliceOconfig program**)

When sliceOmatic loads a GLI image, it will automatically search for an associated TAG file and load it if present. Do not attempt to load a TAG file directly, this will only confuse sliceOmatic.

1.2.3 The Geom Files

The 3D module of sliceOmatic is used to create and manipulate 3D polygonal surfaces. These surfaces can be exported in a number of 3D formats: STL, MOVIE.BYU, DXF and VRML. Files in STL or MOVIE.BYU format can also be imported in the program.

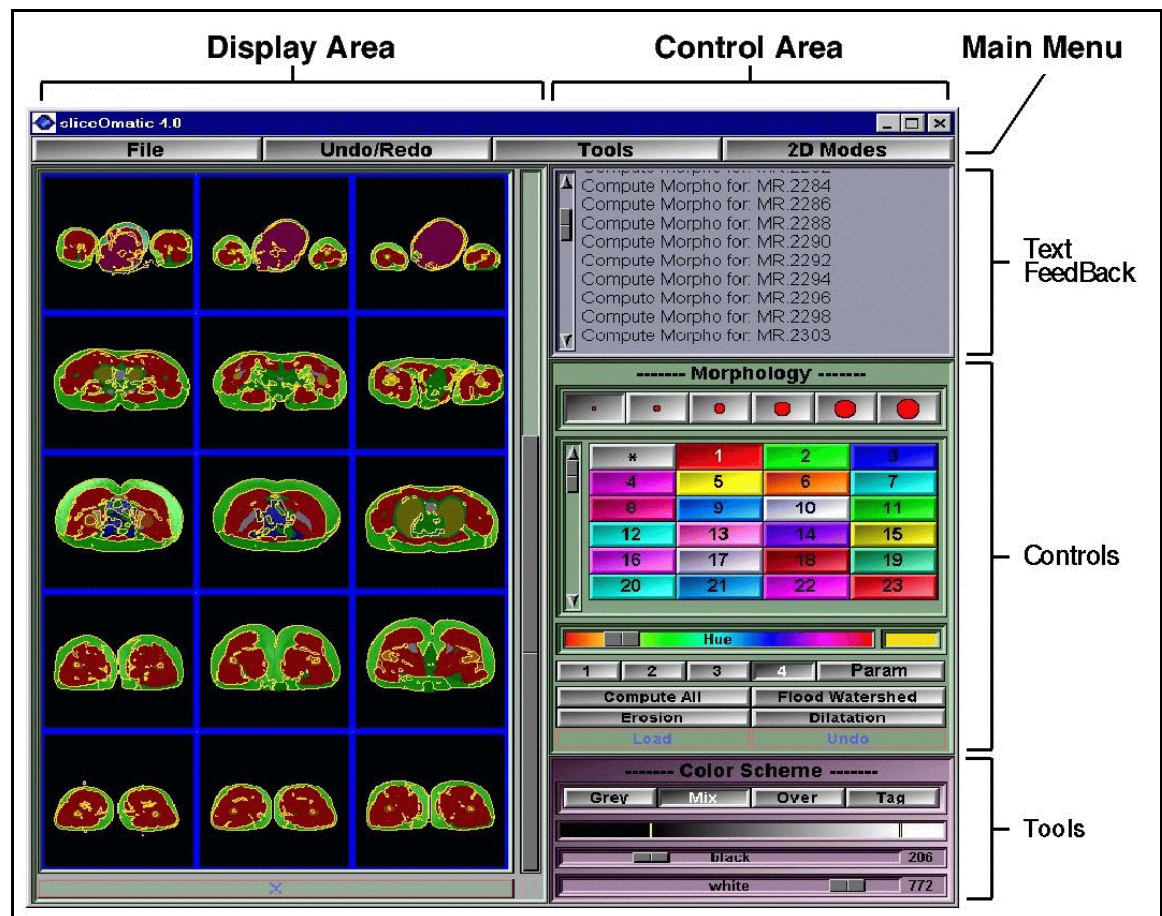
1.2.4 The Script Files

Reading, sorting and changing the orientation of all the slices of a data set can be a long task. SliceOmatic can help you automate this task by generating a script file. SliceOmatic can generate for you a script file that contains all the information necessary to reread all the files currently in sliceOmatic. Alternatively, you can write your own scripts and use them to read and manipulate your data sets. The syntax of these files is given in **Appendix C: The Command line Syntax**.

1.3 The sliceOmatic Screen

The screen is divided in 3 main areas:

- the **Main Menu**
- the **Display Area**
- the **Control Area**.



The Control Area is itself divided in 4 areas:

- the **Text Feedback window**. This window provides you with textual feedback.
- the **Command Line**. You can also enter commands to the program by typing them when the cursor is over this window and pressing “Enter”.
- the **Mode Dependent Controls**. The controls in this area will change according to the mode selected in the main menu.
- the **Mode Dependent Tools**. The tools can be enabled or disabled from the main menu. The availability of some tools may also be affected by the currently selected mode.

1.4 Image Selection and Image Groups

1.4.1 Image Groups

All images read in sliceOmatic will automatically be assigned to an Image Group. All the images of the same series taken the same day with the same modality and orientation will belong to the same Image Group. Usually, groups are split along the image's series, but it can happen that multiple series belong to the same group.

There are 3 group classifications depending on the images they contain:



The 3D group:

All the images are parallel, uniformly spaced with no gaps.



The sorted parallel group:

All the images are parallel, sorted but not uniformly spaced.



The mixed group:

The images are either not sorted or not parallel.



The scout group:

The images are scouts.

The criterias used by sliceOmatic to create groups when it loads images ensure that it creates only 3D and sorted parallel groups. However, the user can change the group's composition in the Admin mode and create mixed groups.

Some operations will only be available to 3D groups, and others will be restricted to sorted parallel groups.

1.4.2 Image Selection

Most of sliceOmatic's actions are performed on the currently selected images or the currently selected groups. Other actions will affect the current image or the current group. You can have multiple currently selected images, but only one of these will be the current image. SliceOmatic offers you a simple and intuitive way to select these images. Either with the mouse (**Section 3.2: Image Selection**) or with an image list (**Section 4.2.1: The Admin mode**).

By default, in Mode One, only the visible image is the current image and it is the only selected image, and in Mode All, all the images are selected, and the image having the white border is the current image. Changing from one mode to another

will reset the image selection to these default values. (See **Section 3: The Display Area**).

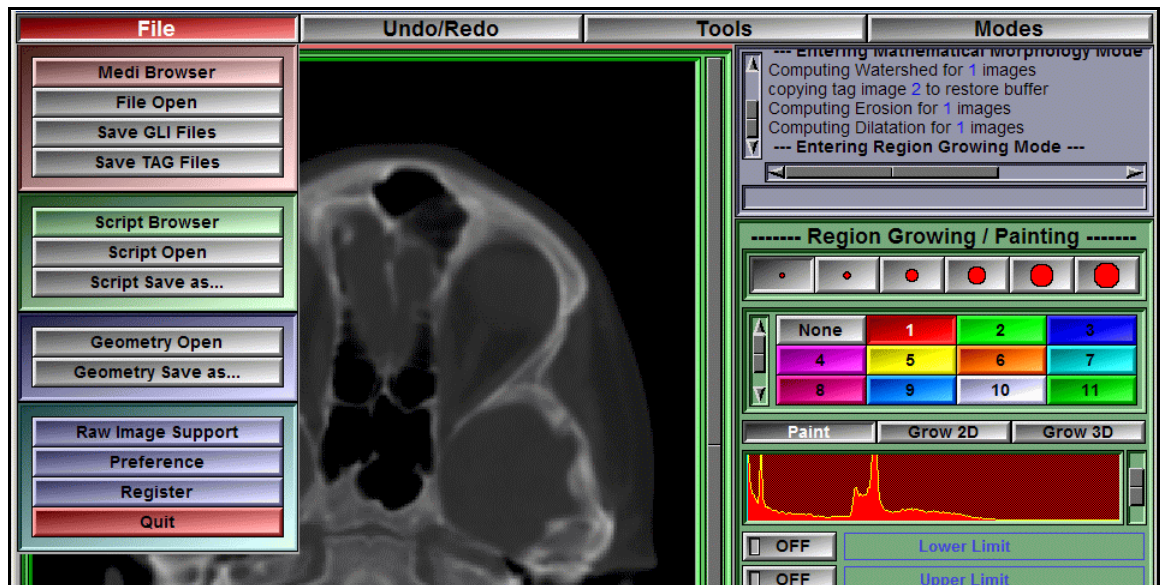
2 The Main Menu

The main menu is located at the top of the screen. Its 4 buttons will activate 4 sub-menus: **File**, **Undo/Redo**, **Tools** and **Modes**.



2.1 The File Menu

The File menu contains 13 buttons presented in 4 groups:

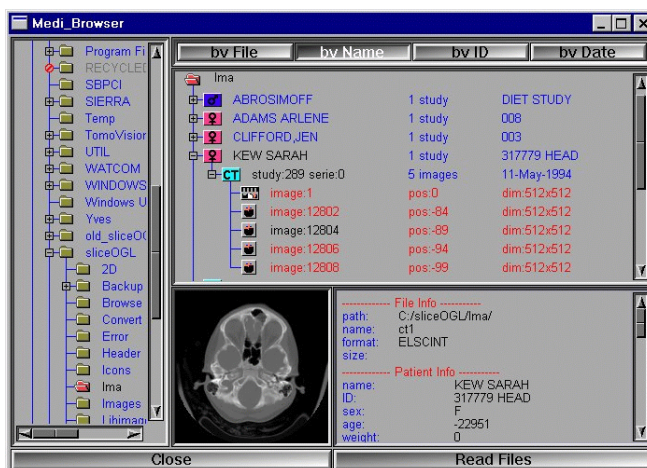


- The buttons of the first group are used to manipulate image files. With these, you can input images in sliceOmatic, either with the “**Medi Browser**” program or the “**File Open**” window. You can also save the results of the manipulation of the grey-level images with the “**Save GLI Files**” and of the segmentation with the “**Save TAG Files**” window.
- The buttons of the second group are used to manipulate script files. The script files are used to read multiple images and do some basic manipulation on these. You can read a script file either with the “**Script Browser**” program or the “**Script Open**” window. You can also create a script that will reopen all the files currently opened in sliceOmatic with the “**Script Save as...**” window.

- The buttons of the third group are used to manipulate polygonal surface files. You can read a surface file with the “**Read Geometry**” window and save the active surfaces with the “**Save Geometry as ...**” window.
- The buttons of the last group allow you to access the **Raw_Header** program in order to read images from unsupported format, the **sliceOconfig** program to customize sliceOmatic’s interface, the **Tomovision_License** program to register your sliceOmatic modules, and finally to **Quit** the program.

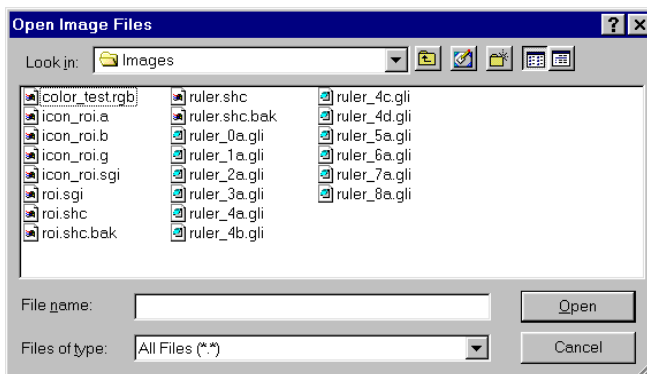
2.1.1 The “Medi Browser” button

This button will start the **Medi Browser** program. This Explorer-like program enables you to preview and select the images you want to read in sliceOmatic. For a detailed description of the **Medi Browser** program, please refer to **Section 7: The Medi Browser Program**.



2.1.2 The “File Open” button

If you already know the name of the image file you want to read, this button will activate a Windows file browser. From this window, you can select multiple file names. All the selected files will be read into sliceOmatic when you click the “OK” button.



2.1.3 The “Save GLI Files” button

Pressing this button will cause sliceOmatic to save all selected GLI files if these files are not in their original orientation.

Note

Only the files that are in a different orientation than the original images will be saved. In other words, this option will only save images created in the re-sliced mode.

License

If you do not have the **BASIC Module** license, this button will be disabled.

2.1.4 The “Save TAG Files” button

Pressing this button will cause sliceOmatic to save all modified TAG files. If the file does not already exist, it will be created either in the same directory as the GLI file, (with the same name and the “.tag” extension) or in the TAG_Repository area, depending on the selected preferences (See **Section 9.2: The TAG Module Preferences**).

Note

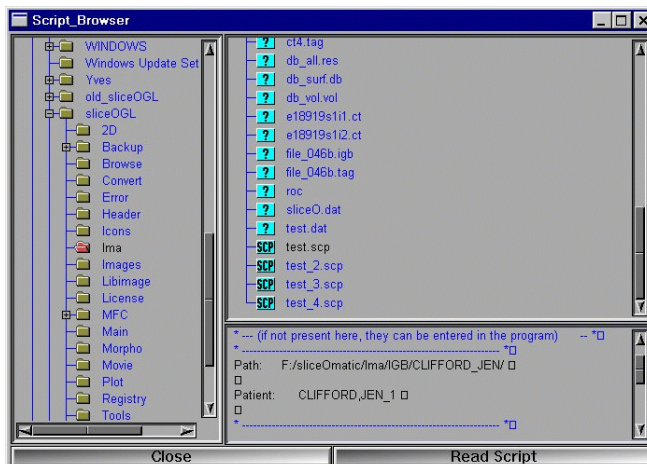
Only the files that have been modified will be saved.

License

If you do not have the **TAG Module** license, this button will be disabled.

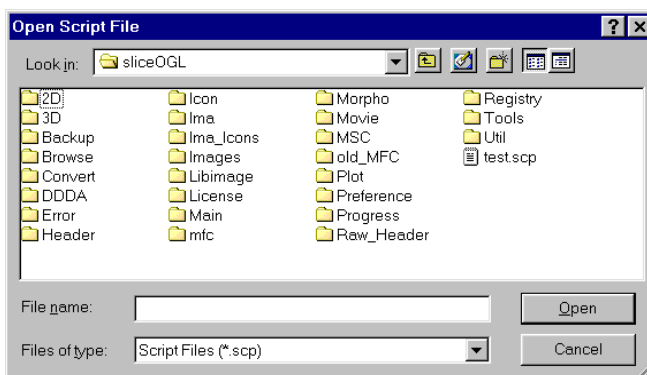
2.1.5 The “Script Browser” button

This button will start the **Script_Browser**. This Explorer-like program enables you to preview and select the scripts you want to read in sliceOmatic. For a detailed description of the **Script_Browser** program, please refer to **Section 8: The Script_Browser Program**.



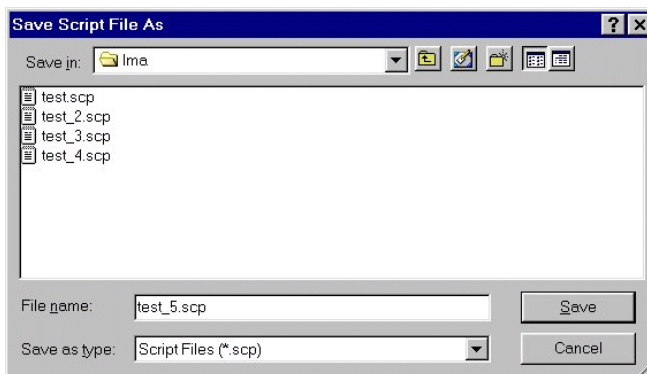
2.1.6 The “Script Open” button

If you already know the name of the script file you want to read, this button will activate a Windows file browser. From this window, you can select the desired script file. The selected file will be read into sliceOmatic when you click the “Open” button.



2.1.7 The “Save Script as ...” button

This button will activate a Windows file browser. From this window, you can enter the desired name and location for the script file. When you click the “Save” button, a script file containing the name, orientation and order of all the currently opened files will be written at the desired location. You can use this script to reload the images you are currently working on.

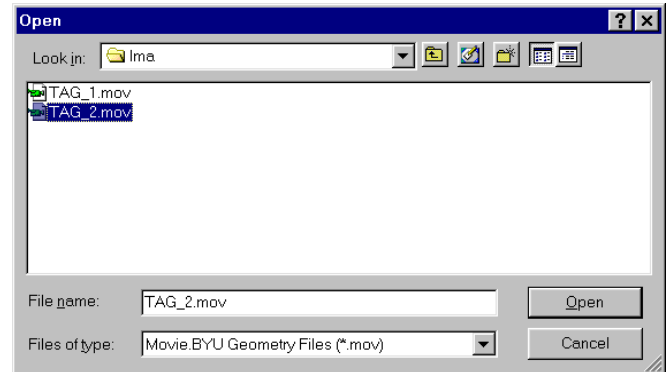


License

If you do not have the **BASIC Module** license, this button will be disabled.

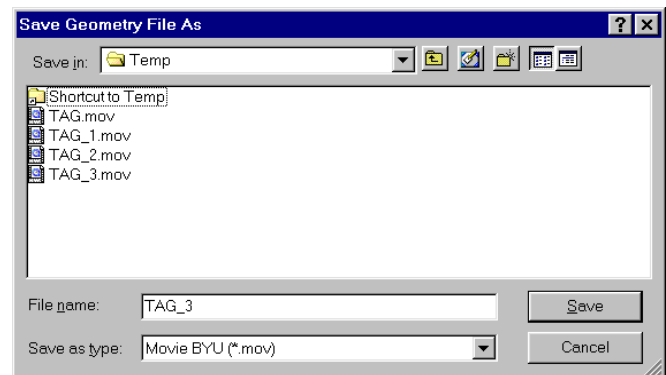
2.1.8 The “Geometry Open” button

This button will activate a Windows file browser. From this window, you can select one geometry file. The selected file will be read into sliceOmatic when you click the “Open” button. The program can read geometry in MOVIE.BYU and STL format.



2.1.9 The “Save Geometry as ...” button

This button will activate a Windows file browser. From this window, you can enter the desired name and location for the geometry file. You can save your geometries in one of the following formats: MOVIE.BUY, Autocad DXF, Stereographic’s STL (ASCII or binary), VRML or Qavefront’s OBJ.



Note

The STL format can only contain one geometry per file. If more than one geometries are currently selected, the STL file format will not be available.

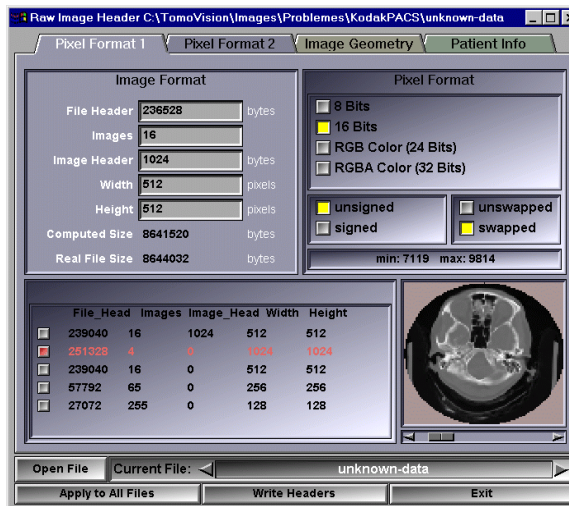
License

If you do not have the **3D Module** license, this button will be disabled.

2.1.10 The “Raw Image Support” button

This button will start the **Raw Header** program.

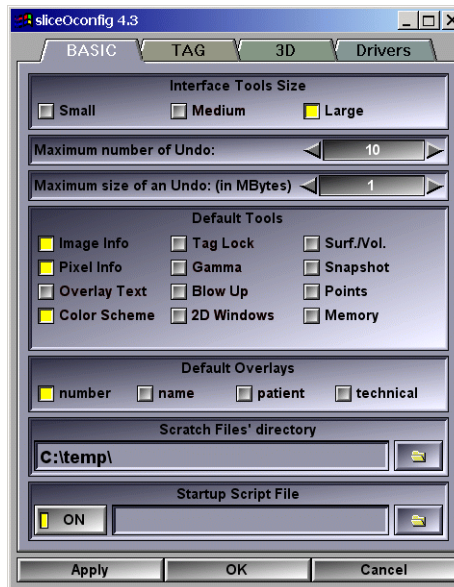
For a detailed description of the **Raw Header** program, please refer to **Section 10: The Raw Header Program**.



2.1.11 The “Preferences” button

This button will start the **sliceOconfig** program to help you setup your startup preferences. Any changes you make to the preferences will be visible the next time you start sliceOmatic.

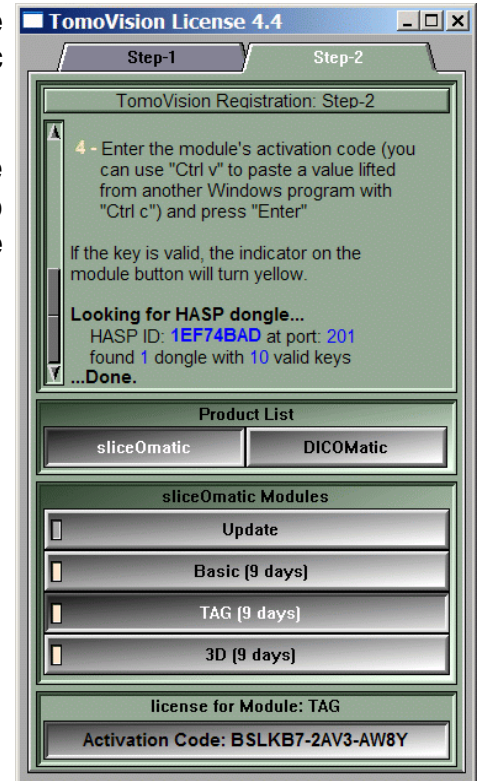
For a detailed description of the **sliceOconfig** program, please refer to **Section 9: The sliceOconfig Program**.



2.1.12 The “Register” button

This button will start the **Tomovision_License** program in order to register your sliceOmatic modules.

For a detailed description of the **Tomovision_License** program, please refer to the installation guide, **Section 11: The TomoVision License Program**.



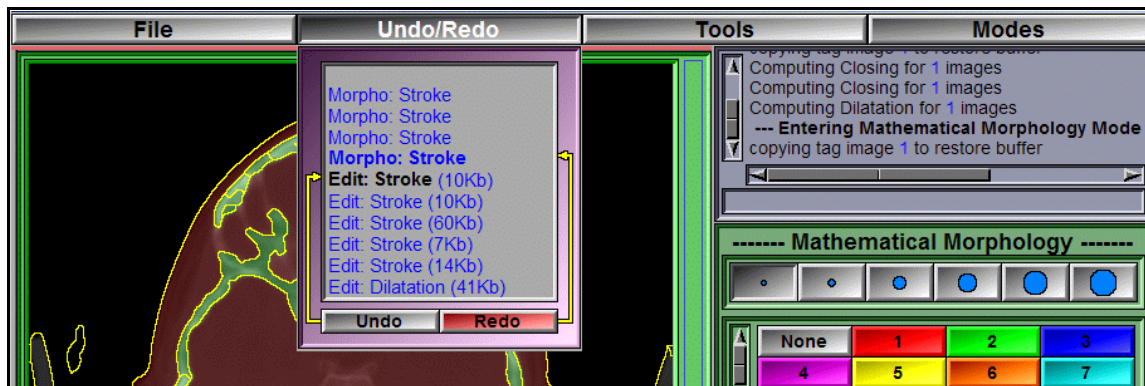
2.1.13 The “Quit” button

This button causes you to exit from the program. If the program detects any modifications to the TAG images since you last saved them with the “**Save TAG Files**” button, a warning pop-up will prompt you to save the changes or lose them.



2.2 The Undo/Redo Menu

Most (but not all) of the actions you do in sliceOmatic can be undone. By default, the Undo buffer keeps track of your 10 last actions. These will be displayed in this menu. All “undone” actions can be “redone” until you perform a new action.



Clicking on the **Undo** button will undo the action associated with the button by the arrow on the left side of the menu. This action will be displayed in **Bold Black** font.

Clicking on the **Redo** button will redo the action associated with the button by the arrow on the right side of the menu. This action will be displayed in **Bold Blue** font.

Some of the mode windows will also have an Undo button; clicking on it is equivalent to the Undo button in this menu.

2.2.1 the Undo and the Memory

Undo operations can take a lot of memory. To try to limit this, sliceOmatic lets you configure two parameters:

- The maximum number of Undo,
- the maximum size of each Undo.

Both parameters can be changed with the sliceOconfig program or with the commands:

Set: undo_nb value (0<=value<= 20)

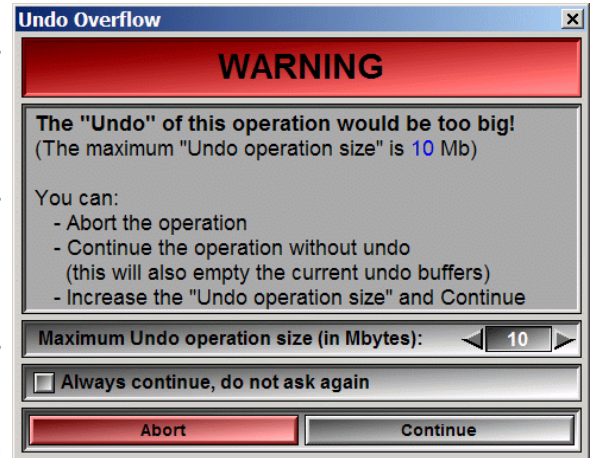
Set: undo_size value (value in Mbytes)

Setting the number of Undo to 0 will disable all Undo operations.

Also, if you are running low on memory, one of the options of the Memory Manager tool is to clear the Undo memory. This will erase all Undo operations currently in memory.

If an operation would take more Undo memory than the maximum allowed for one operation, a warning pop-up will appear. You will be given the choice of aborting the current operation, continue the operation but lose the Undo or increase the maximum size of an Undo operation.

This warning pop-up will tend to appear if you operate on a large number of images at once. You will also have the occasion to check the “always continue” box so that the pop-up does not appear anymore. Instead a warning message will be displayed in the text window each time the undo limit is exceeded and the Undo possibilities are lost.



2.2.2 The Undo/Redo and the Load/Restore operations

It is easy to confuse the Undo/Redo and the Load/Restore operations. The Undo/Redo enable you to backtrack your last brush strokes. The Load/Restore give you more control on what you do.

Most of the tag modes in sliceOmatic will give you the possibility to affect the pixels with the left mouse button and to “Restore” or bring back the previous values of the pixels with the right mouse button. It is different from the Undo in the sense that you “unpaint” with the mouse, choosing which pixels will be restored. These “Restore” values come from a saved copy of the tag image: the “Restore buffer”. You can load the current tag image in the Restore buffer at any time with the “Load” command. By default, the tag image is automatically loaded in the Restore buffer the first time you modify its tag values.

Please note that restoring the image with the right mouse button is a brush stroke and this operation can be undone with the Undo/Redo operations.

The following key shortcuts can also be used:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
Ctrl-z	UNDO	Undo the last operation
Ctrl-y	REDO	Redo the last Undo
none	LOAD	Load the current TAG image in the Restore buffer
none	RESTORE	Overwrite the current TAG image with the content of the Restore buffer

A complete description of the keyboard shortcuts is presented in **Appendix A: The Keyboard shortcuts**.

The following commands are related to the Undo/Redo and Load/Restore operations:

Undo:

Undo the last keystroke (if available).

Redo:

Redo the last Undo (if available).

Load: [*t_ima*]

Load the current TAG image, or TAG image of the image matching the template, if present, in the Restore buffer

Restore: [*t_ima*]

Overwrite the current TAG image, or TAG image of the image matching the template, if present, with the content of the Restore buffer.

Note

“*t_ima*” is a template that can match one or multiple images. See **Appendix C.8: The Templates**.

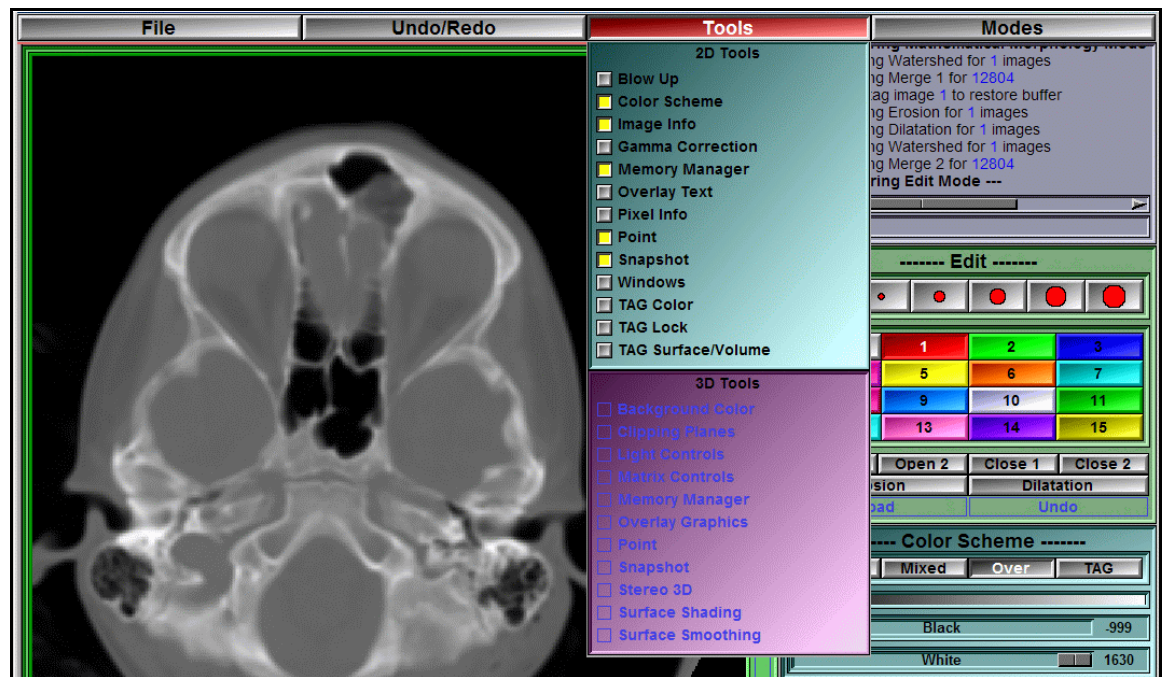
A complete description of these commands is presented in **Appendix C: The Command Line Syntax**.

2.3 The Tools Menu

This menu will enable you to select which of the tools you want to be visible in the control area. Depending on the current mode of the program, either the 2D tools or the 3D tools will be available.

Warning

If the program is not full screen or if the screen resolution is not sufficient, some of the tools may not have enough room to be displayed. If this happens, you can decrease the size of the tools through the Preferences configuration (c.f. **section 9: the sliceOconfig program**).

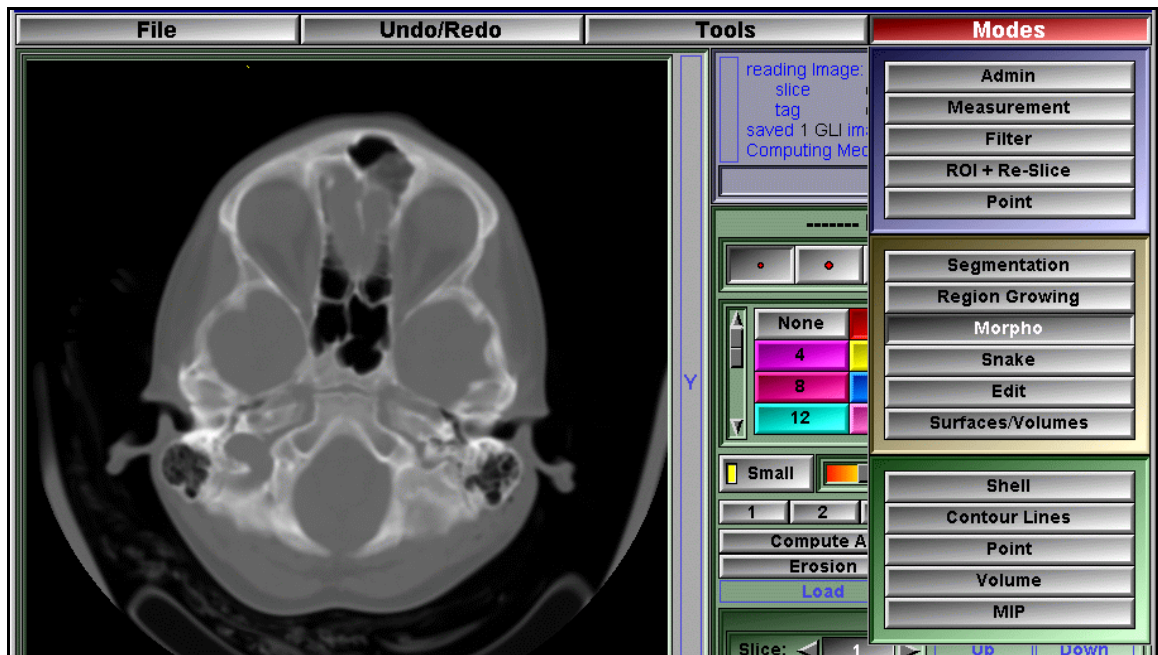


For a complete description of the different tools, see **Sections 4.1: The BASIC Tools**, **Sections 5.1: The TAG Tools** and **Section 6.1: The 3D Tools**.

If you select more tools than the program can fit in its window, the latest selections will be given priority.

2.4 The Modes Menu

This menu is used to select the operation mode of the program. The File menu contains 15 buttons presented in 3 groups:



- The first group is composed of the Modes associated with the **BASIC Module** of sliceOmatic and the **GLI files**. The available modes are:

Admin In this mode, you can remove images from sliceOmatic and modify the groups.

Measurements In this mode, you can take 2D measurements, such as distances and angles, on the images.

Filters In this mode, you can filter the GLI images, either to increase contrast or to smooth out noise.

Registration In this mode, you can align a stack of 2D slices using markers.

ROI + Reslice In this mode, if you have a 3D data set, you can reslice your volume in any direction..

A complete discussion of these modes is presented in **Section 4.2: The BASIC Modes**.

- The second group is composed of the modes associated with the **TAG Module** of sliceOmatic and the **TAG Files**. The available modes are:

Edit	Interactive editing of the TAG images.
Geometric Mask	Use geometrical shapes to create or modify the TAG values.
Morpho	Apply mathematical morphology on the images.
Region Growing	Locally threshold the image or grow a region of specific GLI values from a seed.
Snakes	Use Active Contours (Snakes) to segment the images.
Thresholding	Do a simple grey level segmentation to generate the TAG images.

A complete description of these modes is presented in **Section 5.2: The TAG Modes**.

- The third group is composed of the modes associated with the **3D Module** of sliceOmatic and the **Geometry Files**. The available modes are:

Shell	Create a 3D polygonal surface from the TAG images.
Contour	Extract the contour of the Tag values on each slice.
Volume	Create images with the Volume Rendering technique.
MIP	Create images with the Maximum Intensity Projection technique.

A complete description of these modes is presented in **Section 6.2: The 3D Modes**.

3 The Display Area

In this screen area, you can see the images that have been loaded in the program.

In the Basic and Tag modes, this area can be split in up to 4 display windows. Each of these windows can show the 2D images in either the **Mode One** or the **Mode All** modes. In Mode One, only one 2D slice is shown at a time. In Mode All, all the slices can be viewed simultaneously. You can toggle between these modes either by pressing the "**space-bar**" while the cursor is within the window, or with the "**ALL**" and "**ONE**" buttons in the **Image Info Tool**. (For more information on these buttons, see **Section 4.1.4: The Image Info Tool**)

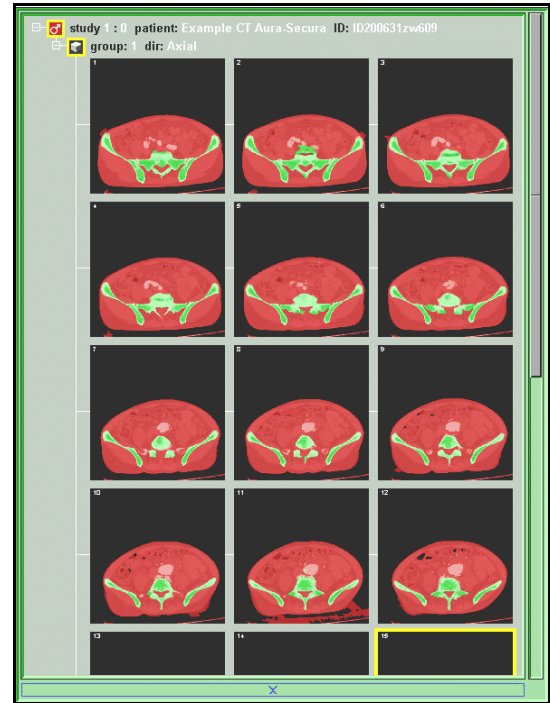
In the 3D modes, this area is used to display the 3D surfaces or volumes. The orientation, position and size of the 3D geometries can be interactively modified with the mouse. You have a choice of 3 interface styles. See **Section 9.3: The 3D module preferences**, for more information on the possible interfaces.

3.1 Mode All and Mode One

The 2D display windows (BASIC or TAG modes) can be used to display either all your images (Mode All) at once or just one of the images at a time (Mode One).

Mode All

All the images are displayed. If they cannot all fit on the screen, you can use the vertical slider to pan through them. The images are shown grouped hierarchically by “groups” and by patients. Complete branch of this tree can be collapsed or expanded using the +/- symbol at the left hand side of the corresponding icons. Images are placed in the same group if they are from the same patient, the same modality, the same scanning direction and the same size and origin. The group's icon will tell you if the images form a 3D volume (all slices are parallel, ordered sequentially without holes), a set of parallel slices (not ordered sequentially or with holes), or a set of unmatched slices.



Mode All

Note

By default, the program will not place unmatched slices in the same group. However, in the Admin Mode, you can create arbitrary groups.

The current image will be highlighted by a yellow border, and its group's and patient's information will also be highlighted.

To help distinguish between selected and unselected images, unselected images will be drawn without their red component.

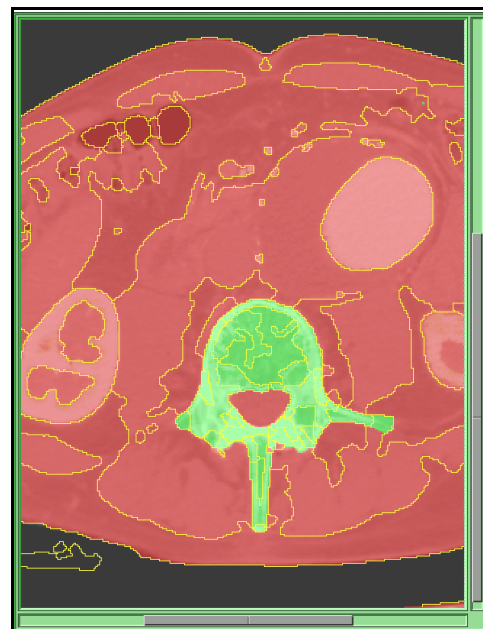


Study 1, group 1: image 1,2 and 3 are selected. Image 2 is the current image.

Mode One Only the current image is displayed. If it cannot fit on the screen, you can use the horizontal and vertical sliders to pan through the image.

Pressing the “Ctrl” key can also be used to drag the image with the mouse.

The displayed image is selected either with the **Slice Selection Tool**, from the keyboard shortcuts, or by pressing the space-bar when the cursor is over the desired slice in **Mode All**.



Mode One

3.1.1 From the Graphic Interface

You can change the display mode from the “Image Info” tool. A complete description of these modes is presented in **Section 4.1.4: The Image Info Tool**.

3.1.2 From the Keyboard

Pressing the following keys will affect these two modes (mode All and One):

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
not mapped	DISPLAY-MODE-ONE	Select the display mode.
not mapped	DISPLAY-MODE-ALL	
Space-bar	DISPLAY-MODE-TOGGLE	
Page up	SLICE-PREVIOUS	Go to the previous / next image of the current group.
Page Down	SLICE-NEXT	
Home	GROUP-PREVIOUS	Go to the previous / next group of the current study.
End	GROUP-NEXT	
Insert	STUDY-PREVIOUS	Go to the previous / next study.
Delete	STUDY-NEXT	
Keypad "+"	SCALE-PLUS	Increases / decrease the magnification of the image.
Keypad "-"	SCALE-MINUS	

If the cursor is within the **Display** area, pressing the following keys will do the following:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
Arrows "←"	CURSOR_LEFT	Move around in the image one pixel at a time.
Arrows "→"	CURSOR_RIGHT	
Arrows "↑"	CURSOR_UP	
Arrows "↓"	CURSOR_DOWN	

Ctrl Cause the mouse to drag the image.

You can also change the Display Mode and magnification through the **Image Info Tool**. See **Section 4.1.4: The Image Info Tool** for more information.

You can also capture an image of the sliceOmatic screen by pressing the "Print Scrn" key. The image will be saved in the "C:\Temp" directory in BMP or TARGA format.

3.1.3 From the Command Line

You can use either a script file or the command line to enter the following commands:

Mode: all

Mode: one [image_number]

Select the current display mode for the current window. If "Image Number" is present, the corresponding image will be the current image.

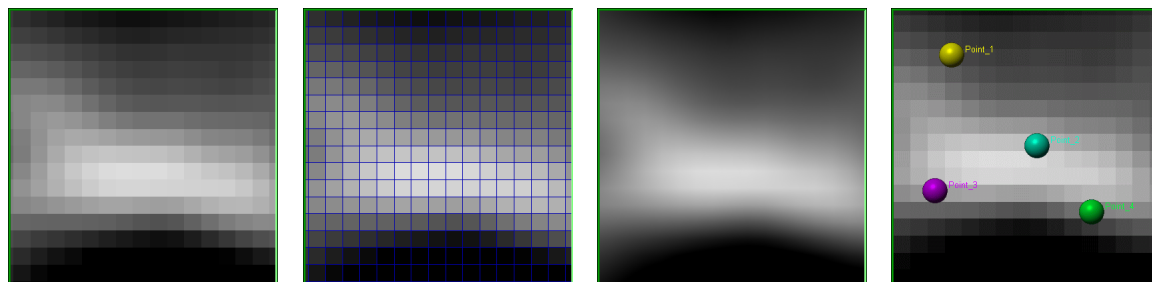
The following variables can also be used in the commands:

\$DISPLAY_2D_MODE (Read/Write, character string)

\$DISPLAY_2D_MODE_ALL (Read/Write, array of strings)

A complete description of these commands and variables is presented in **Appendix C: The Command Line Syntax**.

3.2 Image Graphic States



Normal viewing

Grid ON

Interpolation ON

Points ON

A number of state variables can be activated to change the visualization state of each of the 2D display windows. These are:

- Grid** At high magnifications, you can turn on or off a blue grid to help see the pixels.
- Interpolation** Image magnification is done by replicating the values of the pixels. This gives a “pixelized” look to the image. If you would rather see a smooth image, you can turn on the image interpolation. However, bear in mind that the interpolation is just for cosmetic purposes. The segmentation is done at the level of the pixel, so having an interpolated image will not increase the precision of the results. It will also slow down the graphic refresh rate of the program.
- Pilot** The “Pilot Lines” from axial slices of the same patient can be superimposed on scout scans.
- Points** The Point tool enables you to place points on the image. You can enable the visualization of these points at any time. These are discussed in more details in **Section 4.1.8: The Point Tool**.
- Color Scheme** You can visualize either the GLI image, the TAG image or a combination of both. These are discussed in more details in **Section 4.1.2: The Color Scheme Tool**.
- Cursor Mode** If multiple 2D windows are used, you can overlay the plane of the current image on the other windows. These are discussed in more details in **Section 4.1.10: The Windows Tool**.
- Overlays** You can turn On or Off 4 levels of text overlays giving information on the images content. These are discussed in more details in **Section 4.1.6: The Text Overlay Tool**.

Note

The Color Scheme Cursor Mode and the Overlays are not controlled individually per display windows, so the current choice of color scheme and overlays will be applied to all 2D windows.

3.2.1 From the Graphical Interface

Only the Overlays and the Color Scheme state variables can be activated from the graphical interface. The other variables have to be activated from the keyboard shortcuts or the command line.

3.2.2 From the Display Area

Only the points can be manipulated from the display area. See **Section 4.1.6: The Text Overlay Tool** for more details.

3.2.3 From the Keyboard

Pressing the following keys will affect the graphic state variables:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
<i>not mapped</i>	IMAGE-GRID-ON	Enable / disable the grid visualization at high magnification.
<i>not mapped</i>	IMAGE-GRID-OFF	
"G" or "g"	IMAGE-GRID-TOGGLE	
<i>not mapped</i>	IMAGE-PILOT-ON	Enable / disable the pilot lines visualization on scout images.
<i>not mapped</i>	IMAGE-PILOT-OFF	
"I"	IMAGE-PILOT-TOGGLE	
<i>not mapped</i>	IMAGE-SMOOTH-ON	Enable / disable the image interpolation.
<i>not mapped</i>	IMAGE-SMOOTH-OFF	
"I" or "i"	IMAGE-SMOOTH-TOGGLE	
<i>not mapped</i>	POINT-ON	See section 4.1.8
<i>not mapped</i>	POINT-OFF	
"P" or "p"	POINT-TOGGLE	
Enter	POINT-INSERT	
Shift-Enter	POINT-DELETE	

<i>not mapped</i>	OVERLAY-FILE-ON	See section 4.1.6
<i>not mapped</i>	OVERLAY-FILE-OFF	
Shift-F5	OVERLAY-FILE-TOGGLE	
<i>not mapped</i>	OVERLAY-NAME-ON	
<i>not mapped</i>	OVERLAY-NAME-OFF	
Shift-F6	OVERLAY-NAME-TOGGLE	
<i>not mapped</i>	OVERLAY-PATIENT-ON	
<i>not mapped</i>	OVERLAY-PATIENT-OFF	
Shift-F7	OVERLAY-PATIENT-TOGGLE	
<i>not mapped</i>	OVERLAY-TECHNICAL-ON	
<i>not mapped</i>	OVERLAY-TECHNICAL-OFF	
Shift-F8	OVERLAY-TECHNICAL-TOGGLE	
F1	COLOR-SCHEME-MODE-GLI	See section 4.1.2
F2	COLOR-SCHEME-MODE-MIX	
F3	COLOR-SCHEME-MODE-OVER	
F4	COLOR-SCHEME-MODE-TAG	
-	COLOR-SCHEME-MIX-DECREASE	
=	COLOR-SCHEME-MIX-INCREASE	
<i>not mapped</i>	WINDOW-CURSOR-OFF	See section 4.1.10
<i>not mapped</i>	WINDOW-CURSOR-MODE1	
<i>not mapped</i>	WINDOW-CURSOR-MODE2	
"L" or "I"	WINDOW-CURSOR-TOGGLE	

3.2.3 From the Command Line

The following commands can be used in the command line or in a script file:

Color: grey|over|tag See section 4.1.2
Color: mix [value]
Color: black|white [value]

Set: start_2d_overlays value See section 4.1.6
Overlay: file|name|patient|technical on|off|toggle

The following variables can be used in the commands:

\$COLOR_SCHEME_MODE (Read/Write, character string)
\$COLOR_SCHEME_MIX (Read/Write, float)
\$WINDOW_2D_CURSOR_MODE (Read/Write, character string)
\$DISPLAY_2D_GRID (Read/Write, character string)
\$DISPLAY_2D_GRID_ALL (Read/Write, array of strings)

\$DISPLAY_2D_PILOT	(Read/Write, character string)
\$DISPLAY_2D_PILOT_ALL	(Read/Write, array of strings)
\$DISPLAY_2D_POINTS	(Read/Write, character string)
\$DISPLAY_2D_POINTS_ALL	(Read/Write, array of strings)
\$DISPLAY_2D_SMOOTH	(Read/Write, character string)
\$DISPLAY_2D_SMOOTH_ALL	(Read/Write, array of strings)
\$DISPLAY_2D_OVERLAY_FLAG	(Read/Write, bit field)

A complete description of these commands and variables is presented in **Appendix C: The Command Line Syntax**.

3.3 Image Selection

Actions in sliceOmatic will usually be performed on the current image, or on all the selected slices. By default, in Mode One, the displayed slice is the only one selected, and in Mode All, all the slices are selected. This selection however can be changed, either in the Admin Module, from the command line, or with the mouse in Mode All. Unselected images will be displayed in red, selected images in grey.

3.3.1 From the Graphical Interface

You can change the selected images from the “Admin” mode controls. A complete description of these controls is presented in **Section 4.2.1: The Admin mode**.

3.3.2 From the Display Area

- Clicking outside the images will unselect all images.
- Clicking outside the images and dragging the mouse will select all the images inside the selection box.
- Clicking on an image will select this image.
- Clicking on an image while pressing the CTRL key will add this image to the selected ones.
- Clicking on an image while pressing the SHIFT key will select all images from the last selected image to the pointed image.
- Double-clicking on an image will select all the images in this image group (see **Section 1.4.1 Image Groups** for a description of the image groups)
- Double-clicking on an image while pressing the CTRL key will add all the images in this image group to the selected ones (see **Section 1.4.1 Image Groups** for a description of the Image Groups)

3.3.3 From the Keyboard

Pressing the following keys will affect these two modes (Mode All and One):

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
<i>none mapped</i>	DISPLAY-MODE-ONE	Changing the display mode will also select one or all images.
<i>none mapped</i>	DISPLAY-MODE-ALL	
Space-bar	DISPLAY-MODE-TOGGLE	

3.3.3 From the Command Line

The following commands can be used in the command line or in a script file:

Select: `t_ima [t_ima ...]`

Note

“*t_ima*” is a template that can match one or multiples images. See **Appendix C.8: The Templates**.

The following variables can also be used in the commands:

\$DISPLAY_MODE [\(Read/Write, character string\)](#)

A complete description of these commands and variables is presented in **Appendix C: The Command Line Syntax**.

4 The BASIC Module

The BASIC Module regroups the functions that are necessary to import, visualize, re-slice and make measurements on medical images.

License

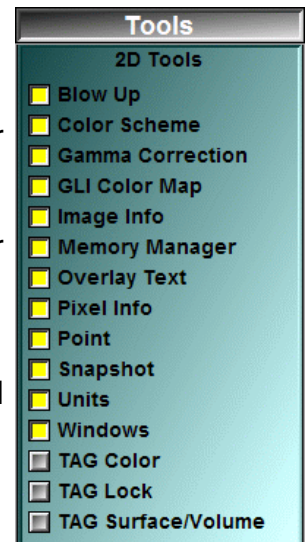
Without the BASIC Module License, a watermark will be displayed in the display windows and the following will be disabled:

- The “**Script Save As...**” button in the File Menu
- The “**Write**” button in the measurements mode
- The “**Save to script**” button in the registration mode.

4.1 The BASIC Tools

Associated with the BASIC Module is a series of tools to:

- blow-up the region under the cursor (Blow-Up)
- change the brightness and contrast of the images (Color Scheme)
- change the gamma correction factor (Gamma Correction)
- Change the colors used to display GLI images (GLI color map)
- select the image being displayed (Image Info)
- free unused image memory (Memory Manager)
- enable text overlays with the patient information and technical data on the images (Overlay Text)
- give information on the pixels (Pixel Info)
- place reference points on the images (Point)
- copy the window’s content to an image (snapshot)
- Change the units used to display information (Units)
- open/close up to 4 viewing windows (Windows)
- change the color used to visualize a Tag (TAG Color)
- protect Tag values from modifications (TAG Lock)
- compute Tag surfaces and volumes (TAG Surface/Volume)



Note

Three of these 2D tools (the Surface/Volume, TAG Color and the TAG Lock) are only used in conjunction with TAG images. They will be described in the section 5.1 The TAG Tools.

For each of the BASIC Tools, we will present the tool, describe the layout and function of its graphical interface, the display area manipulations that can influence the tool, the key shortcut available for this tool as well as the command line and variables that are related to the tool.

You can find a more detailed description of the keyboard shortcuts, their use and their syntax in the section: **Appendix A: The keyboard shortcuts.**

A complete description of the command line syntax and its variables is presented in **Appendix C: The Command Line Syntax.**

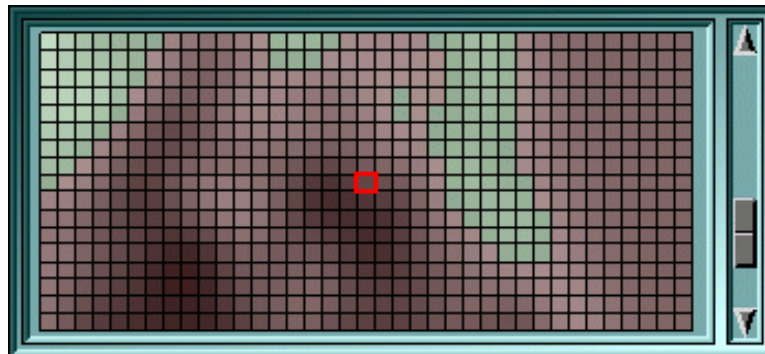
4.1.1 The Blow-Up Tool

This window gives a magnified view of the image under the cursor in the Display Area. The center red square in the Blow-Up area corresponds to the pixel under the cursor in the Image Display Area.

Note

To help graphic performances, the blow-up window is refreshed only when the processor is free. Thus, if the mouse is moved, the image in the blow-up window may not follow immediately.

4.1.1.1 From the Graphical Interface



The Scale slider The magnification of the blow-up window can be modified with the slider located to its right. At its smallest magnification (cursor at the bottom), one pixel of the screen shows one pixel of the image.

4.1.1.2 From the Display Area

There is no display area interaction with this tool.

4.1.1.3 From the Keyboard

There is no keyboard interface to this tool.

4.1.1.4 From the Command Line

There is no command line or variables associated to this tool.

4.1.2 The Color Scheme Tool

The color scheme will affect the appearance of the images in the display section.

The four buttons on the tool, “**Grey**”, “**Mixed**”, “**Over**” and “**Tag**” control how the images are displayed in the Image Area. They are used to display either the GLI image, the TAG image or a combination of both.

4.1.2.1 From the Graphical Interface



Grey Only the GLI image is visible.

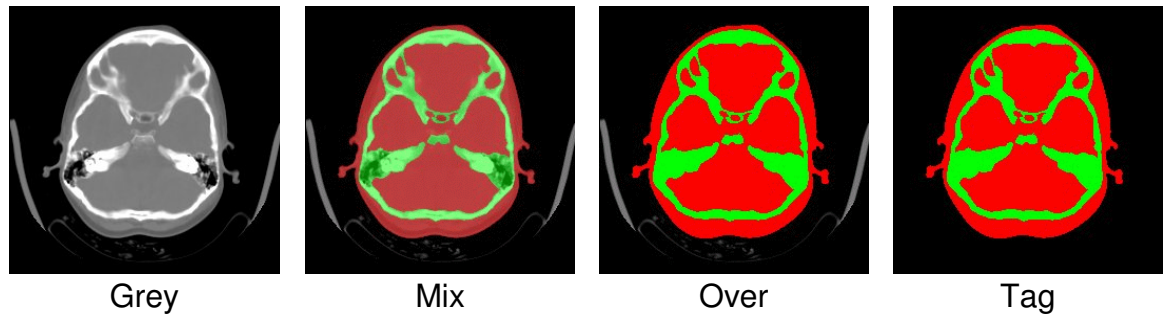
Mix The Tag color image is mixed with the GLI image. By default, each image is half its normal intensity and the two are added together. The “mixed” value can be modified with the “+” or “-” keys so that the TAG image will appear more or less dense.

Note

The “+” and “-” keys used to modify the “mixed” value are the keys at the left of the “Backspace” key. The Keypad “+” and “-” keys are used to increase/decrease the image size.

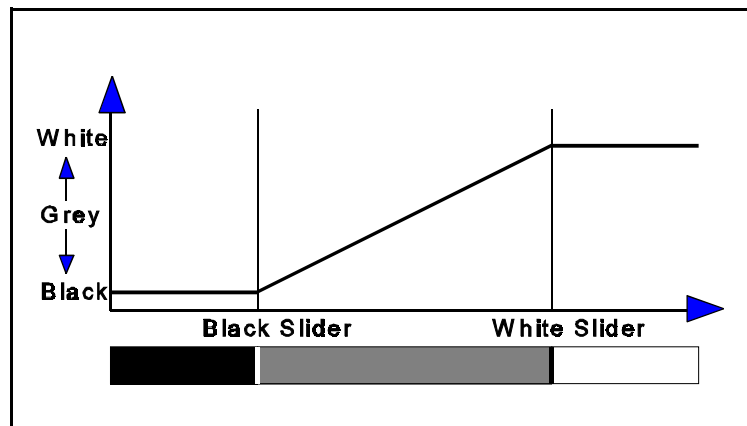
Over The Tag color image is displayed over the GLI image. The GLI image is thus only visible in the regions where the Tag values are 0.

TAG Only the Tag color image is visible.



Color-map This window displays the grey level color-map used to display the GLI images.

Black / White These sliders are used to control the contrast and brightness of the GLI image.



- All values smaller than the value of the black slider are black.
- All values greater than the value of the white slider are white.
- All values in between are interpolated linearly.

4.1.2.2 From the Display Area

There is no display area interaction with this tool.

4.1.2.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
F1	COLOR-SCHEME-MODE-GLI	Set the color scheme mode for all the 2D windows
F2	COLOR-SCHEME-MODE-MIX	

F3	COLOR-SCHEME-MODE-OVER	
F4	COLOR-SCHEME-MODE-TAG	
-	COLOR-SCHEME-MIX-DECREASE	Decrease / increase the “mix”
=	COLOR-SCHEME-MIX-INCREASE	density by .1 (from: 0.1 to 0.9)

4.1.2.4 From the Command Line

The following commands can be used in the command line or in a script file:

Color: grey

Color: mix [value]

Color: over

Color: tag

This will select the color scheme used to display the images. In addition, if “value” is present for the “mix” scheme, it will be used for Tag density. The accepted range for “value” is from 0.1 to 0.9.

Color: black [value]

Color: white [value]

This will change the values associated with the black and the white sliders. The accepted range for “value” is the same range as the GLI pixel values.

The following variables can be used in the commands:

\$COLOR_SCHEME_MODE (Read/Write, character string)

\$COLOR_SCHEME_MIX (Read/Write, float)

4.1.3 The Gamma Correction Tool

The Gamma correction is used to compensate for the non-linear response of the screen. The grey-level values of the image are corrected to take the screen response into account.

4.1.3.1 From the Graphical Interface

The Gamma correction value is set by comparing the 3 grey surfaces: two of these (left and right) are composed of a mix of black and white lines, the other (center) is a mid-level grey. The visual stimuli of all 3 surfaces should be the same.



Gamma slider This slider is used to select the Gamma correction value. Adjust the slider so that the 3 grey surfaces have the same intensity.

4.1.3.2 From the Display Area

There is no display area interaction with this tool.

4.1.2.3 From the Keyboard

There is no keyboard interface to this tool.

4.1.3.3 From the Command Line

The following commands can be used in the command line or in a script file:

Gamma: *value*

Fix the gamma correction value. Value can range between 0.5 and 5.0.

The following variables can be used in script commands:

\$GAMMA

(Read/Write, float)

Note

Some graphic cards also have a Gamma correction factor, so you may want to adjust the screen gamma through the card's interface instead.

4.1.4 The GLI Color Map Tool

If the GLI (Grey Level Images) are monochrome, you can display them using a color map. By default the standard grey level color map is used. The lowest values are black and the highest values are white.

4.1.4.1 From the Graphical Interface



The map buttons You have a choice of 4 color maps, the first 2 are standard and inverse grey levels, the second 2 uses colors and can be modified by the user.

4.1.4.2 From the Display Area

There is no display area interaction with this tool.

4.1.4.3 From the Keyboard

There is no keyboard interface to this tool.

4.1.4.4 From the Command Line

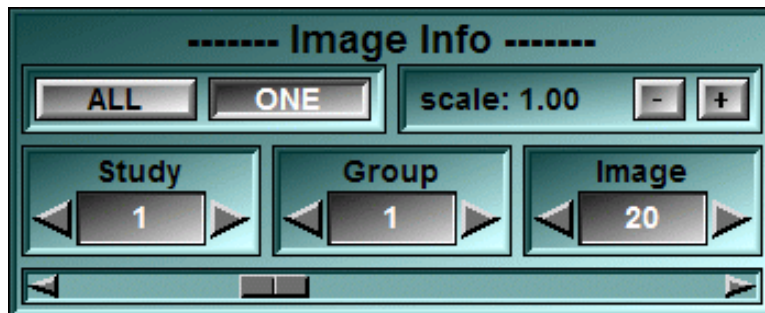
The following variables can be used in the commands:

\$COLOR_MAP_MODE (Read/Write, character string)

4.1.5 The Image Info Tool

With this tool, you control the images shown in the **Display Area**. You can change the scale of the displayed images, select the current image being displayed, or choose to display all the images.

4.1.5.1 From the Graphical Interface



ALL / ONE These buttons are used to toggle the Display Mode of the images in the Display Area between **Mode One** (one image is displayed) and **Mode All** (all the images are displayed). For more information on these modes, refer to **Section 3.1: Mode One and Mode All**. Pressing the space-bar will also toggle between these modes.

Scale You control the size of the images with these buttons. The current scale factor being displayed is either a negative number, the shrink factor, in **Mode All**, or a positive number, the magnification factor, in **Mode One**.

The "+" and "-" buttons:

Clicking on the "+" or "-" buttons will increase or decrease the size of the images in the Display Area. Pressing the "+" or "-" keys on the keypad will have the same effect.

Study Select the current study. You can also use the Insert / Delete keys to change the current study selection. In Mode All this tool will be disabled and it will display the study currently under the cursor.

Group Select the current group in the current study. You can also use the Home / End keys to change the current study selection. In Mode All this tool will be disabled and it will display the group currently under the cursor.

Image Select the current image in the current group. You can also use the Page Up / Page Down keys to change the current study selection. In Mode All this tool will be disabled and it will display the image currently under the cursor.

Image slider This slider can also be used to select the current image in the Display Mode **One**.

4.1.5.2 From the Display Area

The values displayed in the interface will reflect the mode of the selected window (Mode One or Mode All), the scaling of the currently selected group and the study, group and image number of the image under the cursor.

4.1.5.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
<i>not mapped</i>	DISPLAY-MODE-ONE	Select the display mode for the current 2D window
<i>not mapped</i>	DISPLAY-MODE-ALL	
Space	DISPLAY-MODE-TOGGLE	
Keypad "+" Keypad "-"	SCALE-PLUS SCALE-MINUS	Increase / decrease the magnification of the image(s)
Page Up Page Down	SLICE_NEXT SLICE_PREVIOUS	Go to the next / previous image of the current group
Home End	GROUP_NEXT GROUP_PREVIOUS	Go to the next / previous group of the current study
Insert Delete	STUDY_NEXT STUDY_PREVIOUS	Go to the next / previous study

4.1.5.4 From the Command Line

The following commands can be used in the command line or in a script file:

Mode: all

Mode: one [image_number]

Place the display area in “**mode one**” or “**mode all**”. If “**image_number**” is present, this image will be the one displayed in mode one.

Mode: scale *value*

Change the display scale factor

The following variables can be used in the commands:

\$STUDY_ALL	(Read only, array of integers)
\$STUDY_CUR	(Read/Write, integer)
\$STUDY_MAX	(Read only, integer)

\$GROUP_ALL	(Read only, array of integers)
\$GROUP_CUR	(Read/Write, integer)
\$GROUP_MAX	(Read only, integer)

\$DIRECTION_ALL	(Read only, array of integers)
\$DIRECTION	(Read/Write, integer)
\$DIRECTION_MAX	(Read only, integer)

\$IMAGE_ALL	(Read only, array of integers)
\$IMAGE_CUR	(Read/Write, integer)
\$IMAGE_MAX	(Read only, integer)

\$DISPLAY_MODE	(Read/Write, character string)
-----------------------	--------------------------------

4.1.6 The Memory Manager Tool

This tool enables you to visualize and control the amount of memory used by the slicOmatic.

The memory used by the program is divided in 4 groups:

- The **sliceOmatic** memory. This is the memory used by the program without loading any images. This value is fixed and is estimated at 50 MBytes.
- The **Image** memory. To accelerate its graphic refresh, sliceOmatic keep copies of the images it displays. This is the memory used by the original slices and their copies.
- The **Undo** memory. This is the memory used to keep the undo operations.
- The **3D Geom** memory. This is the memory used by the 3D models.

In order to run, the program need to fit into your computer's memory. That memory is composed of 2 parts: your RAM memory, and the swap space. The maximum size that the program can have is either the sum of these values, or the maximum addressable space in Windows (2Gb) if this value is smaller than that sum.

When the program become to big to fit in the RAM memory, part of it will be "swapped" to the swap space on the hard drive and the program's performance will degrade. The automatic memory manager will try to prevent this by removing seldom used copies of the images from the image memory. As soon as the amount of memory used by the program reach a critical "high water" mark, it will start cleaning the image memory until the memory usage fall under a safer "low water" mark.

You can also free up memory manually through the tool's graphic interface, you can "Cleanup" the image memory or delete the Undo and 3D Geom memory.

Doing a cleanup of the image memory will erase the copies of the images kept by the program. The only inconvenience this will cause is a small performance degradation since the next time the program needs to display these images, it will have to recreate them instead of fetching them from memory.

Deleting the Undo or the 3D Geom memory however will have some consequences: Deleting the Undo memory will remove any accumulated Undo. Deleting the 3D Geom memory will delete all 3D geometries from the program's memory.

4.1.6.1 From the Graphical Interface

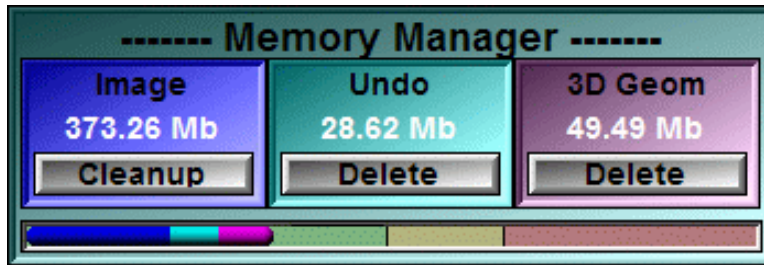



Image Erase all the copies of the images kept in memory to accelerate refresh.

Undo Delete all Undo operations from the Undo buffer.

3D Geom Delete all the 3D geometries

Memory bar Indicate the amount of used memory. The total length of the  bar is the maximum addressable memory space for the program. The yellow region represents the interval between the low water and the high water marks. The blue portion of the memory bar represents the Image memory, The cyan portion represents the Undo memory and the magenta portion represents the memory used by the 3D geometries.

4.1.6.2 From the Display Area

There is no display area interaction with this tool.

4.1.6.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
<i>not mapped</i>	MEMORY-CLEANUP-IMAGE	cleanup of unused image memory
<i>not mapped</i>	MEMORY-CLEANUP-UNDO	delete all “undo” buffers
<i>not mapped</i>	MEMORY-CLEANUP-GEOM	delete all the 3D geometries

4.1.6.4 From the Command Line

The following commands can be used in the command line or in a script file:

memory: images

cleanup of unused image memory

memory: undo

delete all “undo” buffers

memory: geom

delete all 3D geometries

The following variables can be used in the commands:

\$MEMORY_MANAGER	(Read/Write, string)
\$MEMORY_RAM	(Read Only, integer)
\$MEMORY_TOTAL	(Read Only, integer)
\$MEMORY_SLICEOMATIC	(Read/Write, integer)
\$MEMORY_SYSTEM	(Read/Write, integer)
\$MEMORY_HIGH_WATER	(Read/Write, integer)
\$MEMORY_LOW_WATER	(Read/Write, integer)
\$MEMORY_IMAGES	(Read Only, integer)
\$MEMORY_UNDO	(Read Only, integer)
\$MEMORY_GEOM	(Read Only, integer)

By default, the variables are initialized with:

\$MEMORY_MANAGER =	ON
\$MEMORY_TOTAL =	Value given by Windows for the total addressable space
\$MEMORY_RAM =	Value given by Windows for the amount of RAM memory in the computer
\$MEMORY_SLICEOMATIC =	Size of the program without any images. Estimated to 50 MBytes
\$MEMORY_SYSTEM =	Amount of RAM memory reserved by Windows. Estimated to 100 MBytes
\$MEMORY_HIGH_WATER =	Computed from: \$MEMORY_RAM - \$MEMORY_SYSTEM
\$MEMORY_LOW_WATER =	Computed from: (80% of MEMORY_RAM) - \$MEMORY_SYSTEM

4.1.7 The Text Overlay Tool

Patient and image information can be overlaid on the image.

Note

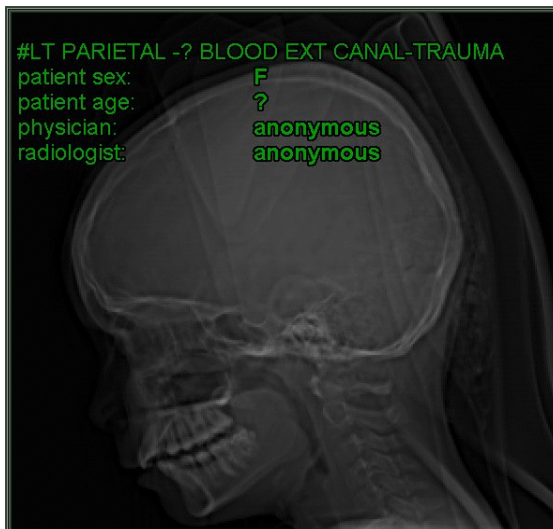
If the display size of the images is too small, only the image number from the File overlay will be displayed. Also, the Name, Patient and Technical overlays will not be displayed.



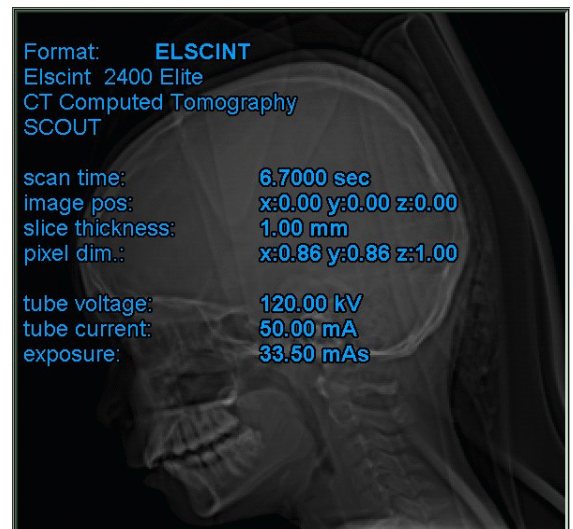
Number



Name



Patient



Technical

4.1.7.1 From the Graphical Interface



There are 4 levels of information you can display corresponding to the 4 buttons of this tool. The different information (if known) displayed are:

- File:** Image sequence number in sliceOmatic and the file name (In white)
- Name:** Patient name, patient id, hospital name, physician name, study, series and image number, date and time of acquisition (In yellow). Also, if the image is “trusted”, labels identifying the Left, Right, Head, Feet, Anterior and Posterior sides of the patient will be displayed
- Patient:** Patient sex, age, and weight, radiologist name, comments (In green)
- Tech.:** Technical information on the image format, scanner’s manufacturer and model, image modality (CT, MR...), image orientation, scan protocol, contrast agent, table position and height, scan time, image position, slice thickness, pixel dimension and other information depending of the image modality (In cyan).

4.1.7.2 From the Display Area

There is no display area interaction with this tool.

4.1.7.3 From the Keyboard

The following commands can be mapped to keyboard keys as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
<i>not mapped</i>	OVERLAY-FILE-ON	Enable / disable the “File” Overlay
<i>not mapped</i>	OVERLAY-FILE-OFF	
Shift-F5	OVERLAY-FILE-TOGGLE	
<i>not mapped</i>	OVERLAY-NAME-ON	Enable / disable the “Name” Overlay
<i>not mapped</i>	OVERLAY-NAME-OFF	
Shift-F6	OVERLAY-NAME-TOGGLE	

<i>not mapped</i>	OVERLAY-PATIENT-ON	Enable / disable the "Patient" Overlay
<i>not mapped</i>	OVERLAY-PATIENT-OFF	
Shift-F7	OVERLAY-PATIENT-TOGGLE	
<i>not mapped</i>	OVERLAY-TECHNICAL-ON	Enable / disable the "Technical" Overlay
<i>not mapped</i>	OVERLAY-TECHNICAL-OFF	
Shift-F8	OVERLAY-TECHNICAL-TOGGLE	

4.1.7.4 From the Command Line

The following commands can be used in the command line or in a script file:

Overlay: file on|off|toggle

change the value of the "File" overlay to on, off or toggle it.

Overlay: name on|off|toggle

change the value of the "Name" overlay to on, off or toggle it.

Overlay: patient on|off|toggle

change the value of the "Patient" overlay to on, off or toggle it.

Overlay: technical on|off|toggle

change the value of the "Technical" overlay to on, off or toggle it.

Set: start_2d_overlays *value*

Used by the ".ini" file. Control all overlay from one bit field value. Value is an hexadecimal number where each bit controls the state of one of the overlays. The bit 1 (x01) is for the file overlay, 2 (x02) for the name overlay, 3 (x04) for the patient overlay and 4 (0x08) for the technical overlay. As an example, if values is 5, then only the file and patient overlays are enabled.

The following variables can be used in the commands:

\$OVERLAY_2D (Read/Write, bit field)

4.1.8 The Pixel Info Tool

In this tool, information about the pixel under the mouse pointer is displayed.



- Pixel info** This box displays the horizontal and vertical position of the cursor in the image. This position is given in image pixels. The value (0,0) is the lower left corner.
- GLI info** This box displays the numerical value of the pixel under the cursor. For CT images, this value should be in Hounsfield units. For color images, the 3 RGB values will be displayed.
- Tag info** This box displays the Tag value of the pixel under the cursor. The Tag value can range from 0 to TAG_MAX. (By default, TAG_MAX=127 and can be changed through the Preferences interface)
- Coord. Info** This box displays the 3D coordinates of the pixel under the cursor. This value is given in the patient's reference system. It is computed from the image origin, the pixel dimensions and the gantry tilt. Please refer to **section 10.3** for a brief discussion of the 3D coordinate systems

4.1.8.2 From the Display Area

The values displayed in the interface are continuously updated to reflect any mouse movements.

4.1.8.3 From the Keyboard

There is no keyboard interface to this tool.

4.1.8.4 From the Command Line

The following variables can be used in a command:

\$TAG_VALUE (Read/Write, integer)

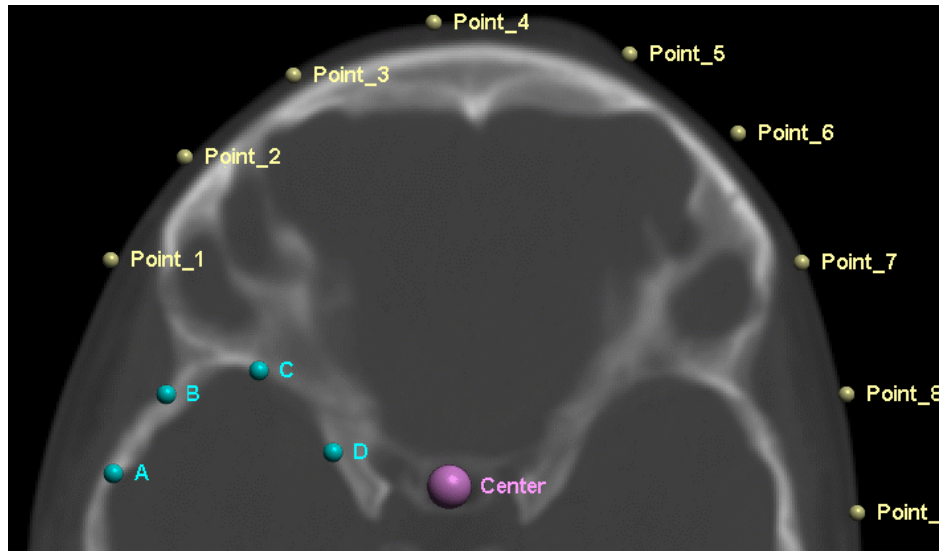
\$GLI_VALUE	(Read/Write, integer)
\$CURSOR_2D_POS_X	(Read/Write, float)
\$CURSOR_2D_POS_Y	(Read/Write, float)
\$CURSOR_2D_POS_Z	(Read/Write, float)
\$CURSOR_2D_POS	(Read/Write, array of 3 floats)
\$CURSOR_3D_X	(Read/Write, float)
\$CURSOR_3D_Y	(Read/Write, float)
\$CURSOR_3D_Z	(Read/Write, float)
\$CURSOR_3D_POS	(Read/Write, array of 3 floats)

Note

These variables are only defined if the cursor is over an image.

4.1.9 The Point Tool

With this tool, you can place points on the 2D images. Points will be created under the cursor either with the left mouse button, or when you press the “Insert” key of the keyboard. Alternatively, pressing the right mouse button, or the “Delete” key of the keyboard will delete the point under the cursor (or the closest point if none is under the cursor). You can also use the mouse to drag a point.



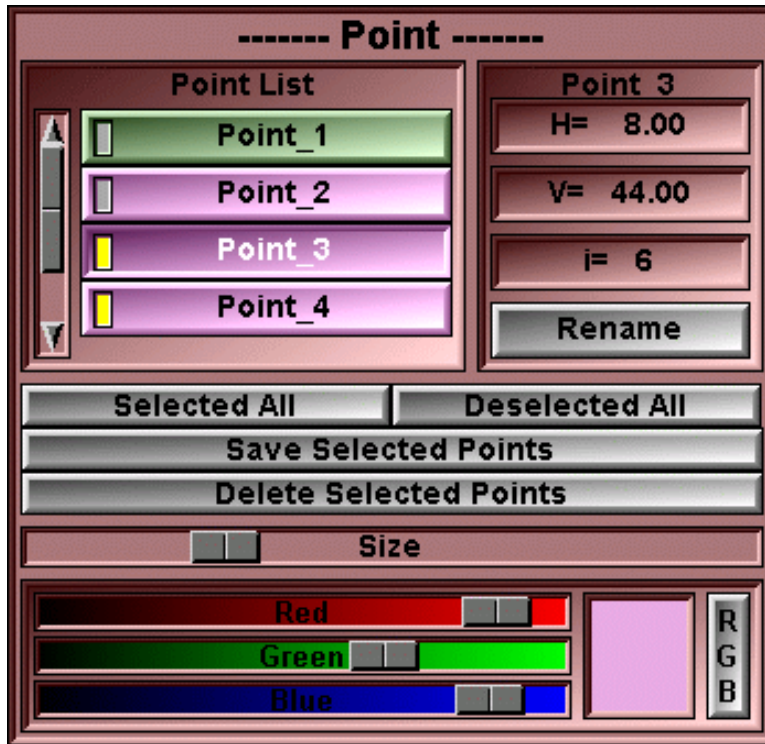
The points are created in 3D space using the image's origin, orientation and the pixel dimensions. The list of created points is shared between the Basic Module's Point mode and the 3D Module's Point mode. Points created on the 2D images will be visible in the 3D space and inversely, points created on the 3D surfaces will be visible on the 2D images.

Points can also be read from a file or manipulated from the command line.

Note

You can use the POINT-ON key to display and manipulate the points when the point tool is disabled. If the Point tool is disabled, the mouse buttons interface is not available and the points can only be placed and removed with the keyboard shortcuts and the command line.

4.1.9.1 From the Graphical Interface

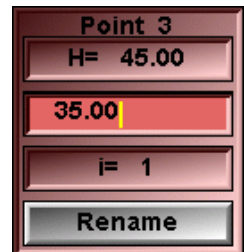


Point List

This is a list of all the Points. You can select the points you want to modify from this list. The indicator's light of the selected points is turned ON. The button of the last point to have been selected or unselected will appear pressed. It is the current point. Information on the current point will be displayed in the box at the right of the list. You can modify the position and name of the Current point from the controls in this box.

Position Boxes

The 3D coordinates of the current point will be displayed here. Clicking in these boxes will enable you to modify their values from the keyboard.



Rename Button

Clicking on this button will present you with an edition box. You can edit the point's name in this box. Press "Enter" to accept the changes.



Select All

Select all the points from the list

- Deselect All** Deselect all the points from the list
- Save Selected** Save all the selected points in a script file. A Save dialog box will appear. For each of the selected points, the following entries will be written in the file:
 Point: "*name*" create *x y z*
 Point: "*name*" color *R G B*
 Point: "*name*" size *val*
- Delete Selected** Delete all the selected points
- Size Slider** This slider is used to control the size of the selected points' graphic representation. At a size of zero (left) the point will be represented as a 2-pixels-wide point on the screen. At larger sides, a shaded sphere will be used to display the point.
- Color Editor** Upon creation, the points are assigned a random color. Afterward, using the Color Editor, you can change the color of all selected points.

4.1.9.2 From the Display Area

If the Points are visible, with or without the Point Tool activated

Points will be created under the cursor when you press the "Enter" key (POINT-INSERT) of the keyboard. Alternatively, the "Shift-Enter" key (POINT-DELETE) of the keyboard will delete the point under the cursor (or the closest point if none is under the cursor).

If the Point Tool is activated

Points will be created under the cursor with the left mouse buttons, and deleted with the right mouse button. You can also use the mouse to drag a point.

4.1.9.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

Key map	Command name	Action
<i>not mapped</i>	POINT-ON	Show / hide the points in the current window if the point tool is not activated
<i>not mapped</i>	POINT-OFF	
"p" or "P"	POINT-TOGGLE	

- Enter** **POINT-INSERT** Insert a point under the cursor
- Shift-Enter** **POINT_DELETE** Delete the point closest to the cursor

4.1.9.4 From the Command Line

The following commands can be used in the command line or in a script file:

Point: label (on|off)

Add/remove the labels when displaying the points.

Point: *name* create *x y z*

This command is used to create a new point. The point will be labeled "name" and is placed at x, y, z. (these are 3D coordinates)

Point: *t_point* color *R G B*

Change the color of all the points matching the template name *t_name*.

Point: *t_point* delete

Delete all points matching the template

Point: *t_point* pos *x y z*

Change the coord. of all points matching the template to x y z

Point: *t_point* size *value*

Change the size of all points matching the template (size=0 for 1 pixel wide points)

Point: *t_point* surf *surface_name*

The following variables can also be used in script commands:

\$DISPLAY_2D_POINTS (Read/Write, character string)

\$DISPLAY_2D_POINTS_ALL (Read/Write, array of strings)

Note

"t_point" is a template that can match one or multiples point's names. See **Appendix C.8: The Templates.**

4.1.10 The Display Area Snapshot Tool

You can save the content of the Display Area window with this tool.

You first select the format for the snapshot. The choice is between Windows' BMP format and TARGA. Each time you press the "Click!" button, an image of the Display Area window will be saved to the scratch directory (by default the "C:\Temp" directory). The image will be named "sliceO_xx.ext" where "ext" is either "bmp" or "tga" and "xx" is a sequential number assigned to the image upon creation.

Unless you use the command line interface with the "file_name" option, the program cannot save more than 100 images (from 00 to 99).

4.1.10.1 From the Graphical Interface



Click! Create an image with the content of the Display Area window.

Format Select the format of the snapshot image with this tool.

4.1.10.2 From the Display Area

There is no display area interaction with this tool.

4.1.10.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
Print Scrn	SNAPSHOT	Create an image with the entire sliceOmatic window.

Note

Unlike the "Click!" button that only saves the Display Area window, this key will save the entire sliceOmatic window.

4.1.10.4 From the Command Line

The following commands can be used in the command line or in a script file:

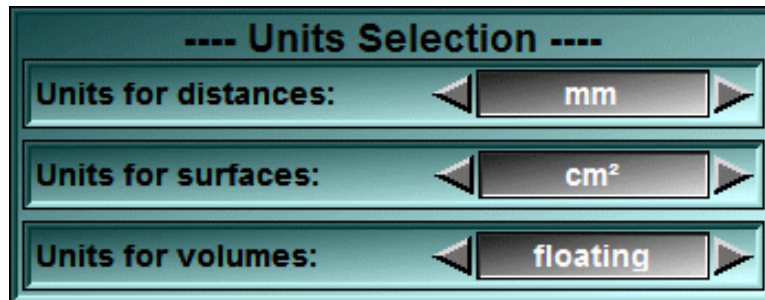
Snapshot: [*file_name*]

Save the content of the Display Area window to a file in the scratch directory. If “file_name” is present, it will be used, otherwise the file name is “sliceO_xx.ext”.

4.1.11 The Units Tool

A number of tools and mode display and save dimension information. You can change the units used for these. These are just cosmetic changes, the actual computation are all based on the units specified in the image's headers.

4.1.11.1 From the Graphical Interface



The distances selection The choices are: floating, m, cm, mm or μm
The surfaces selection The choices are: floating, m^2 , cm^2 , mm^2 or μm^2
The volumes selection The choices are: floating, m^3 , cm^3 , mm^3 or μm^3

Warning

The "floating" value will select the best possible units to display the values. This may cause the units to change from slice to slice.

4.1.11.2 From the Display Area

There is no display area interaction with this tool.

4.1.11.3 From the Keyboard

There is no keyboard interface to this tool.

4.1.11.4 From the Command Line

The following commands can be used in the command line or in a script file:

Set: units_dist flag

Set the units for the distance information. The value of flag are: 0=floating, 1=m, 2=cm, 3=mm, 4= μm .

Set: units_surf flag

Set the units for the surface information. The value of flag are: 0=floating, 1=m², 2=cm², 3=mm², 4=μm².

Set: units_vol flag

Set the units for the volume information. The value of flag are: 0=floating, 1=m³, 2=cm³, 3=mm³, 4=μm³.

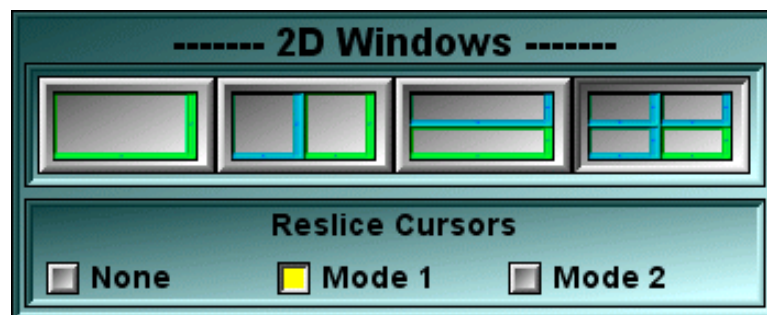
4.1.12 The Windows Tool

This tool enables you to display up to four 2D windows in the display area. Each of these windows can display different images, in different directions or with different display modes.

Only one window is the current window. The current window has a green border. The current window is the one that will be affected by the interface (image changes, mode changes...). Simply clicking inside a window makes it the current window.

You can also display cursor lines showing the position and orientation of each window relative to the others. Each window has an associated color, and the cursor showing a window's orientation in the other windows will be displayed with that color.

4.1.12.1 From the Graphical Interface



Window buttons Just click on one of the 4 available configurations.

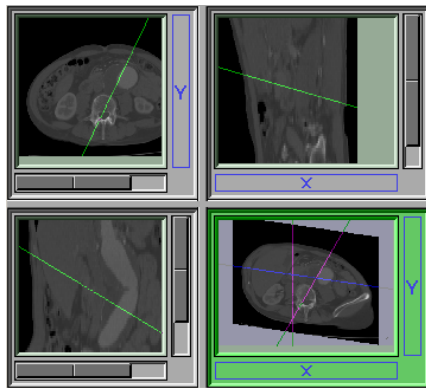
The Reslice Cursors modes

You can select one of the three following modes:

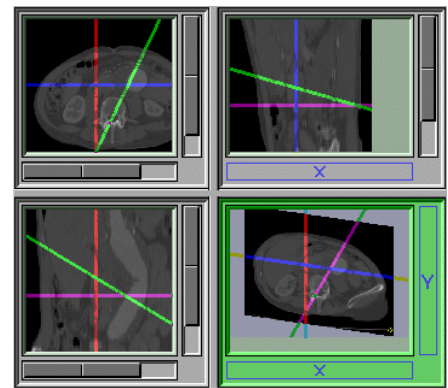
None No Reslice cursors are displayed.

Mode1 The line from the current window is displayed in all the other windows. The lines from all the other active windows are displayed in the current window.

Mode2 The line from all active window are displayed in all the other active windows.



Reslice cursors **Mode 1**



Reslice cursors **Mode 2**

4.1.12.2 From the Display Area

You can resize the windows by dragging the separators between them. If a window becomes too small, it is disabled. When the program starts, only window 1 is visible and the separators are at the top and left side of the display area.

4.1.12.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>key map</i>	<i>command name</i>	<i>Action</i>
<i>not mapped</i>	WINDOW-CURSOR-OFF	Set the Reslice cursor mode
<i>not mapped</i>	WINDOW-CURSOR-MODE1	
<i>not mapped</i>	WINDOW-CURSOR-MODE2	
"L" or "I"	WINDOW-CURSOR-TOGGLE	

4.1.12.4 From the Command Line

The following commands can be used in the command line or in a script file:

window: cursor *value*

Change the reslice cursor mode. Where "*value*" is "none", "mode1" or "mode2".

window: color *wind* *R* *G* *B*

Change a window's color. Where "*wind*" is the window number (1 to 4) and *R*, *G* and *B* are the color components (between 0 and 255). This color is used in the border of the window and in its cursor lines.

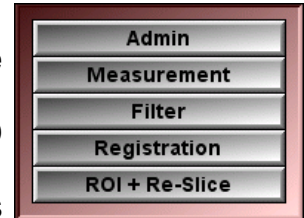
The following variables can be used in the commands:

\$WINDOW_2D_ALL	(Read Only, array of integers)
\$WINDOW_2D_CUR	(Read/Write, integer)
\$WINDOW_2D_CUR_COLOR	(Read/Write, array of 3 integers)
\$WINDOW_2D_CURSOR_MODE	(Read/Write, string)
\$WINDOW_2D_MAX	(Read Only, integer)

4.2 The BASIC Modes

There are 5 modes associated with the BASIC Modules:

- The **Admin** mode is used to sort, group, and delete the images.
- The **Measurement** mode offers a series of 2D measurements tools.
- The **Filter** mode enables you to apply filters to the images to enhance their readability or smooth out noise.
- The **Registration** mode is used to align a stack of 2D slices using markers.
- The **ROI + Re-Slice** mode enables you to re-slice the slice's volume in any direction.



For each of the BASIC Modes, we will present the Mode, describe the layout and function of its graphical interface, the display area manipulations that are possible in this mode, the key shortcuts available for this mode as well as the command line and variables that are related to the mode.

You can find a more detailed description of the key shortcuts, their use and their syntax in the section: **Appendix A: The keyboard shortcuts.**

A complete description of the command line syntax and its variables is presented in **Appendix C: The Command Line Syntax.**

4.2.1 The Admin Mode

In this mode the slices can be closed, and slice order can be modified.

Warning

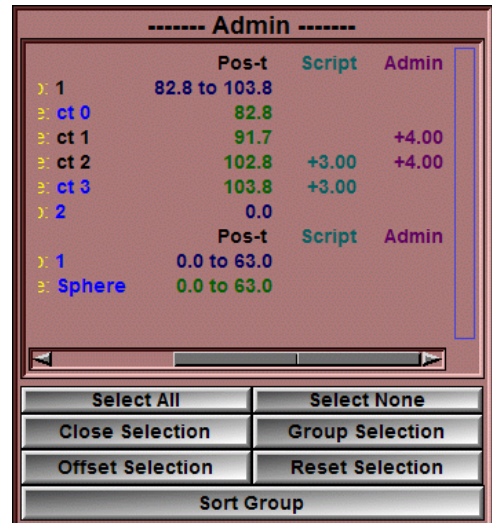
Only slices in their original orientation can be manipulated in the Admin Mode.

Most of the computations in sliceOmatic need the slices inside each groups to be ordered in space. When it read a slice, sliceOmatic attempt to order them automatically, but sometime you need to step-in and move slices around. Just changing the order of the images in the groups is not enough, you must change the position of the image in space to make sure that their “t” values are sorted.

The “t” value is the distance from the origin to the image’s plane. By default it is the value computed from the slice origin and orientation (the header value). You can change this value when you read the images through the command line or a script file with the “t=”

argument in the “read: image” command (the script offset). It can also be changed in this mode with the “offset selection” button (the admin offset).

The “t” value of the slice is the sum of the header value + the script offset + the admin offset. If a script offset or an admin offset are present, they will be displayed in the Admin window.



4.2.1.1 From the Graphic Interface

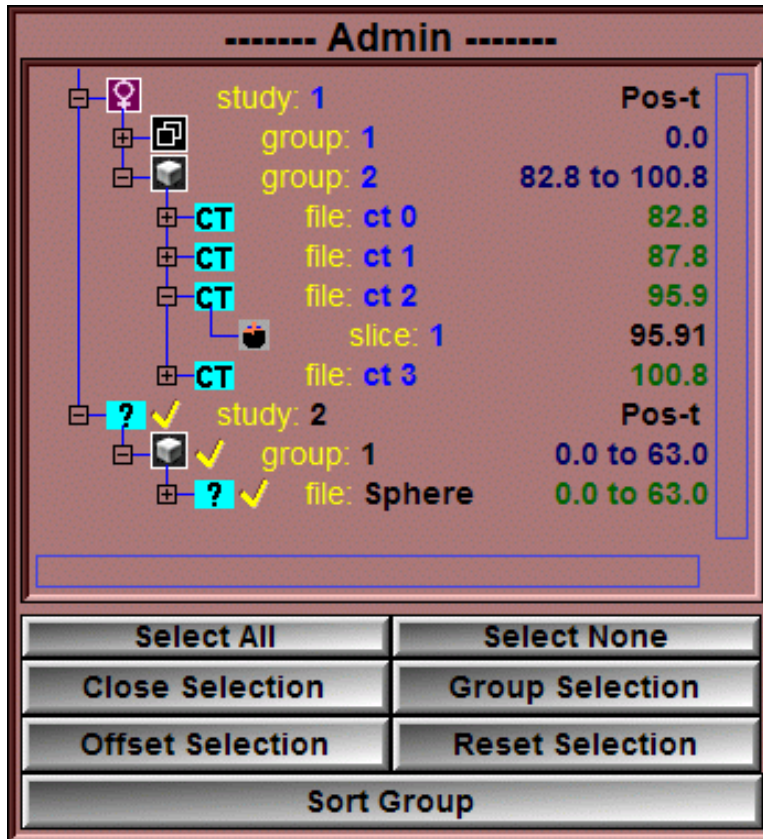


Image list

Select an image either by clicking on its button or directly from the DISPLAY AREA (c.f. **Section 3.2: Image Selection**). The "Close", "Group", "Offset" and "Reset" options are only enabled if an image has been selected.

Select All

All the images will be selected

Select None

All the images will be unselected.

Note

In **Mode One**, the current image will always be selected

Close Selection

This button will remove the selected images from the program.

Group Selection

A new group will be created and all the selected images will be moved to it.

Offset Selection This button is used to add an offset in the “t” direction to all selected images. The button will be replaced by a text input window where you can type the offset value.



Reset Selection Reset the offset values off all selected slices.

Sort Group This button will sort all the images of the selected groups in ascending values of “t”.

Note

“t” is the distance from the origin to the image’s plane. For axial images, $t = Z$, for sagittal images, $t = X$, for coronal images, $t = Y$.

Warning

Volume computation can only be performed on 3D or sorted parallel groups. (c.f. **Section 1.4.1: Image Groups**)

4.2.1.2 From the Display area

You can change the order of the images by clicking on a selected image with the left button of the mouse and dragging the selected images to the desired position. All the other images will be automatically repositioned. The dragged images will be placed immediately after the image on which they are dropped. To place an image at the beginning of a group, drop that image on the group’s icon.

4.2.1.3 From the Keyboard

There is no keyboard interface to this mode.

4.2.1.4 From the command line

The following commands can be used in the command line or in a script file:

Select: `t_ima [t_ima ...]`

Admin: `select t_ima [t_ima ...]`

The images specified will be selected.

ex: **Admin: select 1[2-5] 2[2-5]** will select images 12 to 14 and 22 to 25

Admin: [t_ima] close

Delete the images.

Admin: [t_ima] group

Group together the images.

Admin: [t_ima] sort

Sort the images. The images are sorted according to their "t" value.

Admin: [t_ima] fill val

Change the pixel fill value associated to this image.

Admin: [t_ima] dim x y z

Change the dimensions of the images matching t_ima. The values of x, y and z can be preceded by a + or - sign.

Admin: [t_ima] inc x y z

Change the pixel increment (distance between pixel centers) of the images matching t_ima. The values of x, y and z can be preceded by a + or - sign.

Admin: [t_ima] org x y z

Change the origin of the images matching t_ima. The values of x, y and z can be preceded by a + or - sign.

Note

For the **dim**, **inc** and **org** commands:

- If the "value" string contains a "+" sign, that value will be added to the image's original value.
- If the "value" string contains a "-" sign, the value will be subtracted from the image's original value.
- If the "value" string does not contain a sign, that value will replaced the image's original value.

Note

"t_ima" is a template that can match one or multiples images. See **Appendix C.8: The Templates**.

4.2.2 The Filter Mode

In this mode, you can modify the GLI images. It can be used to increase contrast and help in the visualization of the images.

Two classes of filter are implemented: The Convolution Filter and an Anisotropic Filter. Each of these has a distinct interface.

4.2.2.1 The Convolution Filter



Filter list Clicking on one of the filter buttons will select the corresponding filter. The available filters are: Median, Means, Gaussian, LoG, Sharpen, Laplace, Roberts and Sobel. A brief description of each filter with some image examples are located below.

Kernel Size You can adjust the Kernel Size of the Mean, Median, Gaussian and LoG filters.

Demo images Three demo images are provided to help in the filter and mix selection. The image on the left is unfiltered, the image on the right is fully filtered and the center image is a mix of these. The mix parameter is controlled by the mix slider.

Mix slider Filtering operations are controlled by the "mix" slider. The filtered image is mixed with the original image in a proportion that is controlled by the mix slider.

- If the slider is completely to the left, the filtering operation will not affect the image.
- If the slider is completely to the right, the image will be replaced by its filtered version.

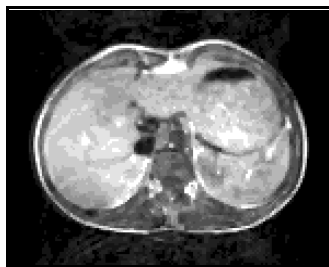
Compute Filter Clicking on this button will apply this filter to the selected images.

Undo The "Undo" button undoes the previous filter operations. It is a shortcut to the "Undo" button of the Undo/Redo menu. It can only undo filter operations. If the last operation in the undo buffer is not a filter operation, this button is disabled.

The available filters are:



Original



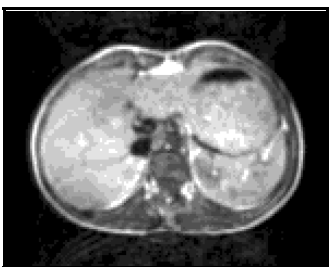
Median (3x3)

Median

For each pixel i,j in the original image, the resulting pixel will be computed by taking the median value of the pixel and its neighbours.



Original



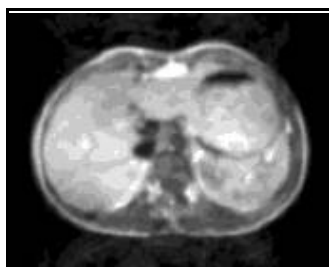
Means (3x3)

Means

For each pixel i,j in the original image, the resulting pixel will be computed by taking the mean value of the pixel and its neighbours.



Original

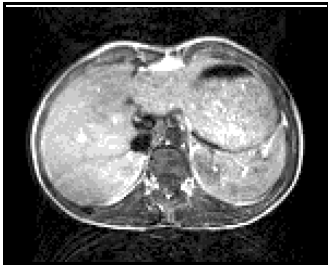


Gaussian (5x5)

Gaussian

The resulting image is produced by convolving the source image with a Gaussian kernel:

$$e^{-\frac{x^2+y^2}{2\sigma^2}}$$



Original

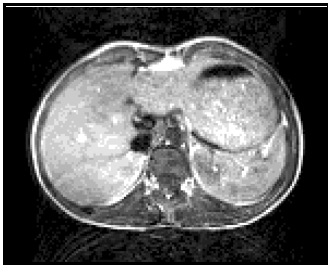


LoG 7x7

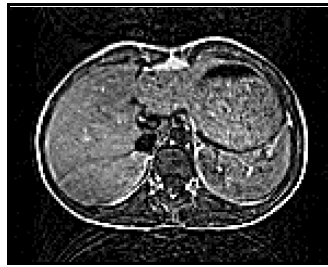
Laplacian of a Gaussian (LoG)

The resulting image is produced by convolving the source image with a kernel formed by the Laplacian of a Gaussian :

$$\nabla^2 e^{-\frac{x^2+y^2}{2\sigma^2}}$$



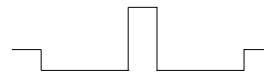
Original



Sharpen (mix ≈ .2)

Sharpen

The resulting image is produced by convolving the source image with the kernel of profile:



Original



Laplace

Laplace

The resulting image is produced by convolving the source image with the kernel:

-1	-1	-1
-1	8	-1
-1	-1	-1



Original



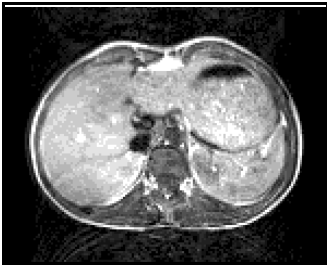
Roberts

Roberts

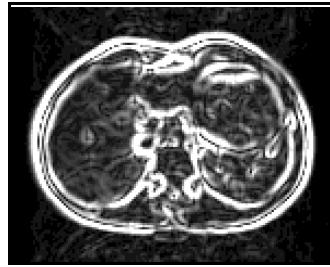
The resulting image is produced by convolving the source image with the two kernels A and B and adding the results: res = ABS[A] + ABS[B]

$$A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$$

$$B = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$



Original



Sobel

Sobel

The resulting image is produced by convolving the source image with the two kernels A and B and adding the results: $res = ABS[A] + ABS[B]$

$$A = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$$

$$B = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

The Median, Mean and Gaussian filters are used to reduce the noise in the images. The Mean and Gaussian filters will blur the edges while the Median filter will maintain clean edges.

The Contrast and Laplace filters are contrast enhancement filters. These are useful when you would prefer to see anatomical structures more clearly.

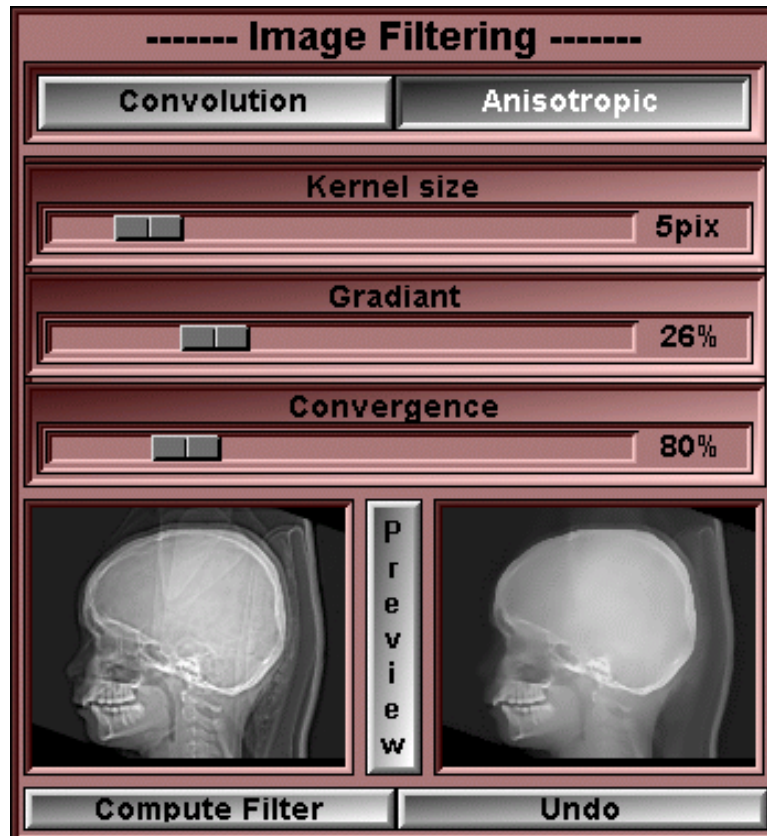
The Roberts and Sobel filters are edge detection filters designed to increase the visibility of the edges in the images.

Technical Note

Contrast, Laplace, Roberts and Sobel filters are very sensitive to the noise in the image. You may want to precede these operations with a noise reducing filter (Median, Means, Gaussian).

4.2.2.2 The Anisotropic Filter.

This filter is based on an algorithm proposed by Bruno Migeon and Véronique Serfaty of the INRIA. This filter has 3 adjustable parameters.



Kernel Size This parameter controls the influence of a pixel on the resulting image as a function of its distance. The influence of a pixel on its neighbors decreases exponentially with its distance.

$$e^{-\alpha * Dist}$$

The value of “kernel size” is the distance at which the influence of a pixel on the resulting image is 10%.

Gradient This parameter controls the influence of a pixel as a function of its value. Pixels whose values are too different from one another have less influence on the resulting image, thus preserving sharp edges in the image. If Δ is the difference between 2 pixels, the influence of one pixel on the other decreases exponentially with Δ .

$$e^{-\beta * \Delta}$$

The value of "Gradient" is the value of Δ (expressed in percentage of the image's dynamic range) where the influence on the resulting image is 10%.

Convergence The filter is applied on the image iteratively, until we are satisfied that we have attained convergence. The "Convergence" parameter controls this process. To stop the iteration, less than "convergence" (expressed as a percentage of the total number of pixels) must have been modified by the last iteration.

Preview Compute a preview of the image at the left of the button, and displays it in the window at the right of the button. This button is only activated if the filter parameters are different from those used to display the image currently previewed.

Compute Filter Clicking on this button will apply the filter to the selected images.

Undo The "Undo" button undoes the previous filter operations. It is a shortcut to the "Undo" button of the Undo/Redo menu. It can only undo filter operations. If the last operation in the undo buffer is not a filter operation, this button is disabled.

Technical Note

For more information on the Anisotropic filter, please refer to "Adaptive multiscale anisotropic diffusion filtering using the maximum entropy principle". Bruno Migeon, Véronique Serfaty, Rapport de recherche N. 2174, Janvier 1994, INRIA.

4.2.2.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
<i>not mapped</i>	FILTER-MODE-MEANS FILTER-MODE-MEDIAN FILTER-MODE-GAUSSIAN FILTER-MODE-LOG FILTER-MODE-LAPLACE FILTER-MODE-ROBERTS FILTER-MODE-SOBEL FILTER-MODE-ANISOTROPIC	Fix the default filter mode
<i>not mapped</i>	FILTER-KERNEL-3x3 FILTER-KERNEL-5x5 FILTER-KERNEL-7x7 FILTER-KERNEL-9x9 FILTER-KERNEL-11x11	Fix the default kernel size

FILTER-KERNEL-15x15
 FILTER-KERNEL-19x19
 FILTER-KERNEL-25x25
 FILTER-KERNEL-31x31
 FILTER-KERNEL-INCREASE
 FILTER-KERNEL-DECREASE

not mapped FILTER-COMPUTE

Apply the default filter to the selected images

4.2.2.4 From the command line

The following commands can be used in the command line or in a script file:

Filter: a_kern value

Fix the default kernel size for the anisotropic filter.

Filter: a_grad value

Fix the default gradient influence for the anisotropic filter.

Filter: a_conv value

Fix the default convergence criteria for the anisotropic filter.

Filter: kernel size

Fix the default kernel size for the convolution filters. The accepted values are 1, 3, 5, 7, 9, 11, 15, 19, 25 and 31.

Filter: mix value

Fix the default “mix” value for the convolution filters. “Value” must be between 0 and 1.

Filter: t_ima (mean|median|gaussian|log|sharpen) [mix [kern_size]]

Filter the images with the selected filter. If “mix” is present, it will supersede the default value. “Mix” must be between 0.0 and 1.0. If Kern_size is present it will supersede the default value. “Kern_size” must be one of: 1, 3, 5, 7, 9, 11, 15, 19, 25 and 31.

Filter: t_ima (roberts|laplace|sobel) [mix]

Filter the images with the selected filter. If “mix” is present, it will supersede the default value. “Mix” must be between 0 and 1.

Filter: t_ima anisotropic [a_kern a_grad a_conv]

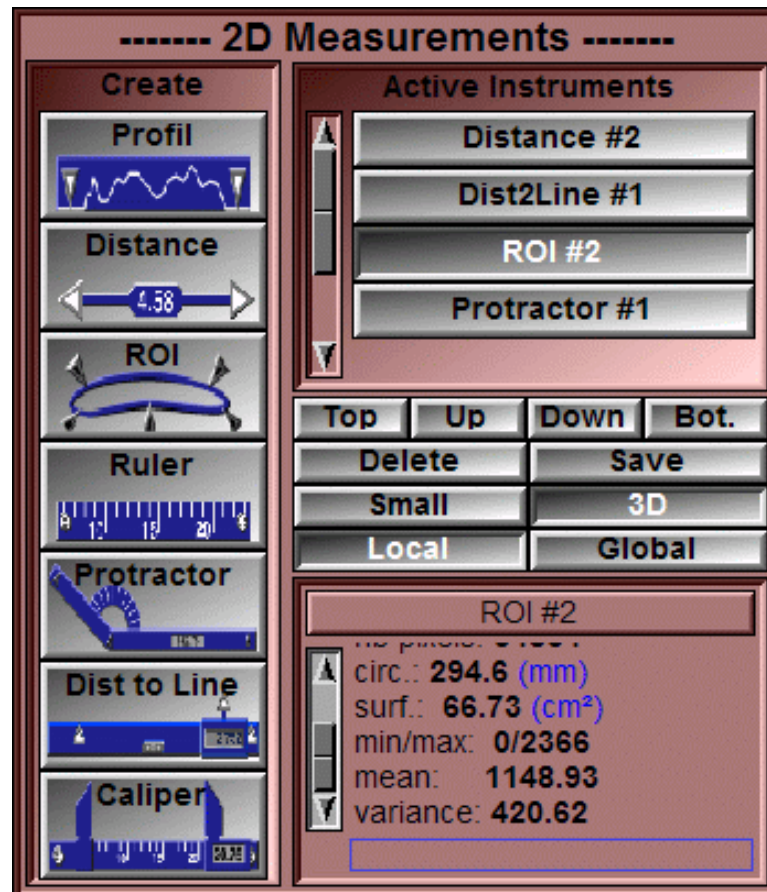
Filter the images with an anisotropic filter. If the a_kern, a_grad and a_conv values are present, they will supersede the default values.

Note

"t_ima" is a template that can match one or multiples images. See Appendix **C.8: The Templates**.

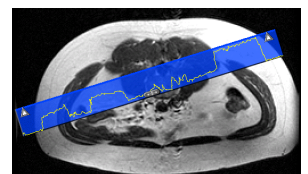
4.2.3 The Measurements Mode

In this mode, you can create and manipulate 2D measurement instruments,

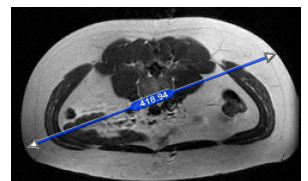


Create Instrument Clicking on one of the tools buttons will put the corresponding instrument at the bottom of the current image. The available instruments are:

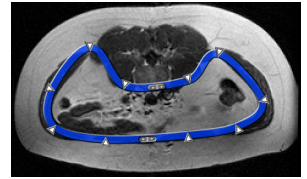
Profile The Profile instrument gives a curve of the pixel values along its edge.



Distance This instrument gives the distance between 2 points.

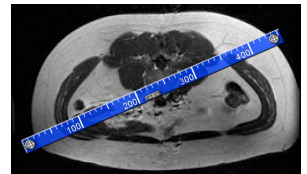


ROI This instrument enables you to compute some data inside a Region Of Interest (ROI). The ROI is formed by a Cardinal spline. You can move the control points simply by dragging them with the mouse. If you want more precision, you can add new control points by clicking on the ROI's perimeter. You can also remove a control point by pressing the "Delete" key while the cursor is over it. The computed values are:

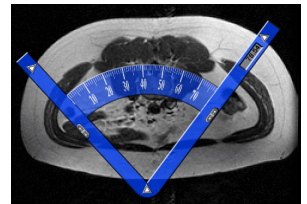


- **Nb Pixels:** The number of pixels in the region
- **Min/max:** The minimum and maximum values of the GLI pixels in the ROI
- **Mean:** The mean value of the GLI pixels in the ROI
- **Variance:** The variance of the GLI pixel values inside the ROI
- **Circonf.:** The length of the ROI perimeter
- **Surface:** The surface covered by the ROI.

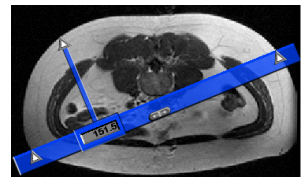
Ruler This instrument is a simple ruler, graduated in the units of the image.



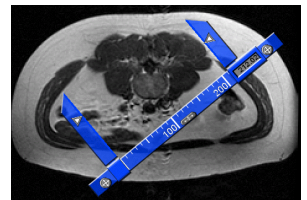
Protractor This instrument gives you the angle between 3 points.



Dist2Line This instrument measure the distance between a line (defined by 2 points) and a point.



Caliper This is another instrument to measure distances on the images.

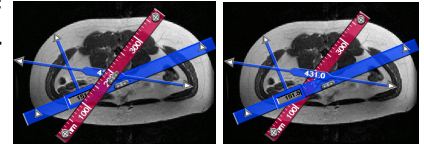


Active List Selecting an instrument from this single selection list will change the color of this instrument to red and its information will be displayed in the **Information box**,

Note

Only the buttons for the instruments in the current window will be activated.

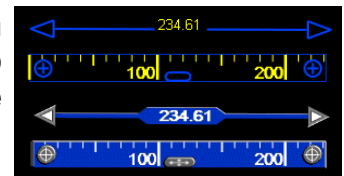
Top/Up/Down/Bottom The instrument are stacked in the order of their creation. You can change that order with these buttons.



Delete This button will cause the instrument selected by the Active List to be deleted. If no instrument is selected, this button will be disabled.

Save This button will write to a file the values associated with the instrument selected by the Active List. If no instrument is selected, this button will be disabled. The user is given the choice of saving as a script or saving the data associated with the tool in text form.

Small / 3D This setting affects the appearance of all instruments. In the “Small” mode, a simple line drawing is used to represent the instruments. In the 3D mode, a more detailed 3D look is given to the instruments.



Local / Global The instrument can be present either only on the image where it was created or on all the images of the group where it was created.

Information box The numerical values from the selected instrument will be displayed here.

4.2.3.2 From the Display area

When the tools are created, they will be at the base of the current image.

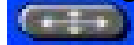
The tools can be directly manipulated in the Display Area by clicking and dragging one of their control points. There are two kinds of control points:

The anchor point



The anchor points icons are either an arrow or a circle with a cross. Moving these points will drag the part of the tool that is connected to it.

The drag point



The drag point icon is an oval with arrows. Dragging this point will move the complete tool.

4.2.3.3 From the Keyboard

There is no keyboard interface to this mode.

4.2.3.4 From the command line

The following commands can be used in the command line or in a script file:

Measurement: *t_measure write file_name*

Create a script file to re-create all the measurements matching the *t_measure* template.

Measurement: *t_measure data file_name*

Create a data file with all the measurements matching the *t_measure* template.

Measurement: *t_ima dist name a.x a.y b.x b.y*

Create distance measurement tool named "name" between points "a" and "b" on the image matching "t_ima".

Measurement: *t_ima dist2 name a.x a.y b.x b.y c.x c.y*

Create distance2line measurement tool named "name" between points "a", "b" and "c" on the image matching "t_ima".

Measurement: *t_ima ruler name a.x a.y b.x b.y*

Create ruler measurement tool named "name" between points "a" and "b" on the image matching "t_ima".

Measurement: *t_ima profile name a.x a.y b.x b.y*

Create profile measurement tool named "name" between points "a" and "b" on the image matching "t_ima".

Measurement: *t_ima angle name a.x a.y b.x b.y c.x c.y*

Create protractor measurement tool named "name" between points "a" "b" and "b" on the image matching "t_ima".

Measurement: *t_ima caliper name a.x a.y b.x b.y left.x left.y right.x right.y*
Create caliper measurement tool named "name" between points "a", "b", "left" and "right" on the image matching "t_ima".

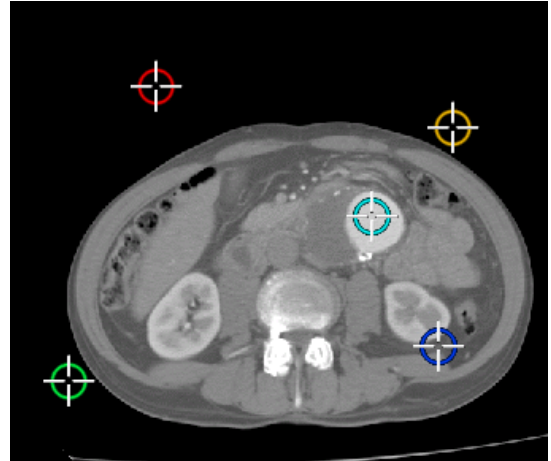
Measurement: *t_ima ROI name nb pt_1.x pt_1.y ... pt_n.x pt_n.y*
Create ROI measurement tool with "nb" points, "1" to "n", on the image matching "t_ima".

4.2.4 The 2D Registration Mode

This module is used to align a stack of 2D slices together.

The registration is done by aligning pairs of matching markers between slices using a least square fit method.

You can use up to 64 different markers per slice. Each marker is used to identify points that are at the same 2D position on different slices. The same markers do not have to be present on every slice; as long as a marker is present on more than 1 slice, it will be used in the registration. The program will analyze all the slices in each selected group and find all the pairs of matching markers on these slices and solve the registration equation for these pairs. The slice's alignment is computed in reference to the position of the first slice in the group.



Reference markers are only used if they are matched on at least one other slice. The number of matched markers necessary to align each slice vary with the desired registration constraints. For translation only, 1 marker is enough, for translation, scaling and rotation, you need at least 2 markers.

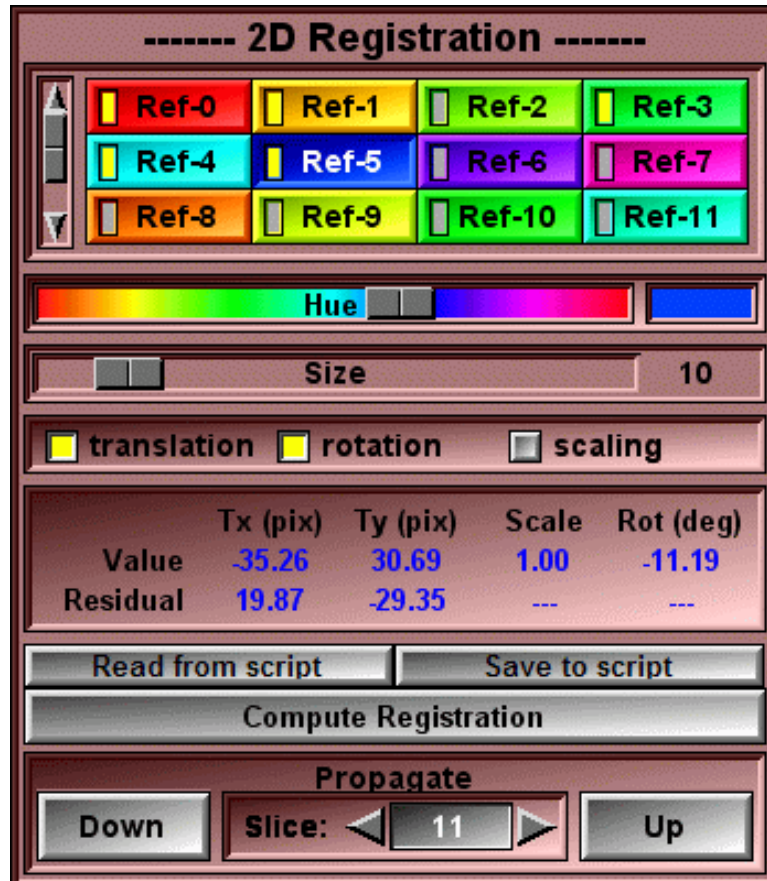
As an example, suppose a group of 3 slices: A, B and C. We place markers 1 and 2 on slice A, markers 1 and 3 on slice B and markers 1, 2, 3 and 4 on slice C. The number of matched points available are: two for slice A (1 and 2), two for slice B (1 and 3) and three for slice C (1, 2 and 3, 4 is unmatched).

Note

Having more matching markers will increase the precision of the results.

The results from the registration are used when computing 3D coordinates (such as the information in the Pixel Info Tool, the positions of the 3D points), and in the 3D modules either when displaying volumes or in computing geometries.

4.2.4.1 From the Graphic Interface



Marker Selection Select the current reference marker from the list of buttons. The light indicator will be on for all the markers defined on the current slice.

A right click on a button enables you to change the marker's label.



Hue Current registration marker color

Size Size of all the registration markers

Constraints The registration can translate, scale and rotate the images. With this tool you can let any of these parameters be affected by the registration.

Results The result of the registration will be displayed for each slice. The horizontal translation (Tx) and the vertical translation (Ty) as well as the scaling and rotation angles are displayed. The Tx and Ty residual for these values give an idea of the error from the least square computation.

Read from script Read a script file. This file should contain marker's description commands.

Save to script Save the marker's values to a script file.

```
# ----- #
# --- script file for markers * -- #
# --- created: 25 Feb 2005 17:22 -- #
# ----- #

# --- Create the markers for each slice. The syntax is:
# registration: id create file_name x y [num]
# - id is either the label or the index of the marker
# - file_name is the name of the file containing the slice
# - x y are the 2D coord (in pixels) of the point in the slice
# - num is the index of the slice in the file (if 3D file)

# --- slice: 1 -----
registration: 0 create "ct4" 372.00 192.00
registration: 2 create "ct4" 197.00 203.00

# --- Re-labelling the markers (if needed). The syntax is:
# registration: index label marker_label
# - index is the index of the marker (from 0 to 63)
# - marker_label is the new label of the marker
```

Sample marker script file

Compute registration Compute the image registration of all the slices in the currently selected groups using all the available pairs of points.

Propagate Copy all the markers from one slice to the next.

4.2.4.2 From the Display area

Markers can be added, dragged and removed from a slice with the mouse:

- The left mouse button is used to place the current marker on the slice.
- The right mouse button is used to remove the marker under the mouse from the slice.

4.2.4.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
<i>not mapped</i>	REGISTRATION-MARKER-INSERT REGISTRATION-MARKER-DELETE	Insert / delete a marker under the cursor
<i>not mapped</i>	REGISTRATION-ROTATION-ON REGISTRATION-ROTATION-OFF REGISTRATION-ROTATION-TOGGLE	
<i>not mapped</i>	REGISTRATION-SCALING-ON REGISTRATION-SCALING-OFF REGISTRATION-SCALING-TOGGLE	
<i>not mapped</i>	REGISTRATION-TRANSLATION-ON REGISTRATION-TRANSLATION-OFF REGISTRATION-TRANSLATION-TOGGLE	
<i>not mapped</i>	REGISTRATION-COMPUTE	Compute the registration

4.2.4.4 From the Command Line

The following commands can be used in the command line or in a script file:

Registration: compute

Compute the registration of all the currently selected slices

Registration: *id* create file_name x y [num]

Place a the marker identified by “id” at the position “x”, “y” (in pixels) on the slice “num” of the file “file_name”. “Num” is optional if there is only 1 slice in “file_name”.

Registration: *id* label marker_name

Assign the label “marker_name” to the marker identified by “id”.

Registration: mode (translation|scaling|rotation)

Select the current registration constraints.

Registration: size *dim* (5<dim<50)

Assign the size "dim" (in pixels) to all the markers.

Registration: *t_marker* color *R G B* (0<RGB<256)

Assign the color "RGB" to all markers matching "*t_marker*".

Registration: *t_marker* write *file_name*

Save all markers matching "*t_marker*" in the file "*file_name*".

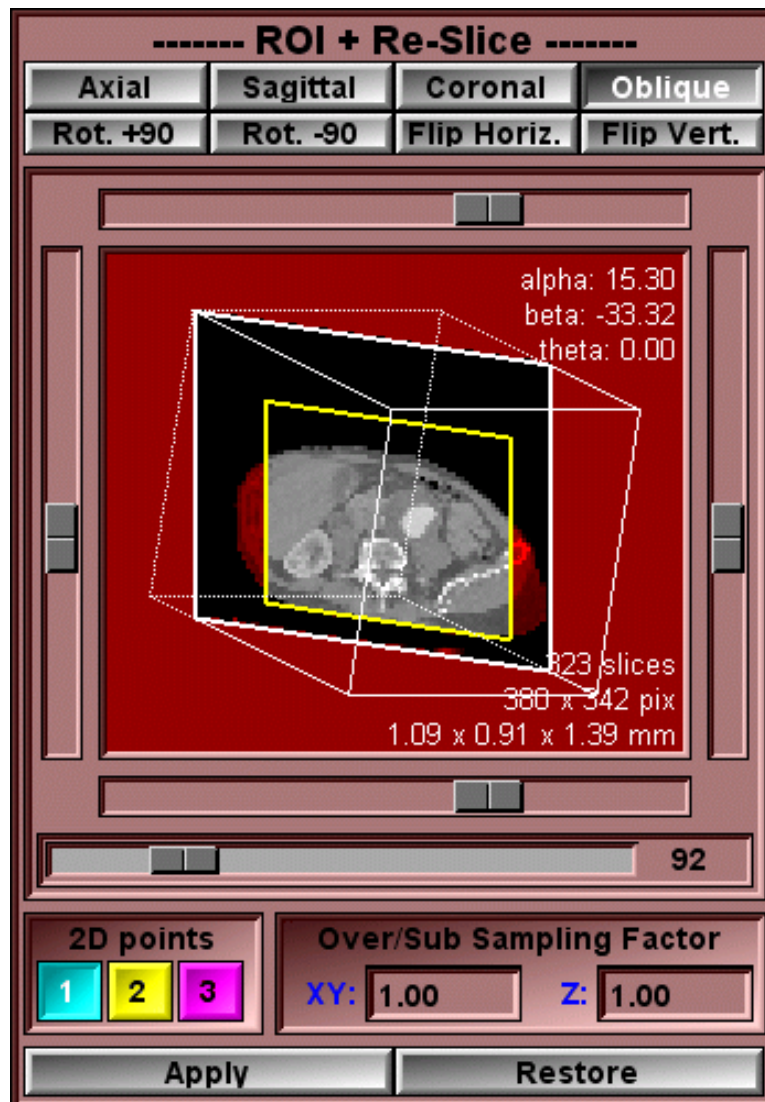
Note

id and *t_marker* are templates for the marker numbers or labels (*id* should only match 1 marker). See **Appendix C.8: The Templates**.

4.2.5 The ROI + Re-Slice Mode

If you have a 3D volume of data, you can re-slice the volume according to any of its main axes. Along with the re-slice operation, you can reduce the size of the images by selecting a "Region Of Interest" (ROI) in the volume.

4.2.5.1 From the Graphic Interface



Orientation Buttons (Axial, Sagittal, Coronal, Oblique)

These buttons select the re-slice axis. If the selected direction is not the original image's direction, the images are oriented so that the patient is:

- Seen from the feet with left side of the patient at the right side of the image for the **Axial** direction.
- Seen from the left side with the patient head toward the top of the image for the **Sagittal** direction.
- Seen from the front with the patient head toward the top of the image for the **Coronal** direction.
- The **Oblique** direction is determined by 3 angles. These angles can be set by the interface or the commands.

Image Flip Buttons (Rot.+90, Rot.-90, Flip Horiz., Flip Vert.)

You can rotate or flip the images with these buttons.

ROI sliders & Preview Window

This window is a preview of the ROI + Re-Slice operation. The left, right, top and bottom sliders control clip planes. They will control horizontal and vertical portions of the image that will be eliminated. You can also limit the number of slices in the ROI by adjusting these sliders in one of the other views (axial, sagittal or coronal).

The slider at the bottom of the preview window enables you to view all the images from the volume. The red bands on the left and right of this slider's range represent the images that will be removed from the ROI.

2D Points

2D points can be used to specify the 3D orientation of the oblique re-slice plane. Select the point you want to place, and use the mouse to place it on a slice in the axial, sagittal or coronal direction.

Over/Sub Sampling Factor

Slices created in the oblique plane can be over or sub sampled. The sampling can be specified in the x-y plane (the plane of the re-slice images) or the z direction (the direction orthogonal to the re-slice image's plane).



Restore Original Slices

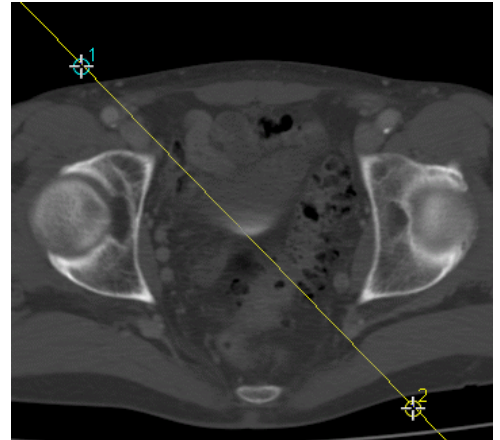
You can restore the original data-set with this button.

Apply

This button activates the re-slice operation. All the current images will be replaced by the re-sliced images.

4.2.5.2 From the Display area

In the oblique mode, you can place up to 3 points in the slices on the display area to define the oblique re-slice plane. If you only place the point “1”, then the rotation applied through the mode’s interface will rotate the re-slice point around that point. If you place all 3 points, the oblique angles will be computed so that the re-slice plane will be the plane that goes through these 3 points.



4.2.5.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
F9	DIR-AXIAL	Re-slice in the Axial direction
F10	DIR-SAGITTAL	Re-slice in the Sagittal direction
F11	DIR-CORONAL	Re-slice in the Coronal direction
F12	DIR-OBLIQUE	Re-slice in the Oblique direction

4.2.5.4 From the command line

The following commands can be used in the command line or in a script file:

roi: [t_group] clip (h|v|d) min max

Set the current clip values for the horizontal, vertical and “depth” directions.

roi: [t_group] rot (right|left)

Add a 90 degrees toward the right or the left to the current image flip matrix.

roi: [t_group] flip (horiz|vert)

Add a flip around a vertical or horizontal axis to the current image flip matrix.

roi: [t_group] dir (axial|sagittal|coronal|oblique)

Set the current orientation.

roi: [t_group] oblique alpha beta [theta]

Set the oblique orientation’s angles.

roi: [*t_group*] compute

Compute the new images using the current orientation, image flip and clip planes.

roi: [*t_group*] restore

Reset the images to their original orientation.

Note

"*t_group*" is a template for the group number. If "*t_group*" is not present, the operation is applied to the currently selected group. See **Appendix C.8: The Templates**.

5 The TAG Module

The TAG Module regroups the functions that are necessary to segment and label tissues in the images and compute anatomical volumes.

License

Without the TAG Module License, a watermark will be displayed in the display windows and the following will be disabled:

- The “**Script TAG Files**” button in the File Menu.
- The “**Write results files**” button in the surface/volume tool.
- The results values will be masked by “xxx” in the surface/volume tool.

5.1 The TAG Tools

There are only a few tools specific to the TAG Module. However, some of the functions in the Basic Module’s tools only make sense when used with Tag Images. These are the Mix, Over and Tag buttons in the Color Scheme Tool and the Tag information box in the Pixel Info Tool. For more information on these, please refer to **Section 4.1: The Basic Tools**.

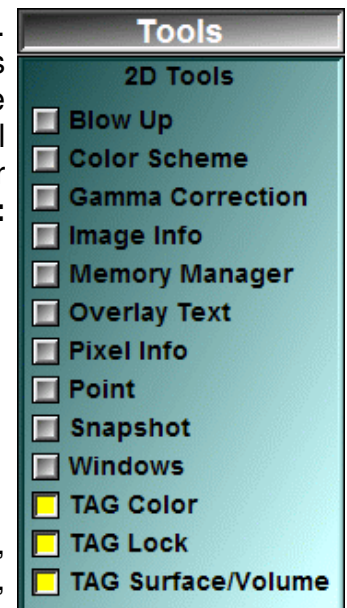
The tools that are specific to the TAG module are:

- The TAG Color tool
- The TAG Lock tool
- The TAG Surface/Volume tool.

For each of the Tag Tools, we will present the tool, describe the layout and function of its graphical interface, the display area manipulations that can influence the tool, the key shortcuts available for this tool as well as the command line and variables that are related to the tool.

You can find a more detailed description of the key shortcuts, their use and their syntax in: **Appendix A: The Keyboard Shortcuts**

A complete description of the command line syntax and its variables is presented in **Appendix C: The Command Line Syntax**



5.1.1 The Tag Color Tool

The Tag Color tool is used to change the color associated with a Tag value.

5.1.1.1 From the Graphical Interface



Tag List Select a tag from the list.

Color Editor You can modify the color associated with the current Tag value with the 3 sliders. The resulting color is displayed in the box beside the sliders. In the **RGB** mode, the sliders control the Red, Green and Blue components of the color. In the **HLS** mode, the sliders control the Hue, Light and Saturation of the color.



5.1.1.2 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
.	TAG-GRAB	Select the color under the cursor as the current Tag value.
"0" to "9"	TAG-0 to TAG-9	Set the current Tag value.

5.1.1.3 From the Command Line

You can use either a script file or the command line to enter the following commands:

Tag: *t_tag* color *R G B*

Change the color of the tag(s) identified by the template "*t_tag*" to the color specified. The R,G,B component must have values between 0 and 255.

The following variables can also be used in script commands:

\$TAG_MAX	(Read / Write, integer)
\$TAG_CUR	(Read / Write, integer)
\$TAG_CUR_COLOR	(Read / Write, RGB array)
\$TAG_ALL	(Read Only, array of integers)

Note

"*t_tag*" is a template that can match one or multiples tags (either their numbers or labels). See **Appendix C.8: The Templates**.

5.1.2 The Tag Lock Tool

The TAG Lock tool is used to protect the results of your segmentation, enabling you to concentrate on segmenting a new tissue without fear of affecting the work already done.

By simply selecting the desired tags from the interface, you can lock them so that they will not be modified by any further operations. The corresponding tag buttons in the mode interfaces will be disabled.

5.1.2.1 From the Graphical Interface



Tag List Select a tag from the list to lock it.

Lock All Lock all the tags.

Unlock All Unlock all the tags

5.1.2.2 From the Display area

There is no display area interaction with this tool.

5.1.2.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>key map</i>	<i>command name</i>	<i>Action</i>
<i>not mapped</i>	TAG_LOCK-CURSOR TAG_UNLOCK-CURSOR TAG_TOGGLE-CURSOR	Lock / Unlock the Tag value under the cursor
<i>not mapped</i>	TAG-LOCK-1 to -4 TAG-UNLOCK-1 to -4 TAG-TOGGLE-1 to -4	Lock / Unlock the Tag 1 to 4

5.1.2.4 From the Command Line

You can use either a script file or the command line to enter the following commands:

Lock: *t_tag* (lock|unlock|toggle)

Lock, unlock or toggle the lock value for all tags matching *t_tag*

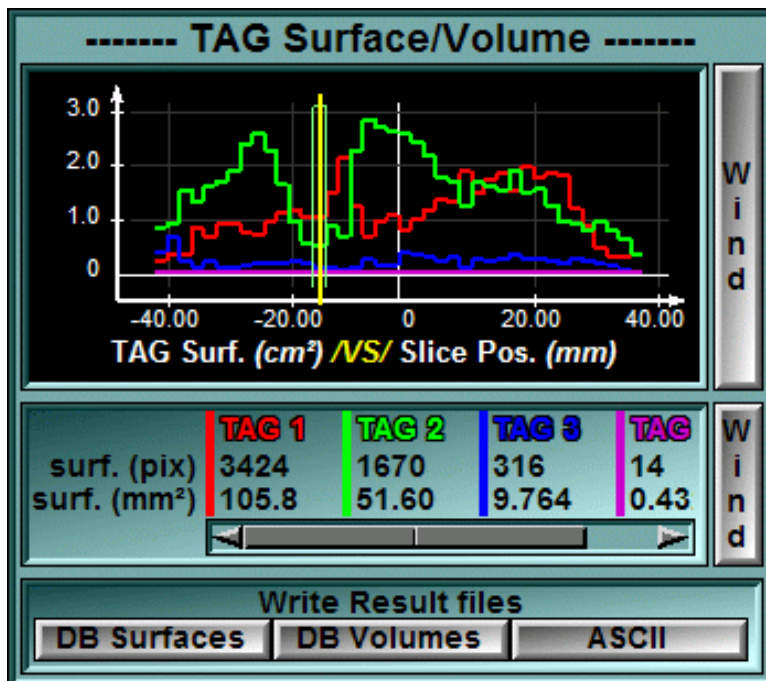
Note

“*t_tag*” is a template that can match one or multiples tags (either their numbers or labels). See **Appendix C.8: The Templates**.

5.1.3 The Tag Surfaces and Volumes Tool

In this tool, you can compute the surface and volume of the Tag images for the selected slices in the current group. These results are displayed in a graph and can be written to 3 different files: a surface database file, a volume database file or an ASCII text file.

5.1.3.1 From the Graphical Interface

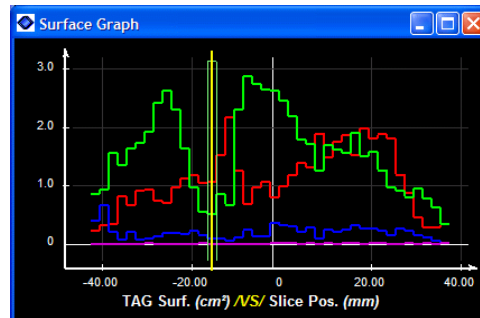


Graph Area

This is a graph of the images' Tag surfaces vs. their "t" position. Also, in **Mode One**, the current image is highlighted by a vertical bar running through its "t" position on the graph and a green box corresponding to the image thickness. A double click in this region will have the same effect as clicking on the "Wind" button.

Wind

Clicking this button will cause a separate window containing the graph area to be created. Only one such window can exist at any time, clicking this button while the window is already created will pop the associated window on top of the other windows.



Note

“t” is the direction orthogonal to the image plane. For axial images, t = Z, for sagittal images, t = X, for coronal images, t = Y.

Surface/Volume This window is used to display the results of the computations. Depending on the Display Mode, the results shown will be:

- Mode **One**: The surface covered by the pixels of each Tag value for the current image (in pixels and in cm²), the mean, minimum, maximum and variance of the GLI values of the pixels under each Tag value.
- Mode **All**: The total volume created by each Tag value (in cm³) and the mean, minimum, maximum and variance of the GLI values of the pixels under each Tag value.

A double click in this region will have the same effect as clicking on the “Wind” button.

Wind

Clicking this button will cause a separate window containing the surface/volume results to be create. Only one such window can exist at any time, clicking this button while the window is already created will pop the associated window on top of the other windows.

	TAG 1	TAG 2	TAG 3	TAG 4
surf. (pix)	3424	1670	316	14
surf. (mm ²)	105.8	51.60	9.764	0.4326
mean	0.01	0.02	0.03	0.04
min	0.01	0.02	0.03	0.04
max	0.02	0.03	0.04	0.05
variance	0.00	0.00	0.00	0.00

DB Surfaces

This will cause a ".srf" results file to be created. This file will give the results from the surfaces' computation in a tabulated format that can be easily imported into a database program. By default this file will only contain the surface values for each Tag. If you also want to change the default surface units, or to export values such as surfaces in pixels, or statistics on the GLI values under the Tags, you must specify these in the Preferences window (c.f. **section 9: The sliceOconfig Program**). A sample “.sur” file is given further down in this section.

DB Volumes

This will cause a ".vol" results file to be created. This file will give the results from the volume computation in a tabulated format that can be easily imported into a database program. As with the “DB Surfaces” file, you can change the default units and content of this file through the Preferences window.

ASCII

This will cause a ".res" results file to be created. This file contains a comprehensive report of the surface area and volume computations. A sample “.sur” file is given further down in this section.

The Surface Area Computation

The surface area covered by a Tag value is computed by multiplying the number of pixels of that value by the surface area of one pixel.

The Volume Computation

Computing the volume of a Tag value for one image is fairly simple. We compute the surface area covered by the Tag value and multiply by the image thickness. For multiple images, a problem arises if the images overlap or if there are gaps between them.

Note

If the images are not sorted according to their "t" values, the program will be unable to compute the volumes. (C,f, **Section 4.2.1: The Admin Mode** for more information on sorting the images)

Using the notation:

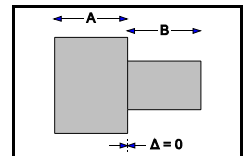
- Z_A = position in Z of the image A
 - N_A = number of pixels of a certain Tag value in image A
 - P_A = surface of a pixel in image A
 - S_A = surface covered by a Tag value on the image A ($= N_A P_A$)
 - T_A = thickness of image A
 - Δ_{AB} = gap or overlap between the two images A and B
 - V_{AB} = volume of a Tag value between the two images A and B
- The gap Δ between two images A and B is computed as follows:

$$\Delta_{AB} = \text{ABS}(Z_A - Z_B) - (1/2T_A + 1/2T_B)$$

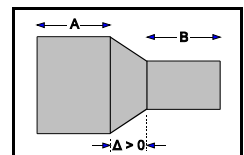
Depending on the value of Δ , there are 3 possibilities when computing the volume between 2 images:

$\Delta = 0$ There is no gap, and the computation of the volume of the Tag value between A and B is straightforward:

$$V_{AB} = 1/2T_A S_A + 1/2T_B S_B$$

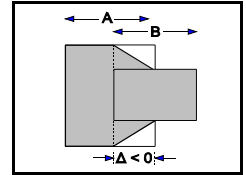


$\Delta > 0$ There is a gap between the slices and we have to interpolate the volume in the gap. This volume will be approximated by a truncated pyramid joining the volumes of both slices.



$$V_{AB} = \frac{1}{2}T_A S_A + \frac{1}{2}T_B S_B + \Delta_{AB} (\frac{1}{3} ABS(S_A - S_B) + \text{MIN}(S_A, S_B))$$

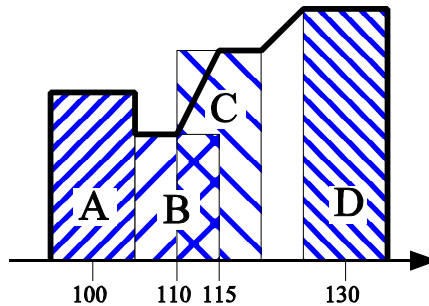
$\Delta < 0$ The images overlap and we have to compute the volume in this overlap region. The volume in the region without overlap is computed as before, and in the overlap we will again use the truncated pyramid.



$$V_{AB} = (\frac{1}{2}T_A + \frac{1}{2}\Delta_{AB}) S_A + (\frac{1}{2}T_B + \frac{1}{2}\Delta_{AB}) S_B - \Delta_{AB} (\frac{1}{3} ABS(S_A - S_B) + \text{MIN}(S_A, S_B))$$

Example 1:

We will compute the volume of the Tag value 1 for 4 images:



All slices are 10.0 mm thick	(T_A to $T_D = 10.0$)
All pixels are 0.25 mm ²	(P_A to $P_D = 0.25$)
Image A: has 400 pixels of Tag value 1 is positioned at Z = 100.0	($N_A = 400$) ($Z_A = 100.0$)
image B: has 300 pixels of Tag value 1 is positioned at Z = 110.0	($N_B = 300$) ($Z_B = 110.0$)
image C: has 500 pixels of Tag value 1 is positioned at Z = 115.0	($N_C = 500$) ($Z_C = 115.0$)
image D: has 600 pixels of Tag value 1 is positioned at Z = 130.0	($N_D = 600$) ($Z_D = 130.0$)

First, we compute the surface area covered by the Tag value 1 for the 4 images:

$$\begin{aligned}
 S_A &= N_A P_A = 400 * 0.25 = 100 \text{ mm}^2 \\
 S_B &= N_B P_B = 300 * 0.25 = 75 \text{ mm}^2 \\
 S_C &= N_C P_C = 500 * 0.25 = 125 \text{ mm}^2 \\
 S_D &= N_D P_D = 600 * 0.25 = 150 \text{ mm}^2
 \end{aligned}$$

Then we compute the volume covered by the Tag value 1. This computation is divided in 5 steps:

- **Half the volume of image A:** (from Z=95 to Z=100)

$$\begin{aligned}
 V_A &= \frac{1}{2} T_A S_A \\
 &= \frac{1}{2} 10.0 * 100 \\
 &= 500 \text{ mm}^3
 \end{aligned}$$

- **The volume between A and B:** (from Z=100 to Z=110)

the value of Δ is:

$$\begin{aligned}
 \Delta_{AB} &= \text{ABS}(Z_A - Z_B) - (\frac{1}{2} T_A + \frac{1}{2} T_B) \\
 &= \text{ABS}(100 - 110) - (\frac{1}{2} * 10 + \frac{1}{2} * 10) \\
 &= 0 \text{ mm}
 \end{aligned}$$

there is no gap! The volume is:

$$\begin{aligned}
 V_{AB} &= (\frac{1}{2} T_A S_A) + (\frac{1}{2} T_B S_B) \\
 &= (\frac{1}{2} 10.0 * 100) + (\frac{1}{2} 10.0 * 75) \\
 &= 875 \text{ mm}^3
 \end{aligned}$$

- **The volume between B and C:** (from Z=110 to Z=115)

the value of Δ is:

$$\begin{aligned}
 \Delta_{BC} &= \text{ABS}(Z_B - Z_C) - (\frac{1}{2} T_B + \frac{1}{2} T_C) \\
 &= \text{ABS}(110 - 115) - (\frac{1}{2} 10 + \frac{1}{2} 10) \\
 &= -5 \text{ mm}
 \end{aligned}$$

the images overlap by 5 mm! The volume is:

$$\begin{aligned}
 V_{BC} &= (\frac{1}{2} T_B + \frac{1}{2} \Delta_{BC}) S_B + (\frac{1}{2} T_C + \frac{1}{2} \Delta_{BC}) S_C \\
 &\quad - \Delta_{BC} (\frac{1}{3} \text{ABS}(S_B - S_C) + \text{MIN}(S_B, S_C)) \\
 &= ((\frac{1}{2} * 10.0 + \frac{1}{2} * -5) * 75) + ((\frac{1}{2} * 10.0 + \frac{1}{2} * -5) * 125) \\
 &\quad - -5 * (\frac{1}{3} \text{ABS}(75 - 125) + \text{MIN}(75, 125)) \\
 &= 187.5 + 312.5 - -5 * (\frac{1}{3} * 50 + 75) \\
 &= 958.33 \text{ mm}^3
 \end{aligned}$$

- **The volume between C and D:** (from Z=115 to Z=130)

the value of Δ is:

$$\begin{aligned}
 \Delta_{CD} &= \text{ABS}(Z_C - Z_D) - (\frac{1}{2} T_C + \frac{1}{2} T_D) \\
 &= \text{ABS}(115 - 130) - (\frac{1}{2} 10 + \frac{1}{2} 10) \\
 &= 5 \text{ mm}
 \end{aligned}$$

There is a 5 mm gap! The volume is:

$$V_{CD} = \frac{1}{2} T_C S_C + \frac{1}{2} T_D S_D + \Delta_{CD} (\frac{1}{3} \text{ABS}(S_C - S_D) + \text{MIN}(S_C, S_D))$$

$$\begin{aligned} &= (\frac{1}{2} 10.0 * 125) + (\frac{1}{2} 10.0 * 150) \\ &\quad + 5 * (\frac{1}{3} \text{ABS}(125 - 150) + \text{MIN}(125, 150)) \\ &= 625 + 750 + 5 * (\frac{1}{3} 25 + 125) \\ &= 2041.66 \text{ mm}^3 \end{aligned}$$

- **Half the volume of image D:** (from Z=130 to Z=135)

$$\begin{aligned} V_D &= \frac{1}{2} T_D S_D \\ &= \frac{1}{2} 10.0 * 150 \\ &= 750 \text{ mm}^3 \end{aligned}$$

The total volume is:

$$\begin{aligned} V &= V_A + V_{AB} + V_{BC} + V_{CD} + V_D \\ &= 500 + 875 + 958.33 + 2041.66 + 750 \\ &= 5125 \text{ mm}^3 \end{aligned}$$

5.1.3.2 From the Display area

There is no display area interaction with this tool.

5.1.3.3 From the Keyboard

There is no keyboard interface to this tool.

5.1.3.4 From the command line

There is no command line or variables associated to this tool.

```

* ----- *
* --- result file for                db_all          -- *
* --- created: 05 Nov 1999 00:02          -- *
* ----- *

--- image[1]: Anonymous_17.1 ----- (pos=79.90) (Thickness=5.00) -----
TAG 2:  8808 pix, 309.66 cm2 (min:0 max:599 mean:132.27 var:72.849)
TAG 3:  6475 pix, 227.64 cm2 (min:0 max:525 mean:7.41  var:23.765)
TAG 4:  3718 pix, 130.71 cm2 (min:0 max:565 mean:82.72  var:96.950)

--- image[2]: Anonymous_17.2 ----- (pos=86.90) (Thickness=5.00) -----
TAG 2:  7386 pix, 259.66 cm2 (min:0 max:566 mean:135.47 var:59.639)
TAG 3:  8572 pix, 301.36 cm2 (min:0 max:584 mean:64.51  var:93.168)
TAG 4:  2896 pix, 101.81 cm2 (min:0 max:418 mean:56.72  var:86.642)

--- image[4]: Anonymous_17.4 ----- (pos=100.90) (Thickness=5.00) ---
TAG 2:  7096 pix, 249.47 cm2 (min:0 max:468 mean:120.47 var:63.770)
TAG 3:  7306 pix, 256.85 cm2 (min:0 max:532 mean:63.78  var:82.042)
TAG 4:  3710 pix, 130.43 cm2 (min:0 max:518 mean:39.87  var:69.789)

...

---- Volumes for selected slices: 1 2 4 5 6 7 8 9 ----
TAG 1:    744.54 cm3
TAG 2:   1280.76 cm3
TAG 3:   1518.62 cm3
TAG 4:    823.31 cm3

note: 1 slices (out of 9) was unselected

```

Example of ".res" file

```

TAG surfaces (in cm2) for each selected slices
slice name  slice number      TAG 1 TAG 2 TAG 3 TAG 4 TAG 5 ...
Anonymous_17.1  1  0  309.66    227.64    130.71    0    0
Anonymous_17.2  2  0  259.66    301.36    101.81    0    0
Anonymous_17.4  4  0  249.47    256.85    130.43    0    0
Anonymous_17.5  5 751.82    0    275.91    148.75    0    0
Anonymous_17.6  6 383.41    0    239.24    130.25    0    0
Anonymous_17.7  7  0  380.14    272.18    158.03    0    0
Anonymous_17.8  8  0  227.53    199.30    146.43    0    0
Anonymous_17.9  9  0  276.50    199.69    168.57    0    0

note: 1 slices (out of 9) was unselected

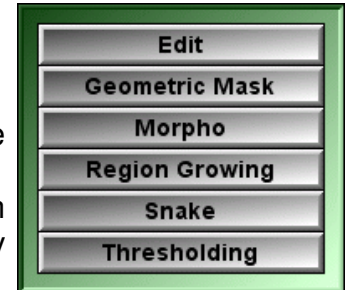
```

Example of ".srf" file

5.2 The TAG Modes

There are 6 modes associated with the TAG Modules:

- The **Edit** mode is used to manually paint the Tags.
- The **Geometric Mask** mode enables you to use geometrical shapes to create / modify the Tag values.
- The **Morpho** mode is used to segment your images with the help of the “Watershed” mathematical morphology operator.
- The **Region Growing** mode enables you to grow segmented regions from seed points.
- The **Snake** mode is used to create Tag regions with the “active contours” or “snake” technique.
- The **Thresholding** mode enables you to segment you data with up to 4 interactive thresholds.



For each of the TAG modes, we will present the mode, describe the layout and function of its graphical interface, the display area manipulations that are possible in this mode, the key shortcuts available for this mode as well as the command line and variables that are related to the mode.

You can find a more detailed description of the key shortcuts, their use and their syntax in: **Appendix A: The Keyboard Shortcuts**.

A complete description of the command line syntax and its variables is presented in **Appendix C: The Command Line Syntax**

5.2.0.1 The Common interface tools

In almost all the TAG mode’s interface, you will find the following tools:

Brush

By clicking on one of the 6 brush buttons, you will select the brush used in the Display Area. The color displayed in the brush buttons is the color of the current Tag value. The shape of the brush will appear as a yellow outline around the cursor when the cursor is in the Display Area. Keys "F5" to "F8" can also be used to select one of the 4 first brushes. The default brush sizes can be changed with the \$BRUSH_RADIUS variable.



TAG Value

To select the current Tag value, click the corresponding button. The first 10 Tag values (None, 1 to 9) can also be selected with the number keys "0" to "9" on the keyboard. You can access the higher tag values with the slider on the left side of the Tag buttons.



You can change the label of the buttons either by right clicking on it, or with the "TAG: label" keyword in the script file (c.f. **Appendix C: The Command Line Syntax**)



5.2.0.2 From the Display area

In almost all TAG modes, the following keyboard interface shortcuts can be used when the mouse is over an image:

TAG-GRAB to "grab" the Tag value under the cursor and make it the current Tag value.

FLOOD_ (2D, 3D and **CONSTRAINED**) to flood the region under the cursor.

5.2.0.3 The common keyboard interface

The following keyboard shortcuts can be used in most of the TAG modes:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
keypad "."	TAG-GRAB	Select the color under the cursor as the current Tag value.
Pad-Enter	FLOOD-2D	Flood-fill a region with the current Tag value.
Shift-Pad-Enter	FLOOD-3D	
Ctrl-Pad-Enter	FLOOD-CONSTRAINED	
"0" to "9"	TAG-0 to TAG-9	Set the current Tag value to your choice of "0" to "9".
F5 to F8	BRUSH-1 to BRUSH-4	Select brushes #1 to #4.
<i>not mapped</i>	BRUSH-5 to BRUSH-6	Select brushes #5 to #6

Note

The different flood-fills are:

- 2D All the pixels adjacent to the pixel under the cursor and having the same Tag color will be filled by the current Tag value.
- 3D The flood will also propagate from slice to slice within the same group
- CONSTRAINED Like the FLOOD_2D, but the flood is constrained by the current brush size. It will not flow out through branches that are smaller than the brush.

5.2.0.4 From the Command Line

Some commands are common to most TAG modes:

Tag: *t_tag* delete

Delete all occurrences of the specified tags in all the selected images.

Tag: *t_tag* color *R G B*

Change the color of the tag identified by “tag_num” to the color specified. The R,G,B component must have values between 0 and 255.

Tag: *t_tag* label *abbreviation* [*long_name*]

Use the labels to identify the tags in the interface and in the result files.

The abbreviation will be used in the interface of the “Edit”, “Morpho”, “Surface/Volume” and “Shell” modes. It should be limited to 7 characters.

The *long_name* argument is optional, it is a longer name that will be used instead of the Tag number in the 3 output files of the Surface and Volume Computation tool. Otherwise, the ID will be used if present. By default, the label “TAG x”, where x is the Tag number, will be used.

Note

“*t_tag*” is a template that can match one or multiples tags (either their numbers or labels). See **Appendix C.8: The Templates**.

The following variables can also be used in script commands:

\$BRUSH_MAX

(Read Only, integer)

\$BRUSH_CUR	(Read / Write, integer)
\$BRUSH_ALL	(Read Only, array of integers)
\$BRUSH_RADIUS_MAX	(Read Only, integer)
\$BRUSH_RADIUS_CUR	(Read / Write, integer)
\$BRUSH_RADIUS_ALL	(Read Only, array of integers)
\$TAG_MAX	(Read / Write, integer)
\$TAG_CUR	(Read / Write, integer)
\$TAG_CUR_COLOR	(Read / Write, RGB array)
\$TAG_ALL	(Read Only, array of integers)

5.2.1 The Edit Mode

In this mode you can edit the TAG images. To edit the image you must choose a current Tag value and a brush. Then you use the mouse to paint the current Tag value on the image in the Display area. The first modification you do on an image will automatically load the image in a "save" buffer which is used when you "erase".

5.2.1.1 From the Graphical Interface



Brush Select the brush used to paint in the Display Area.

TAG Value Select the current Tag value.

Open 1 / Open 2 This operation is useful for reducing noise in the image. Any small regions (≈ 2 pixels across for open 1 and 4 pixels across for open 2) will be erased.

Close 1 / Close 2 This operation is useful for eliminating small holes in the image. Any small regions (≈ 2 pixels across for close 1 and 4 pixels across for close 2) will be filled.

Erosion Shrink the TAG image one pixel in all directions.

Dilatation Expand the TAG image one pixel in all directions.

Load Manually load the image in the restore buffer. See **Section 2.2.2: The Undo/Redo and the Load/Restore operations** for more information on the Load and Erase functions.

Undo Undo last brush stroke. It is a shortcut to the “Undo” button of the **Uno/Redo Menu**. It can only undo “edit” operations.

5.2.1.2 From the Display area

In addition to the keyboard shortcuts seen in section 5.2.0.2, the mouse controls associated with this mode are:

<i>Mouse button</i>	<i>Function</i>
Left	Apply paint.
Right	Erase your modifications.
Middle	Increase the brush to a big square, allowing to paint or erase a block a time.
Middle + Left	Paint a big square.
Middle + Right	Erase a big square.

5.2.1.3 From the Keyboard

The keyboard shortcuts described in section 5.2.0.3 can be used in this mode.

5.2.1.4 From the Command Line

The following commands can be used in the command line or in a script file:

Edit: *t_ima* erosion

Edit: *t_ima* dilatation

Compute erosion and dilatation operation on the TAG images.

Edit: *t_ima* open size

Edit: *t_ima* close size

Compute opening and closing operation on the TAG images. “Size” controls the size of the features that are affected by the operation.

Note

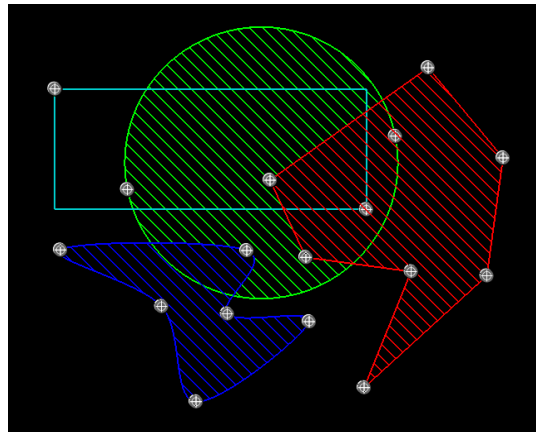
“*t_ima*” is a template that can match one or multiples images. See Appendix **C.8: The Templates**.

5.2.2 The Geometric Mask Mode

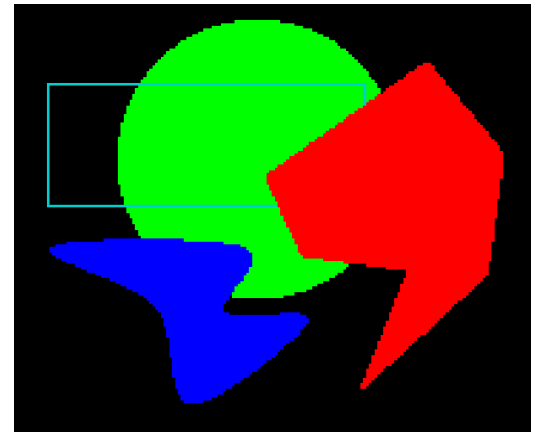
In this mode you can stamp geometrical shapes in the TAG images.

You can use these masks to compute values inside a Region Of Interest. You create the ROI shape with a large enough associated value, and “Add” the mask to the TAG image. All the tag values under the ROI will be incremented by the associated value, and the results from the Surface/Volume computation can now be extracted for only those new tag values

If used in conjunction with the “TAG Lock” tool, you can use this mode to create protected regions in the TAG images.

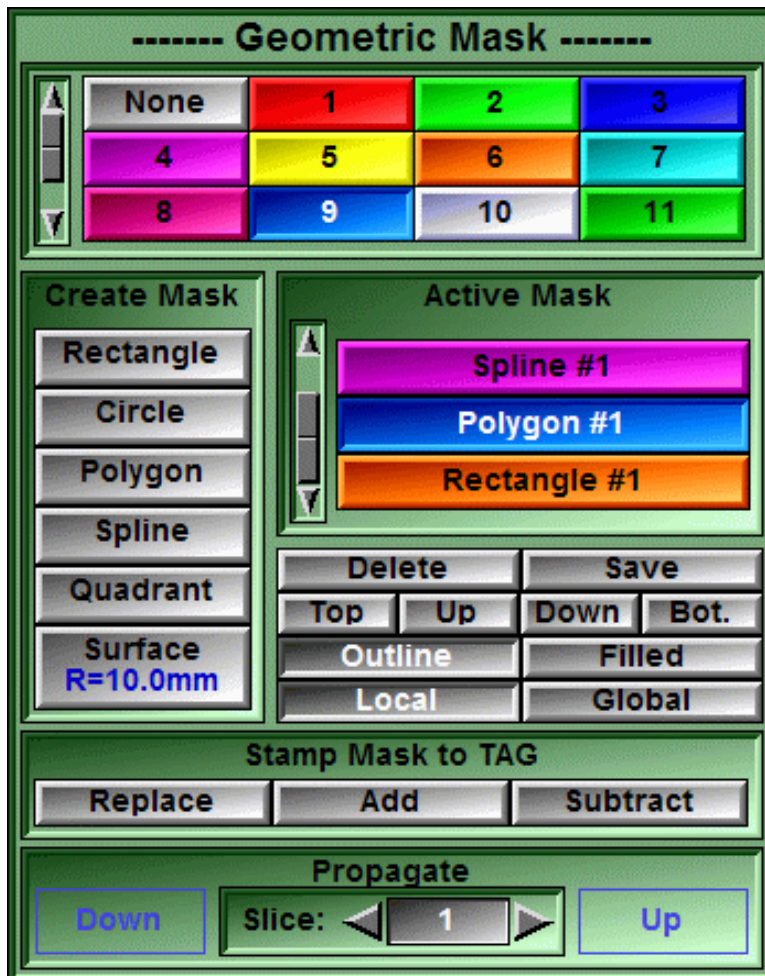


Geometrical masks



Result of the “Stamp: Replace” operation

5.2.2.1 From the Graphical Interface



TAG Value

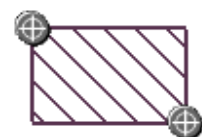
Each mask has a tag value associated with it. You can select this tag value by clicking on the appropriate button before creating the mask, or you can select a mask from the Active Mask List and click on the Tag value's button you want to associate with it.


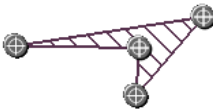
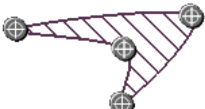
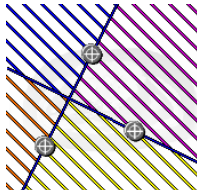
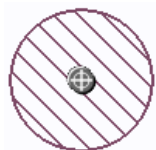
Create Mask List

Select the shape of the mask you want to create. Clicking on one of the buttons in the list will create the mask in the current image. You can then edit this mask with the mouse. You have a choice of 4 basic mask shapes:

Rectangle

The "rectangle" shape is defined by its 2 corner points.



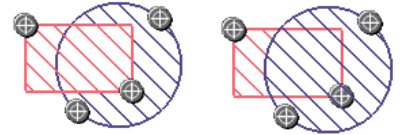
- Circle** The “circle” shape is defined by 2 points on the circumference. 
- Polygon** The “polygon” shape is defined by its vertex. You can add a vertex by clicking in an edge of the shape. You can remove a vertex by placing the cursor over it and pressing the “del” key . 
- Spline** The “spline” used is a Catmull-Rom spline. It has the characteristics of going through every one of its control points. You can add control points by clicking on the border of the shape at the location where you want to insert the new point. You can remove a control point by placing the cursor over it and pressing the “del” key . 
- Quadrant** The “Quadrant” split the image in 4 quadrants. These are defined by a line controlled by 2 points, and another line, perpendicular to the first, passing through a third point. The upper left corner of the image always reside in the first quadrant. In the “filled” mode, the first quadrant will be of the mask’s tag value, the second quadrant of tag+1, etc. 
- Surface** The “surface” shape is a circle of fixed radius. You can set the desired radius by right clicking on the surface button and typing the new value. The surface’s radius must be set before the surface is created. 
- Active Mask List** All the masks that are active for the current image will be displayed in this list. You can select one of these masks by clicking on its button. A number of operations can be done on the selected mask.
- Delete** Delete the selected mask
- Save** Write the information necessary to re-create the selected mask in a script file.

```
# ----- #
# --- geom mask file for           Circle #1      -- #
# --- created: 25 Feb 2005 21:01      -- #
# ----- #

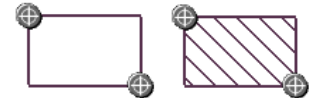
geom_mask: "Circle #1" create circle  25 30 42 36
geom_mask: "Circle #1" tag 3
geom_mask: "Circle #1" global
geom_mask: "Circle #1" filled
```

Sample geom mask script file

Top/Up/Down/Bottom The masks are stacked in the order of their creation. You can change that order with these buttons. The order is important: if you stamp the mask to the TAG images with the Replace option, the mask on top will overwrite all other values.



Outline/Filled The mask can be either just an outline or a filled shape. An outline shape will be an uninterrupted 1 pixel wide line around the shape.



Local/Global The mask can be present either only on the image where it was created or on all the images of the group where it was created.

Stamp Mask to TAG Use the geometrical shape of the masks to “stamp” the tag values. There are 3 sub modes to the stamping:

Replace The tag values under the mask are replaced by the tag value associated with the mask.

Add The tag values associated with the masks are added to the tag values of the TAG image.

Subtract The tag values associated with the masks are subtracted from the tag values of the TAG image.

Note

The tag values are limited to the range 0 to TAG_MAX. The Add and Subtract operation will not cause the tag values to go beyond this range.

Propagate Copy all local masks from one slice to the next. This operation will not affect global masks, since they are already present on all slices.

5.2.2.2 From the Display area

The keyboard shortcuts described in section 5.2.0.2 can be used in this mode.

Also, when a new mask is created, it will be placed in its default position on the current image. You can edit this shape by dragging its control points. You can also add control points to the polygon and spline shape by clicking on the border of the shape at the location where you want to insert the new point. You can remove a control point by placing the cursor over it and pressing the “del” key .

5.2.2.2 From the Keyboard

The keyboard shortcuts described in section 5.2.0.3 can be used in this mode.

5.2.2.3 From the command line

The following commands can be used in the command line or in a script file:

Mask: *name* create rectangle *x1 y1 x2 y2*

Mask: *name* create circle *x1 y1 x2 y2*

Mask: *name* create polygon *n x1 y1 ... xn yn*

Mask: *name* create spline *n x1 y1 ... xn yn*

Mask: *name* create surface *x1 y1 radius*

Create a new mask, named “name” and defined by it’s coordinates x,y. There is 2 sets of x,y for rectangles and circles and “n” for the polygon and the spline.

Mask: *t_mask* tag *tag_num*

Assign the value “tag_num” to the mask matching the *t_mask* template.

Mask: *t_mask* mode [*global|local|outline|filled*]

Change the mode of the mask matching the *t_mask* template.

Mask: *t_mask* delete

Delete the mask matching the *t_mask* template.

Mask: stamp (*replace|add|subtract*)

Stamp all the masks to the Tag image using the specified 3 stamp mode.

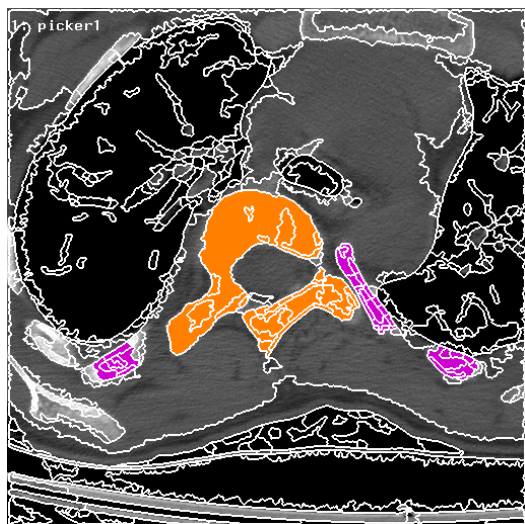
Note

“*t_mask*” is a template that can match one or multiples geometrical masks. See **Appendix C.8: The Templates.**

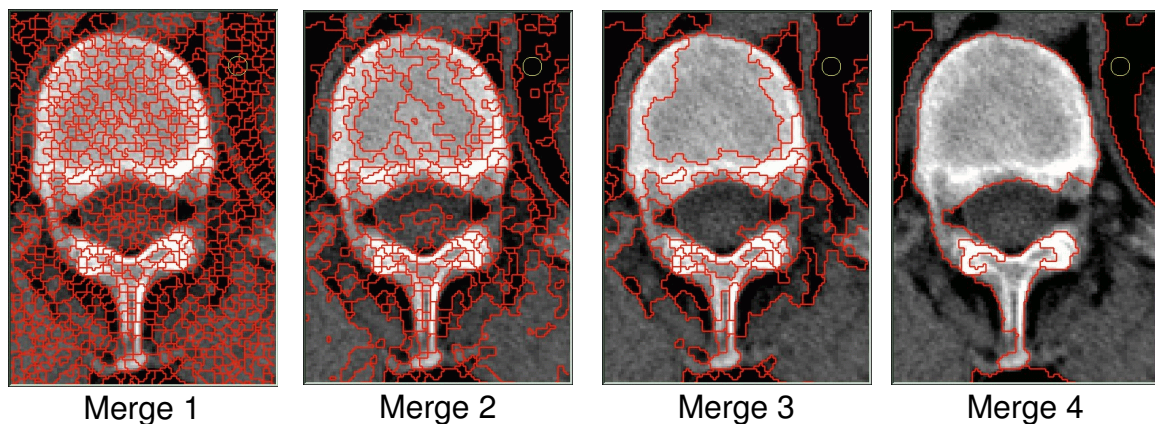
5.2.3 The Morpho Mode

In this mode you can use Mathematical Morphology to segment and edit the TAG images.

Mathematical Morphology segmentation is done by computing the Watershed of the gradient of the image. This will give you a kind of mosaic of the image. Each region of this mosaic can then be filled with the appropriate Tag value. Each region should correspond to no more than one tissue type, filling these regions will be faster than editing the image one pixel at a time.



Computing the Watershed yields a great number of regions; we then proceed to merge these regions together. SliceOmatic enables you to compute four (4) different merges. The images below show the effect of the four defaults merges.



Merge 1

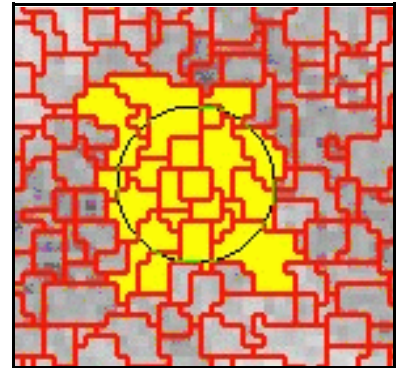
Merge 2

Merge 3

Merge 4

The first step to perform is the computation of the **Watershed** for a GLI image. This can be done by pressing one of the 4 Merge buttons, or the *Compute All* button. Once this is done, the **Water Parting** mesh will be superimposed on the image. The Water Parting is the set of lines that define the different Watersheds. The color and thickness of these lines can be modified with the **Hue** slider and the Line Thickness button (see below). You can then **Flood-Fill** the Watershed with a first approximation of the segmentation obtained through a threshold (you may want to do one or two erosions of the threshold image before doing the flood-fill). This step will fill every pixel of the TAG Image corresponding to a region of the watershed with the highest Tag value of these pixels.

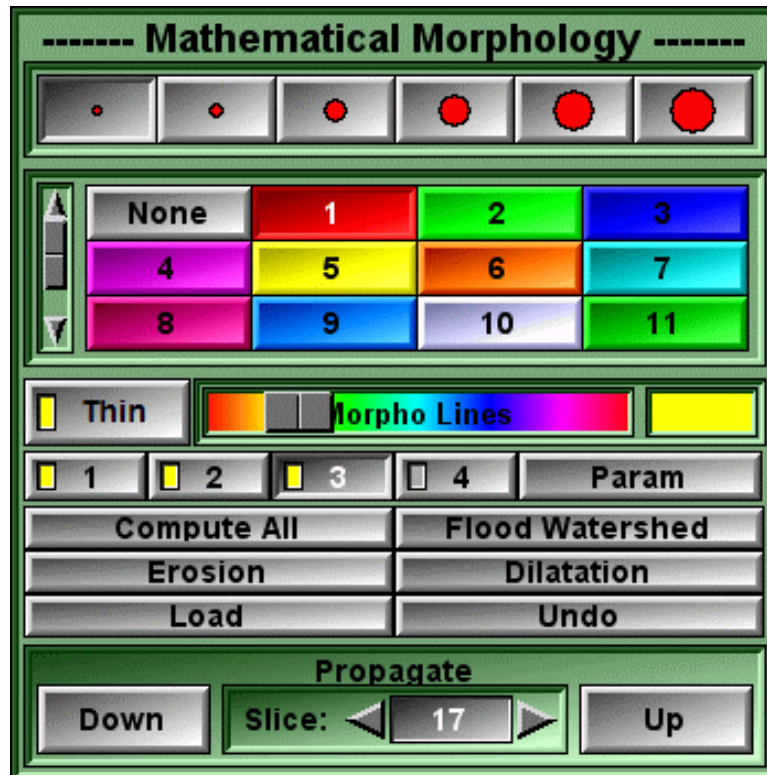
You can then fill individual watershed regions with the mouse. The editing of the TAG image in the **Morpho** mode is similar to the **Edit** mode. You use the left mouse button to add the current Tag value, and the right mouse button to bring back the Tag value from the save buffer. The difference is that instead of modifying only the pixels under the brush, you change the Tag value of all the pixels in the regions touched by the brush.



Pressing the middle mouse button will increase the brush to a big square, allowing you to paint or erase a block at a time.

The first modification you do to an image will automatically load the image in a "save" buffer which is used when you "erase".

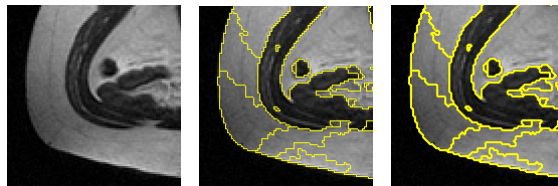
5.2.3.1 From the Graphical Interface



Brush Select the brush used in the Display Area.

TAG Value Select the current Tag value.

Line Thickness Change the Water parting lines' thickness. This button will sequentially take the values "Off", "Thin" and "Thick". The keys "a", "s" and "d" can also be used as shortcuts for these settings.



Hue slider Change the Water parting lines' color to make them more visible. An example of the current color is showed in the box at the right of the slider.

1 to 4 SliceOmatic enables you to compute 4 different merges. The merging of regions is controlled by 2 parameters: the surface of each region (the program will attempt to merge regions with a surface smaller than the threshold value) and the difference between regions' mean values (the program will merge regions together only if this

difference is smaller than the threshold value). By default, the 4 Merge buttons are assigned increasing merge parameter values. These values can be modified with the **Param** button.

These 4 buttons are used to select the associated Watershed merge. If this merge has not yet been computed or if the parameters of this Merge button have been changed, the Watershed merge is computed. These buttons can also be activated with the keys "q", "w", "e" and "r" for 1 to 4 respectively. Depending on the Display Mode selected, the program will compute the Watershed of the current image (Display Mode One), or of all the selected images (Display Mode All). The yellow indicator on each of the merge buttons indicates if this merge exists for the current image.

Param

Display a new area in the menu (see below). These new buttons enable you to modify the merge parameters (surface and mean difference) associated with the 4 merge buttons. Surface is expressed in pixels and the mean difference is expressed in % of the image's dynamic range.

<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 3	<input type="checkbox"/> 4	Param
5	25	40	50	surface
0.20	1.00	2.50	7.50	mean diff.

SliceOmatic will attempt to merge with its neighbor all Watershed regions smaller than "surface". The merge will be done if the difference between the mean value of the pixels in the 2 regions is smaller than the "mean diff." value.

Compute All

Compute the Watershed of all the selected GLI image(s) for all their merge values.

Flood Waters.

The highest Tag value inside each region of the Watershed is used to fill the region. This function is usually used in conjunction with the Threshold segmentation as a first step in the Morphological segmentation: compute a segmentation with the Thresholds, then flood the regions with these results.

Erosion

Shrink the TAG image one pixel in all directions.

Dilatation

Expand the TAG image one pixel in all directions.

Load

Manually load the image in the save buffer. See **Section 2.2.2: The Undo/Redo and the Load/Restore operations** for more information on the Load and Erase functions.

- Undo** Undo last brush stroke. It is a shortcut to the “Undo” button of the **Uno/Redo Menu**. It can only undo Morpho operations.

- Propagate** Use the segmentation of the image selected by “slice” as a seed for the segmentation of an adjacent image. The propagation can be done either on the image immediately preceding (“Up” button) or following (“Down” button) the selected image.

5.2.3.2 From the Display area

In addition to the keyboard shortcuts seen in section 5.2.0.2, the mouse controls associated with this mode are:

<i>Mouse button</i>	<i>Function</i>
Left	Flood all the regions under the cursor.
Right	Restore the “erase” color in all the regions under the cursor.
Middle	Increase the brush to a big square, allowing to paint or erase a larger surface.
Middle + Left	Flood a big square region.
Middle + Right	Restore a big square region.

5.2.3.3 From the Keyboard

In addition to the keyboard shortcuts seen in section 5.2.0.3, the following keyboard keys , Specific to Morpho, can also be used as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
“q”, “w”, “e”, “r”	MORPHO-MERGE-1 to -4	Select Merge 1 to 4
“a”	MORPHO-LINE-OFF	Set the Water parting lines visibility and thickness
“s”, “d”	MORPHO-LINE-1 and -2	
<i>not mapped</i>	MORPHO-EROSION MORPHO-DILATATION MORPHO-OPEN-1 and -2 MORPHO-CLOSE-1 and -2	Morphological operators on the TAG images

5.2.3.3 From the Command Line

The following commands can be used in the command line or in a script file:

Morpho: param *t_merge surf diff*

Fix the watershed merge parameters surface to “surf” and mean difference to “diff” for the merge value matching “t_merge”.

Morpho: *t_ima compute t_merge*

Compute the watershed and merge for the images matching “t_ima” and the merge value matching “t_merge”

ex: Morpho: * compute *

will compute all merge value for all images.

Morpho: *t_ima erosion*

Morpho: *t_ima dilatation*

Compute erosion and dilatation operation on the TAG images.

Morpho: *t_ima open size*

Morpho: *t_ima close size*

Compute opening and closing operation on the TAG images. “Size” controls the size of the features that are affected by the operation.

Note

“t_ima” is a template that can match one or multiples images.

“t_merge” is a template that can match one of the merge values (1 to 4). See

Appendix C.8: The Templates.

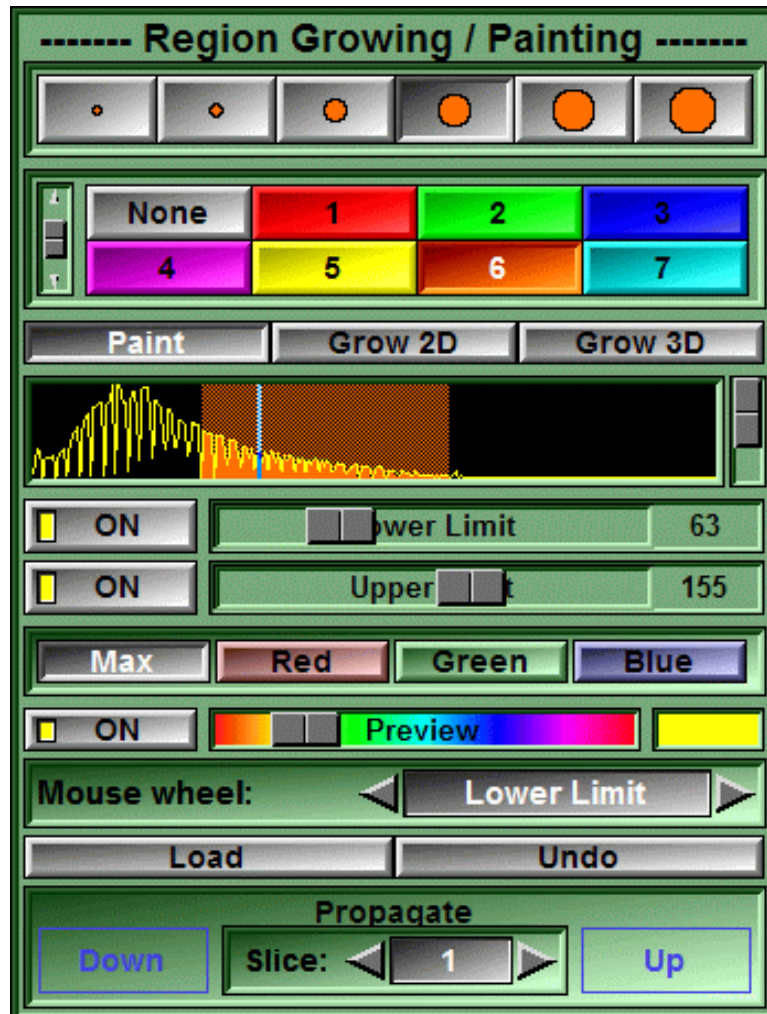
Technical Note

For more information on the Mathematical Morphology operators (erosion, dilatation, opening, closing), please refer to the article: *A New Set of Fast Algorithms for Mathematical Morphology I and II*, Andre Bleau, Jacques De Guise, and A.-Robert LeBlanc. CVGIP: Image Understanding, Vol. 56, No. 2, September 1992, pp. 178-229.

5.2.4 The Region Growing / Painting Mode

In this mode, you can threshold a specific region of the image. You must first select a threshold range with the Upper and Lower limit tools. You can then precisely Tag all the pixels that fall within this range with a paint brush (Paint mode) or grow a 2D or 3D region using the pixels under the brush as a seed.

5.2.4.1 From the Graphical Interface



Brush Select the brush used in the Display Area.

TAG Value Select the current Tag value.

Paint button

A left click on the mouse will activate the brush. All the pixels under the brush whose GLI values are within the threshold range will be tagged. The right mouse button is used to “erase” to modification and bring back the Tag values from the last “load” operation.

Grow 2D button

A left click on the mouse will seed a region under the cursor. In order to grow, the region must meet the following criteria:

- The GLI values of the pixels must be within the threshold range.
- The region will not overwrite a Tag of value equal or superior to the current Tag.
- The region will not grow through a region smaller than the radius of the brush.

The right mouse button can be used to erase the latest grow operation.

Grow 3D button

A left click on the mouse will seed a region under the cursor. In order to grow, the region must meet the following criteria:

- The GLI values of the pixels must be within the threshold range.
- The radius of the region cannot be smaller than the radius of the brush.
- The region will propagate to adjacent slices if these slices are within the same group.

The right mouse button can be used to erase the latest grow operation.

Histogram box

Displays the histogram of the grey values of the GLI image(s). The vertical axis represents the number of pixels having a particular value, while the horizontal axis represents the possible values of the pixels (from Minimum at left to Maximum at right). The threshold range fixed by the lower and upper limits will be superimposed on this histogram. When the cursor is over an image, the GLI value of the pixel under the cursor is indicated by a white vertical bar on the histogram.


Histogram slider

The slider at the right of the histogram is used to scale the vertical axis of the histogram.

Lower limit button

Activate and control the lower limit slider. It will cycle through the values “Off”, “Abs” and “Rel”.

- “Off”: the lower limit is disabled.
- “Abs”: the Lower limit slider directly fixes the minimum GLI value that a pixel can have in order to be within the threshold range for painting or growing.
- “Rel”: the minimum value of the threshold range is computed relative to the GLI value of the pixel under the cursor. The Lower limit slider gives an offset that is subtracted from the GLI value under the cursor.

- Lower limit slider** Give the value that is used to form the lower limit of the threshold range. This slider can be locked in position by pressing the “Scroll Lock” key while the cursor is over it. 
- Upper limit button** Activates and control the upper limit slider. It will cycle through the vales: “Off”, “Abs” and “Rel”.
- “Off”: the upper limit is disabled.
 - “Abs”: the Upper limit slider directly fixes the maximum GLI value that a pixel can have in order to be within the threshold range for painting or growing.
 - “Rel”: the maximum value of the threshold range is computed relative to the GLI value of the pixel under the cursor. The Upper limit slider gives an offset that is added to the GLI value under the cursor.
- Upper limit slider** Gives the value that is used to form the upper limit of the threshold range. This slider can be locked in position by pressing the “Scroll Lock” key while the cursor is over it.
- Color Image** If one of the currently selected images is a color image, you will have to choose which of the color components to use in the segmentation. The choice is between **Max**, **Red**, **Green** and **Blue**. Max is the maximum of the red, green and blue components.
- Preview** If ON, a preview of the segmentation will be displayed in Paint and Grow 2D modes.
- Preview color** This slider enables you to change the preview’s color to make it more visible. An example of the current color is showed in the box at the right of the slider.
- Note
- The preview is unavailable in the Grow_3D sub-mode
- Mouse wheel** The mouse wheel can be used to control the upper or lower limit sliders.
- Load** Manually load the image in the restore buffer. See **Section 2.2.2: The Undo/Redo and the Load/Restore operations** for more information on the Load and Erase functions.
- Undo** Undo last brush stroke. It is a shortcut to the “Undo” button of the **Uno/Redo Menu**. It can only undo “region growing” operations.
- Propagate** Use the segmentation of the image selected by “slice” as a seed for the segmentation of an adjacent image. The propagation can be done either on

the image immediately preceding (“Down” button) or following (“Up” button) the selected image.

Note

The propagate interface is disabled in the Grow_3D sub-mode

5.2.4.2 From the Display area

In addition to the keyboard shortcuts seen in section 5.2.0.2, the mouse controls associated with this mode are:

For the “Paint” sub-mode

<i>Mouse button</i>	<i>Function</i>
Left	Threshold the regions under the cursor.
Right	Restore the tag values in all the regions under the cursor.
Middle	Increase the brush to a big square, allowing to threshold or restore a larger surface.

For the “Grow 2D” and “Grow 3D” sub-mode

<i>Mouse button</i>	<i>Function</i>
Left	Grow a region starting at the current cursor position.
Right	Restore the tag values in all the regions starting at the current cursor position.

5.2.4.3 From the Keyboard

The keyboard shortcuts described in section 5.2.0.3 can be used in this mode.

5.2.4.3 From the Command Line

The following commands can be used in the command line or in a script file:

Region: color *r g b* (0 <= r,g,b <= 255)
Change the color of the preview.

Region: tag max (OFF|ABS|REL) *val* (1 <= tag <= TAG_MAX)
Assign a value and a mode to the upper threshold for the Tag “id”.

Region: tag min (OFF|ABS|REL) *val* (1 <= tag <= TAG_MAX)

Assign a value and a mode to the lower threshold for the Tag “id”.

Region: (all|tag) slider (all|min|max) (Lock|Unlock|Toggle)

Lock or Unlock the sliders.

Region: preview (ON|OFF|TOGGLE)

Enable/disable the displaying of the preview color for Paint and Grow 2D.

Region: wheel (OFF|Upper|Lower)

Assign the mouse wheel to the upper or lower threshold values.

5.2.5 The Snake Mode

In this mode you can use Active Contour (Snake) curves to segment the TAG images.

A Snake is a curve that will tend to minimize its energy. The energy of a Snake is composed of 2 parts: its internal energy, computed from its shape and curvature, and its external energy, computed from the gradient of the image under the curve.

In this mode you will be able to create Snakes either by placing the Snake's points directly on the image, or by extracting the contour of existing Tag data to create new Snakes.

5.2.5 1 From the Graphical Interface



Brush

Select the brush used in the Display Area. The brush size gives the minimum radius of the Snake which in turn controls the “smoothness” of the curve. A bigger brush will create a smoother curve, a smaller brush will let the snake “hug” details more closely. This is a local property of the Snake. You can use different brush sizes to create or edit different portions of the Snake.

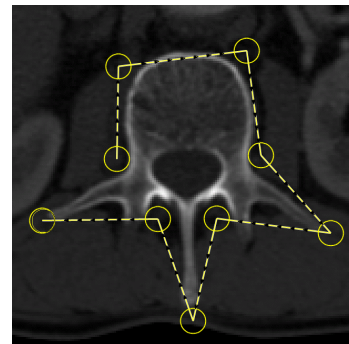
TAG Value	Select the current Tag value. The “Delete” Tag is used to delete all the Snakes under the cursor. When editing Snakes, only the Snakes associated with this Tag will be affected.
Create New Snake	Create a new Snake. The creation mode will remain effective as long as you don’t minimize the Snake’s energy.
Snake From TAG	Create Snakes from the contours of every Tag surface in every selected image.
Polarity	The Snake expects either: <ul style="list-style-type: none"> • a light object on a dark background (+) • a dark object on a light background (-). • The Snake will adapt locally to the highest gradient disregarding its orientation (No Polarity).
Minimize Energy	Minimize the energy of all the Snakes associated with the current Tag of all the selected images.
Read from Script	Read a script file. This file should contain Snake description commands.
Save to Script	Create a script file that can be used to re-create the Snakes of the current Tag.
Snake To TAG	Will fill out the contours of the Snakes with their Tag colors.
Snake To GEOM	Convert the Snake’s curves to geometries (closed polylines) that can be visualized in the 3D modes and exported to any of the 3D formats supported by sliceOmatic.
Propagate	Uses the Snakes of the image selected by “slice” as a starting point for the Snakes of an adjacent image. The propagation can be done either on the image immediately preceding (“Up” button) or following (“Down” button) the selected image. Only the Snakes of the currently selected color will be propagated.



5.2.5.2 From the Display area

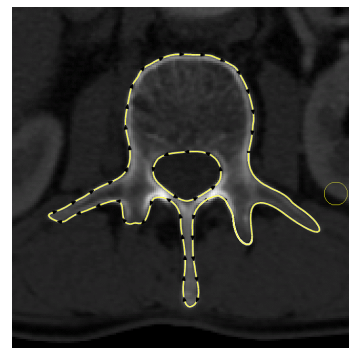
Creating a new Snake

To create a new Snake, you must select a Tag color and a brush. You then press the “Create” button and place points on the image with the left mouse button. The Snake points must form a first approximation of the contour of the object. **The order of these points must be clockwise around the object.** If you are delimiting a hole in the object, the points must be counter-clockwise. You can move existing points of the new Snake by clicking and dragging the point. You can add a new point between existing points by clicking on the segment joining the points. Otherwise, the points are added at the end of the Snake. The radius of each new point is the radius of the brush. This radius will determine the local radius of curvature of the Snake.



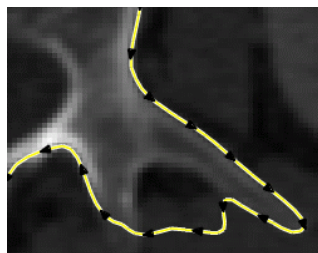
Minimizing the Snake's Energy

You then click on the “Minimize Snake” button to compute the Snake. The Snake will tend to latch to the regions of maximum gradient in the image that are in the neighborhood of the original curve, while preserving the conditions of local curvature. The middle mouse button can also be used to minimize the energy.

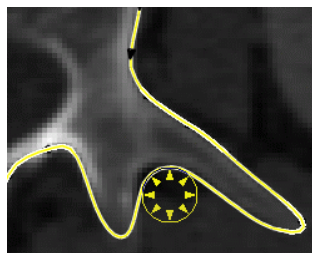


Editing the Snake

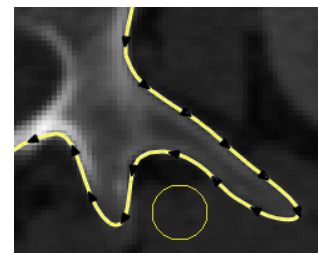
At anytime, you can edit the Snake's curve. The left mouse button is used to push the curve away from the cursor, while the right mouse button will attract the curve toward the center of the cursor. All the points on the curve touched by the cursor, either by pushing or pulling, will also have their radius attribute changed to the current brush radius. You may want to decrease the radius of a section of the curve to hug details more closely, or inversely, you can locally increase the radius to smooth out a section of the curve.



Incorrect Snake



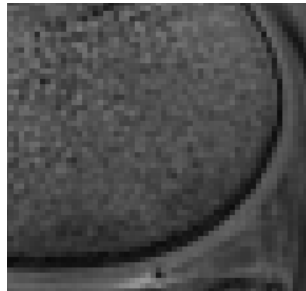
Edit shape and radius



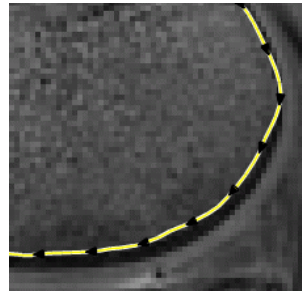
After Minimize

Following the correct gradient

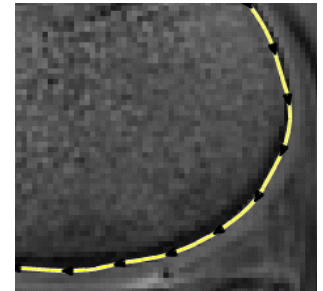
When the object you want to Tag is composed of higher value pixels than the surrounding background, the gradient of the pixels on the border of the object will point away from the Snake curve. SliceOmatic uses this information to help the Snake latch to the correct gradient. If, however, the intensities of the pixel are reversed (dark objects on a light background), you must tell it to the program. This is done with the “Polarity” buttons.



MR image



Latching on the wrong contour



With “Polarity -“

Deleting Snakes

You can delete a curve by pressing the “Delete” key while the cursor is over the curve, or you can select the “Delete” button and delete the curve by pressing the left mouse key while the cursor is over the curve.

5.2.5.3 From the Keyboard

In addition to the keyboard shortcuts seen in section 5.2.0.3, the following keyboard keys, Specific to Snakes, can also be used as a shortcut:

<i>key map</i>	<i>command name</i>	<i>Action</i>
Delete		Delete the Snake under the cursor.

5.2.5.4 From the Command Line

The following commands can be used in the command line or in a script file:

Snake: [t_ima] t_tag radius value

Assign the radius “value” to all the points of all the Snakes associated with the Tag matching the “t_tag” template on the images matching the “t_ima” template.

Snake: [*t_ima*] *t_tag* capture value

Assign the capture range “value” to all the Snakes associated with the Tag matching the “*t_tag*” template on the images matching the “*t_ima*” template. The capture range determines how much the Snake can move to latch on the best gradient.

Snake: [*t_ima*] *t_tag* delete

Delete all the Snakes associated with the Tag matching the “*t_tag*” template on the images matching the “*t_ima*” template.

Note

“*t_ima*” is a template that can match one or multiples images.

“*t_tag*” is a template that can match one or multiples tags (either their numbers or labels). See **Appendix C.8: The Templates**.

Technical Note

When minimizing the Snake's energy, the following steps are used:

The Snake curve is subdivided in small segments about 3 pixel longs. Each segment is assigned a “radius” value. This radius is derived from the brush size used either to create the original points of the Snake, or to edit the Snake.

The internal energy of the Snake is then computed from the local curvature of the segments. This curvature is weighted with the “radius” value of the segments.

The external energy is computed from the gradient of the image under each segment, weighted by the angle between the segment and the gradient's orientation. To compute the correct angle, it is important that:

- The correct gradient polarity be selected
- The Snakes around the organs are created clockwise, and the snakes around holes in the organs are created counter-clockwise.

When minimizing its energy, the snake will move to achieve the smoothest curve while “hugging” the best gradients on the image. The distance the segments can move to achieve this is controlled by the “capture range” of the segment. This value is derived from:

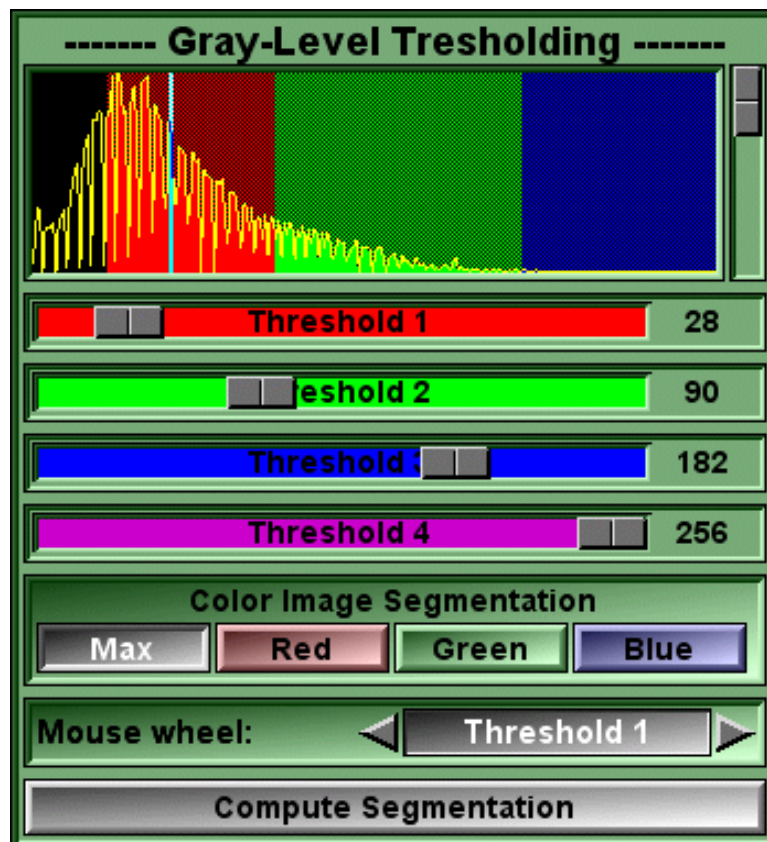
- The segment's local radius.
- The curve's polarity. A “no polarity” value will half the capture range.
- The curve's age. A curve segment that has been manually edited is probably close to where the user wants it, so its capture range is decreased.

5.2.6 The Thresholding Mode

In this mode, you create segmented TAG images from the GLI Images (Grey Level Images). The segmentation is done by a simple grey level thresholding on the GLI images with four different thresholds.

5.2.6.1 From the Graphical Interface

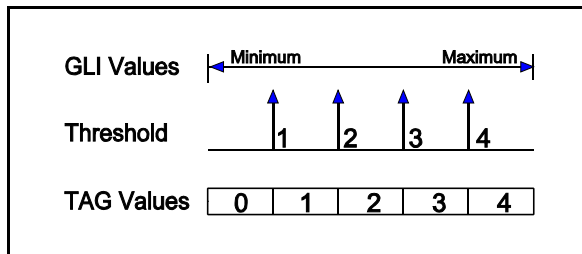
The TAG images displayed while in this mode are previews of what the TAG images would be if you pressed the Compute button. **The actual segmentation is only performed by pressing the Compute button.** The segmentation will then be applied to all the selected images.



Histogram box Display the histogram of the grey values of the GLI image(s). The vertical axis represents the number of pixels having a particular value, while the horizontal axis represents the possible values of the pixels (from Minimum at left to Maximum at right). The colors under the line correspond to the segmentation values fixed by the sliders. When the cursor is over an image, the GLI value of the pixel under the cursor can be seen as a vertical bar on the histogram.

Histogram slider The slider at the right of the histogram is used to scale the vertical axis of the histogram.

Threshold slider The 4 sliders are used to segment the GLI image by its values. The sliders range from the Minimum to the Maximum values of the GLI pixels. The sliders can be locked in position by pressing the “Scroll Lock” key while the cursor is over it.



- All GLI pixels with a value smaller than the first slider will have a Tag value of 0.
- All GLI pixels with a value in between the first slider and the second slider will have a Tag value of 1. Idem for Tag values 2 and 3.
- All GLI pixels with a value higher than the fourth slider will have a Tag value of 4.

Note

The TAG values associated with each threshold slider (by default, 1 to 4) can be changed either with the “Up” or “Down” arrow keys when the cursor is over the threshold slider, or with the command line (see the “segment: threshold” command).

Color Image If one of the currently selected images is a color image, you will have to chose which of the color component to use in the segmentation. The choice is between **Max**, **Red**, **Green** and **Blue**. Max is the maximum of the red, green and blue component.

Mouse Wheel You can use the mouse wheel to change the threshold values. You can select which of the threshold will be affected by the mouse wheel, or disable the mouse wheel control.

Compute Pressing the **Compute Segmentation** button will perform the real segmentation and create the TAG images.

5.2.6.2 From the Display area

The GLI value of the pixel under the cursor is highlighted in the interface's histogram.

5.2.6.3 From the Keyboard

There is no keyboard interface to this mode.

5.2.6.4 From the Command Line

The following commands can be used in the command line or in a script file:

Segment: threshold *id value [tag]*

Fix the interface threshold number “id” to the value “value”. “id” is a number between 1 and 4. “Value” is limited by the dynamic range of the image. The optional “Tag” argument can be used to change the value of the tag associated with the threshold.

Segment: *t_ima* compute [*value ...*]

Compute the segmentation for the desired images (either those matching the “t_ima” template, or the currently selected images). If threshold values are given, they will be used for the segmentation, otherwise, the values fixed by the interface are used.

Segment: slider (all|1|2|3|4) (Lock|unlock|toggle)

Lock or unlock the slider.

Segment: wheel (Off|1|2|3|4)

Assign the mouse wheel to one of the threshold values.

Note

“t_ima” is a template that can match one or multiples images. See **Appendix C.8: The Templates**.

Note

With the “segment: compute” command, you can segment an image with any number of thresholds up to a maximum of TAG_MAX thresholds. (The maximum number of Tags accepted by the program).

6 The 3D Module

The 3D Module regroups the functions that are necessary to visualize the 3D volumes, create 3D polygonal surfaces from the Tag data and analyze them.

Depending on the mode and the drawing technique you selected, the display window will show volumes and/or geometrical primitives such as polygons, line segments or points. The volumes are displayed based on both the information from the 3D data set and its segmentation information using either standard volume rendering technique or Maximum Intensity Projection (MIP).

The geometrical primitives can either be derived from the segmentation information of your data set (the TAG images) with the Shell and Contour modes, or imported directly. The supported import format for the geometries are MOVIE.BYU and STL (ASCII or binary) formats.

When displaying volumes, if all the currently selected groups are “volumes” (.c.f. **section 1.4.1: Image Groups**), the ray-tracing rendering option will be enabled. With this rendering technique, only the volumes will be displayed. With the OpenGL rendering technique, in which case both the volume and geometrical primitives are displayed together.

License

Without the TAG Module License, a watermark will be displayed in the display windows and the following buttons will be disabled:

- The “**Geometry save as...**” button in the File Menu.
- The “**Save**” button in the surface shading tool.

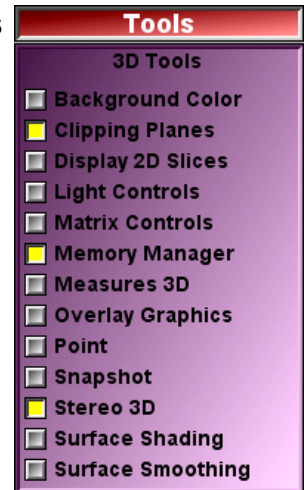
Note

The program will attempt to keep the screen refresh rate at more than 15 frames/second to facilitate interactive manipulation. If the surfaces have too many polygons, the program will only redraw some of them while the surfaces are in movement. See **Section 9.3: The 3D Module Preferences**.

6.1 The 3D Tools

Once one of the 3D modes has been selected, the 3D tools can be activated from the Tools menu. The choices are:

- Background Color
- Clipping Planes
- Display 2D Slices
- Light Controls
- Matrix Controls
- Memory Manager
- Measurement 3D
- Overlay Graphics
- Point
- Snapshot
- Stereo 3D
- Surface Shading
- Surface Smoothing



For each of the 3D Tools, we will present the tool, describe the layout and function of its graphical interface, the display area manipulations that can influence the tool, the keyboard shortcuts available for this tool as well as the command line and variables that are related to the tool.

You can find a more detailed description of the key shortcuts, their use and their syntax in: **Appendix A: The Keyboard Shortcuts**

A complete description of the command line syntax and its variables is presented in **Appendix C: The Command Line Syntax**

6.1.1 The Background Color Tool

This tool is used to control the background color. Each of the 4 corners of the background can be controlled individually. The background color is interpolated linearly from the values at the corners.

6.1.1.1 From the Graphical Interface



Corner Buttons Select one of the 4 corners of the background.

Color Edit You selected corner's color with these controls

6.1.1.2 From the Display area

There is no display area interaction with this tool.

6.1.1.3 From the Keyboard

There is no keyboard interface to this mode.

6.1.1.4 From the Command Line

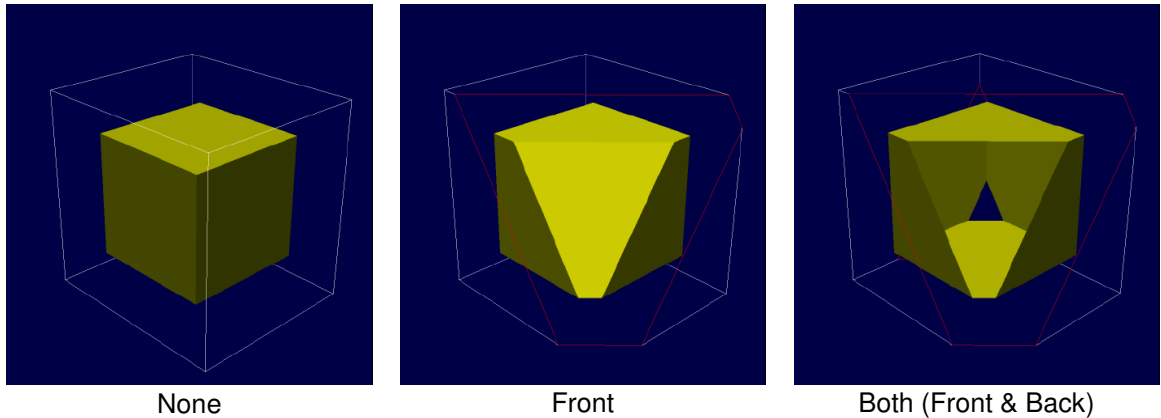
The following commands can be used in the command line or in a script file:

Back: (top|bottom) (left|right) R G B

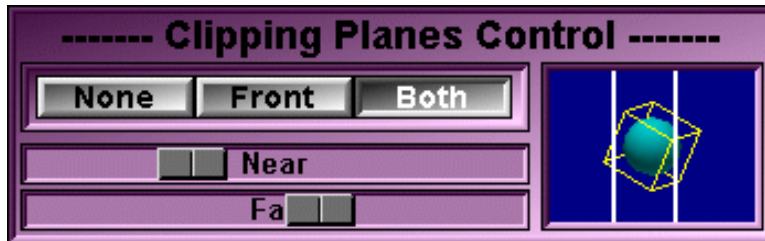
Set the color for a background corner. RGB values must be between 0 and 255.

6.1.2 The Clip Plane Tool

This tool controls the 2 clip planes. These clip planes are parallel to the display window.



6.1.2.1 From the Graphical Interface



None Button The clip planes are disabled

Front Button Only the front clip plane is enabled. The surface's interior will be shaded with a uniform color to give the appearance of a solid object.

Both Button Both front and back clip planes are enabled. The surface's interior will be shaded in the same manner as the exterior to permit viewing of the interior surfaces.

Near/Far Sliders Control the position of the clip planes, towards the camera when sliding to the left, away from the camera when sliding to the right.

Preview Window Shows the scene, from a position at 90 degrees to the right of the camera. Only the bounding boxes of the objects in the scene are displayed along with the clip planes. Depending on the objects' shading, their bounding box will be: a line drawn box, a flat shaded box or a smooth sphere.

6.1.2.2 From the Display area

There is no display area interaction with this tool.

6.1.2.3 From the Keyboard

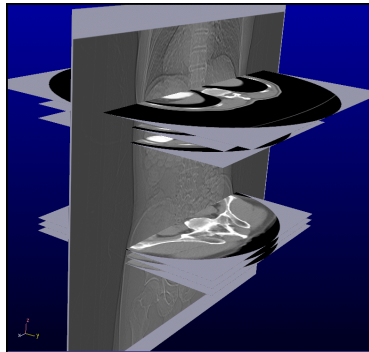
There is no keyboard interface to this tool.

6.1.2.3 From the Command Line

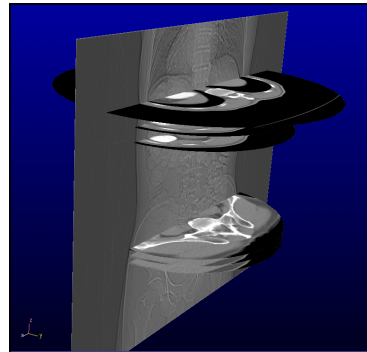
There is no command line or variables associated to this tool.

6.1.3 Display 2D Slices

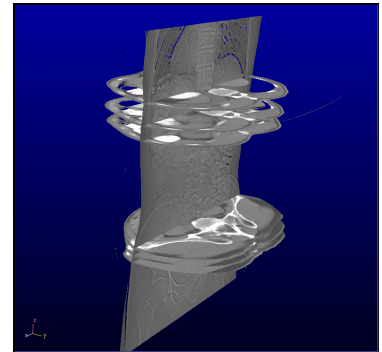
This tool enable you to display the 2D slices in the 3D window.



Transparency: Off



Transparency: 0



Transparency: mid

6.1.3.1 From the Graphical Interface

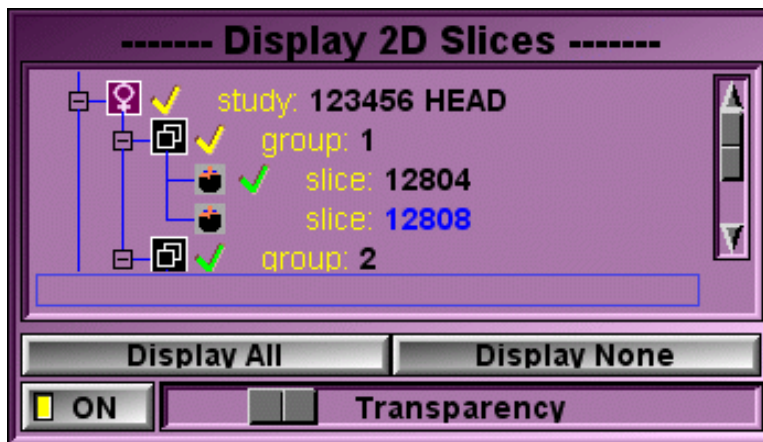


Image list

Select an image by clicking on its button. You can select multiple images by dragging a selection box, or using the "Shift" or "Ctrl" keys. A green checkmark means that the all the images in the hierarchy have been selected. A yellow checkmark means that some but not all the images in the hierarchy have been selected.

Select All

All the images will be displayed.

Select None

None of the images will be displayed.

ON/OFF

Enable/Disable the transparency mode.

- Transparency** The slider select the transparency threshold. The transparency value of the slices is affected by the current color scheme :
- For "Grey", the transparency is function of the GLI pixel value.
 - For "Mixed", the transparency of any untagged pixel is function of the GLI pixel value, The transparency of the tagged pixel is function of the tag number. (tag-1 will disappear before tag-2...).
 - For "Over" and TAG, The transparency of the tagged pixel is function of the tag number. (tag-1 will disappear before tag-2...).

6.1.3.2 From the Display area

There is no display area interaction with this tool.

6.1.3.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
F1	COLOR-SCHEME-MODE-GLI	Set the color scheme mode for all the displayed 2D slices
F2	COLOR-SCHEME-MODE-MIX	
F3	COLOR-SCHEME-MODE-OVER	
F4	COLOR-SCHEME-MODE-TAG	
-	COLOR-SCHEME-MIX-DECREASE	Decrease / increase the "mix" density by .1 (from: .1 to .9)
=	COLOR-SCHEME-MIX-INCREASE	
Page up	SLICE-PREVIOUS	Go to the previous / next image of the current group.
Page Down	SLICE-NEXT	
Home	GROUP-PREVIOUS	Go to the previous / next group of the current study.
End	GROUP-NEXT	
Insert	STUDY-PREVIOUS	Go to the previous / next study.
Delete	STUDY-NEXT	

Note

The program will attempt to keep the screen refresh rate at more than 15 frames/second to facilitate interactive manipulation. If the surfaces have too many polygons, the program will only redraw some of them while the surfaces are in movement. See **Section 9.3: The 3D Module Preferences**.

Note

When you change the displayed slice with the keyboard ("Page up" to "Delete" keys), the current slice will be removed from the list of displayed slices and the new slice will be added to the list. If you press the "Ctrl" key at the same time as the will not be removed from the displayed list.

6.1.3.4 From the Command Line

There is no command line for this tool.

6.1.4 The Light Tool

The shading of the surfaces are determined by the light sources. This tool enables you to control 4 light sources and an ambient light.

6.1.4.1 From the Graphical Interface



- Light List** Select the light source that will be affected by the tool's controls.
- On/Off** The selected light source can be toggled on or off
- X/Y/Z Sliders** Control the selected light direction. The lights are considered infinitely far from the objects. The sliders determine the direction from which the light comes.
- Color Edit** Change the light's intensity and color.

Note

When the Ambient light is selected (Amb. Button), the On/Off buttons and the X/Y/Z Sliders are disabled.

6.1.4.2 From the Display area

There is no display area interaction with this tool.

6.1.4.3 From the Keyboard

There is no keyboard interface to this tool.

6.1.4.4 From the Command Line

The following commands can be used in the command line or in a script file:

Light: *t_light* on

Light: *t_light* off

Switch the desired lights on or off

Light: *t_light* dir *x y z*

Orient the desired lights int the direction defined by the “x”, “y” and “z” vector.

Light: *t_light* color *R G B*

Change the light's color. (R,G and B should be between 0 and 255).

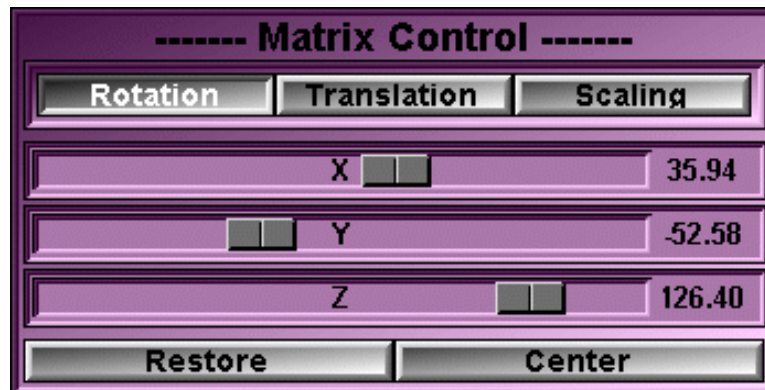
Note

“*t_light*” is a template that can match one or multiples light sources. See **Appendix C.8: The Templates.**

6.1.5 The Matrix Tool

This tool enables you to have a more precise control on the transformation matrix used to position the 3D Camera. The transformations applied with the mouse in the Display Area are immediately reflected here. Any modification to the matrix done with this tool will immediately affect the geometries in the Display Area.

6.1.5.1 From the Graphical Interface



- Rotation** The X/Y/Z sliders control the surfaces' rotation around their axis. The rotations are applied in the following order: X then Y then Z.
- Translation** The X/Y/Z sliders control the surfaces' translation along their axis.
- Scaling** The X slider is used to control the surfaces' scaling factor.
- X/Y/Z Sliders** Control the rotation/translation or scaling applied to the transformation matrix.
- Restore** Reinitialize all transformation matrices and center all currently visible surfaces in the Display Area. (A surface is visible if its shading is either line, flat or smooth.)
- Center** Center the visible surfaces in the Display Area

6.1.5.2 From the Display area

There is no display area interaction with this tool.

6.1.5.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
F9	DIR-AXIAL	Set the matrix to view the volume in the Axial,
F10	DIR-SAGITTAL	Sagittal, Coronal or Oblique direction (as
F11	DIR-CORONAL	defined in the ROI module)
F12	DIR-OBLIQUE	

Note

The same commands (DIR-AXIAL...) Are also used in 2D mode for the slice orientation. The current mode decide if the 2D or 3D command is used.

6.1.5.4 From the Command Line

The following commands can be used in the command line or in a script file:

Matrix: restore

Restore the matrix to identity and re-center all the currently visible surfaces. (A surface is visible if its shading is either line, flat or smooth.)

Matrix: trans x y z

Translate all surfaces by “x”, “y” and “z” units along the main axes.

Matrix: rot x y z

Rotate all surfaces “x” degrees around the x axis, “y” degrees around the “y” axis and “z” degrees around the “z” axis.

Matrix: scale x [y z]

Scale all surfaces. If the scaling factor for “y” and “z” are not present, the scaling factor “x” will be applied to all axes.

Matrix: pivot angle dir_x dir_y dir_z

Rotate all surfaces “angle” degrees around the vector defined by “dir_x”, “dir_y” and “dir_z”.

Matrix: matrix a11 a12 a13 a14 a21 a22 ... a44

Directly set the matrix elements. The 16 parameters of this command will be inserted in the 4x4 transformation matrix.

Matrix: fov *angle*

Change the camera Field Of View. Accepted values for “angle” range from 0.0 to 179.0 degrees. A value of 0 will yield an orthogonal projection. The default Camera has a FOV of 27 degrees.

Matrix: view (pa|ap|front|back|left|right|head|feet|up|down|coronal|sagittal)

Change the camera position to yield the desired view.

Matrix: camera *pos_x pos_y pos_z*

Place the virtual camera at the specified position.

In addition to the global matrix applied to all surfaces, each surface has a local matrix that can be modified through the command line.

Surface: *t_surf* restore

Restore the surfaces’ transformation matrices to identity.

Surface: *t_surf* trans *x y z*

Translate the surfaces by “x”, “y” and “z” units along the main axes.

Surface: *t_surf* rot *x y z*

Rotate the surfaces “x” degrees around the x axis, “y” degrees around the “y” axis and “z” degrees around the “z” axis.

Surface: *t_surf* scale *x [y z]*

Scale the surfaces. If the scaling factor for “y” and “z” are not present, the scaling factor “x” will be applied to all axes.

Surface: *t_surf* pivot *angle dir_x dir_y dir_z*

Rotate the surfaces “angle” degrees around the vector defined by “dir_x”, “dir_y” and “dir_z”.

Surface: *t_surf* matrix *a11 a12 a13 a14 a21 a22 ... a44*

Directly set the matrix elements. The 16 parameters of this command will be inserted in the 4x4 transformation matrix.

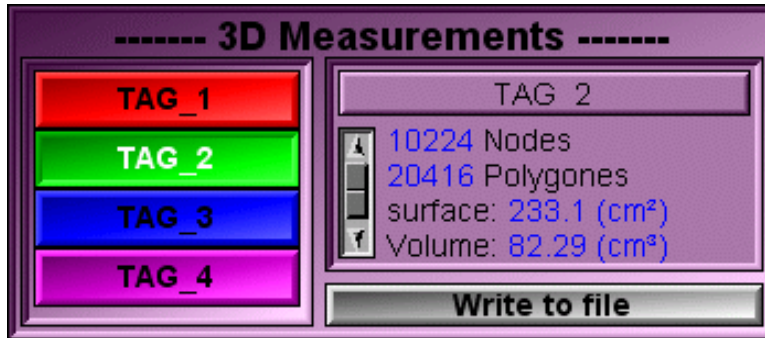
Note

“*t_surf*” is a template that can match one or multiples surfaces. See **Appendix C.8: The Templates**.

6.1.6 The Measurement Tool

This tool enable you to extract some measurements from 3D geometries.

6.1.6.1 From the Graphical Interface



Geometry List Select the geometry for which you want the measurements.

Results The measurements (number of nodes, number of polygons, surface of the polygons and volume of the geometry) will be displayed here.

Write The geometry's measurements can be written to a file..

6.1.6.2 From the Display area

There is no display area interaction with this tool.

6.1.6.3 From the Keyboard

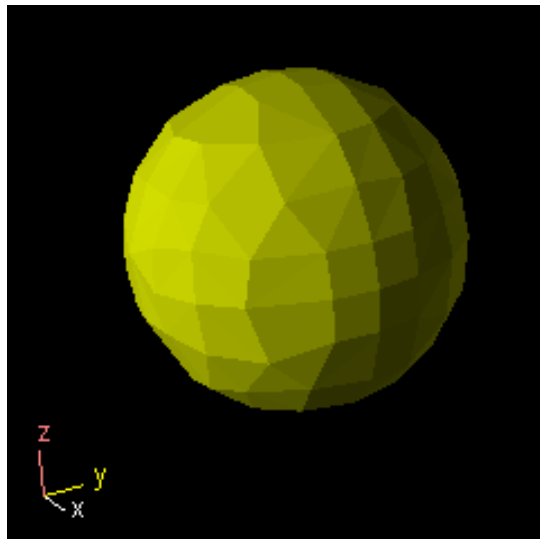
There is no keyboard interface to this tool.

6.1.6.4 From the Command Line

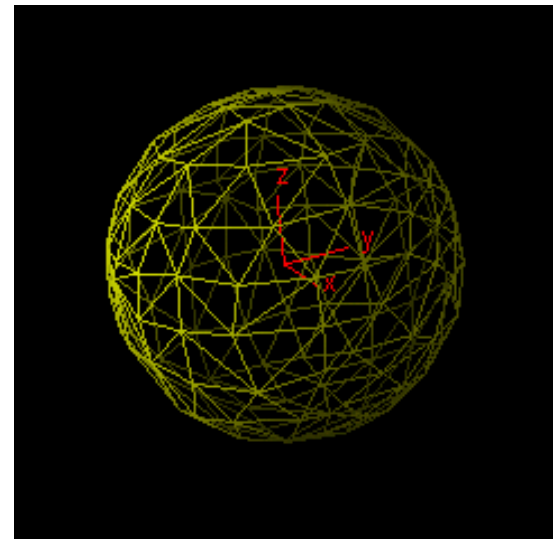
There is no command line for this tool.

6.1.7 The Geometry Overlay Tool

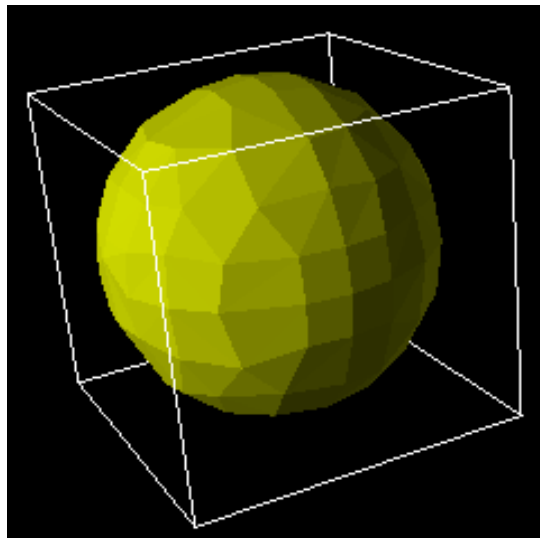
3D control boxes and axis information can be overlaid on the image.



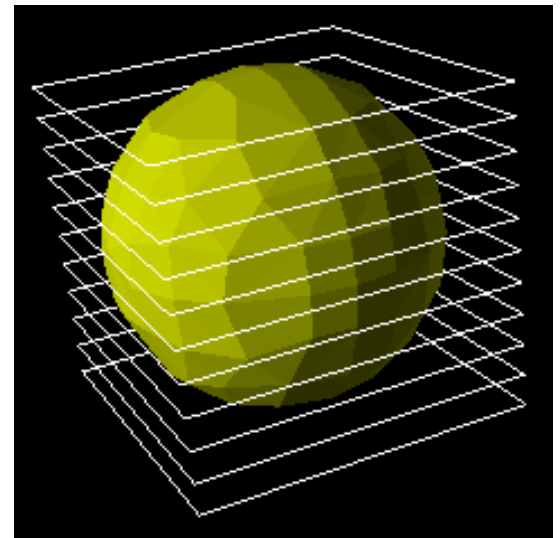
Global



Local

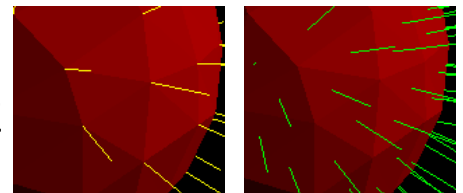


Box



Slices

Two other overlay informations can also be enabled from the keyboard or command line interfaces: The vertex normals and polygons normals. These overlays show the vertex's or polygon's normals as small line segments.



6.1.7.1 From the Graphical Interface



There are 4 graphical objects you can display corresponding to the 4 buttons of this tool. The different objects displayed are:

- Global** Show the global axis system at the bottom left corner of the window
- Local** Show a local axis system at the center of each object
- Box** Show the outline of the bounding box for the geometry
- Slices** Show the outline of each slice.

6.1.7.2 From the Display area

There is no display area interaction with this tool.

6.1.7.3 From the Keyboard

The following commands can also be mapped to keyboard keys as a shortcut:

<i>Key map</i>	<i>Command name</i>	<i>Action</i>
<i>not mapped</i>	OVERLAY-AXIS-ON	set "Global axis"
<i>not mapped</i>	OVERLAY-AXIS-OFF	
Shift-F9	OVERLAY-AXIS-TOGGLE	
<i>not mapped</i>	OVERLAY-LOCAL-ON	set "Local axis"
<i>not mapped</i>	OVERLAY-LOCAL-OFF	
Shift-F10	OVERLAY-LOCAL-TOGGLE	
<i>not mapped</i>	OVERLAY-BOX-ON	set "Bounding box"
<i>not mapped</i>	OVERLAY-BOX-OFF	
Shift-F11	OVERLAY-BOX-TOGGLE	
<i>not mapped</i>	OVERLAY-SLICE-ON	set "Slice outlines"
<i>not mapped</i>	OVERLAY-SLICE-OFF	
Shift-F12	OVERLAY-SLICE-TOGGLE	

not mapped OVERLAY-POLYGON_NORMAL-ON set "Polygon's Normal"
 OVERLAY-POLYGON_NORMAL-OFF
 OVERLAY-POLYGON_NORMAL-TOGGLE

not mapped OVERLAY-VERTEX_NORMAL-ON set "Vertex's Normal"
 OVERLAY-VERTEX_NORMAL-OFF
 OVERLAY-VERTEX_NORMAL-TOGGLE

6.1.7.4 From the Command Line

The following commands can be used in the command line or in a script file:

Overlay: global on|off|toggle

Change the value of the "global axis" overlay to on, off or toggle it.

Overlay: local on|off|toggle

Change the value of the "local axis" overlay to on, off or toggle it.

Overlay: box on|off|toggle

Change the value of the "bounding box" overlay to on, off or toggle it.

Overlay: slices on|off|toggle

Change the value of the "slice outlines" overlay to on, off or toggle it.

Overlay: vertex_normals on|off|toggle

Change the value of the "vertex's normal" overlay to on, off or toggle it.

Overlay: polygon_normals on|off|toggle

Change the value of the "polygon's normal" overlay to on, off or toggle it.

Overlay: color (local|global) R G B

Change the color of the axis, either for the global or local system.

Overlay: color (local_x|local_y|local_z) R G B

Change the color of one the local axis branch.

Overlay: color (global_x|global_y|global_z) R G B

Change the color of one the global axis branch.

The following variables can also be used in script commands:

\$DISPLAY_3D_OVERLAY_FLAG (Read/Write, bit field)

6.1.8 The Stereo Tool

You can use this tool to activate a stereoscopic 3D effect. To create the stereo effect, 2 images are rendered, one for each eye. In order to see the effect, you must wear special glasses.

With liquid crystal shutter glasses, the left and right eye images are time multiplexed. The images are presented alternatively to the screen in synchronism with the shutter glasses. Not all graphic cards will support this technique.

With the color anaglyph glasses, both images are presented on the screen at the same time. The image for the right eye will contain only blue and green colors while the image for the right eye will only contain red colors. In order to see the 3D effect with this technique, all the geometries must contain both red and blue. While the stereo Red/Blue mode is on, sliceOmatic will automatically change the colors of your geometries to match this requirement.

Note

The liquid crystal "shutter" mode is only available if your graphic card supports the OpenGL Stereo Buffers. See **section 9.4: The Drivers Selection** for more details.

6.1.8.1 From the Graphical Interface



No 3D Button No 3D effects are displayed.

Shutter Button This button is used in conjunction with liquid crystal shutter glasses. If your graphic card does not support or is not set up for quad buffer viewing, this button will be disabled.

Red/Blue Button This button is used in conjunction with color anaglyph (red/blue) glasses.

6.1.8.2 From the Display area

There is no display area interaction with this tool.

6.1.8.3 From the Keyboard

There is no keyboard interface to this tool.

6.1.8.4 From the Command Line

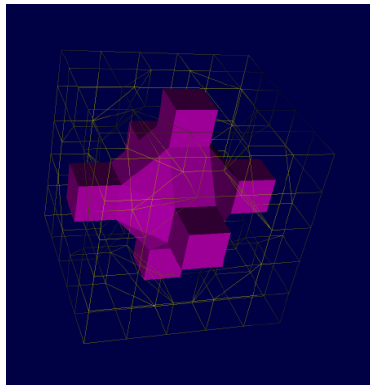
The following commands can be used in the command line or in a script file:

Stereo: *separation*

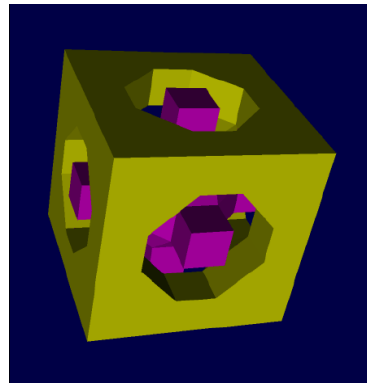
Give the separation between the eyes in cm. (Default value: 6.4 cm)

6.1.9 The Surface Shading Tool

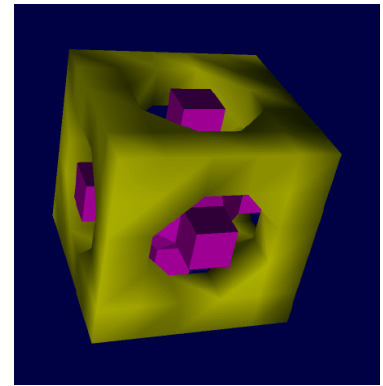
This tool enables you to control the appearance of all the 3D geometries in sliceOmatic. From this tool, you can also delete or save individual geometries.



Line

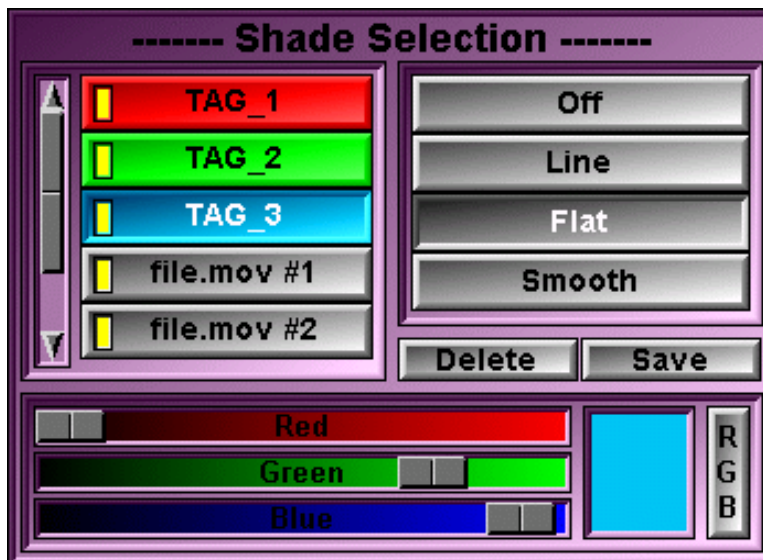


Flat



Smooth

6.1.9.1 From the Graphical Interface



Geometry List This list enables you to select the geometry on which the other controls act. The yellow indicator on the surface's button will be lit if the surface is visible (its shading is not "Off").

Shading List Select the shading you want to apply on the selected geometry. If the geometry is composed of polygons, the choices are:
Off The surface is not shown

Line	The surfaces' polygons are drawn as outlines
Flat	Each of the surface's polygons is drawn with a color determined by its orientation with the light sources and the surface's color.
Smooth	Colors are computed at the polygon's vertices and interpolated on the polygon's surface.

Note

If the geometry is composed of points or lines, only the first 2 choices are available.

- Delete Button** Delete the selected geometry.
- Save Button** Save the selected geometry to a file. The surface saving dialog box will appear. The surface can be saved in either MOVIE.BUY, Autocad DXF, VRML or STL format.
- Color Edit** Change the selected geometry's color (if the selected geometry has been recreated from a Tag, these control will also change the Tag color).

6.1.9.2 From the Display area

There is no display area interaction with this tool.

6.1.9.3 From the Keyboard

There is no keyboard interface to this tool.

6.1.9.4 From the Command Line

The following commands can be used in the command line or in a script file:

Surface: *t_surf* delete

Delete all surfaces that match the template name.

Surface: *t_surf* shade (off|line|flat|smooth)

Set the shading mode of all the surfaces that match the template name to the specified mode.

Surface: *t_surf* color R G B

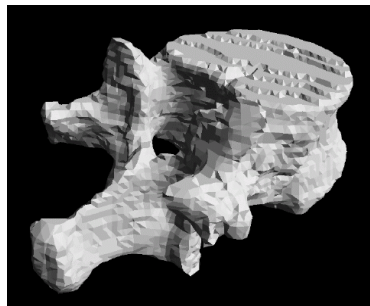
Change the specified surface's colors.

Note

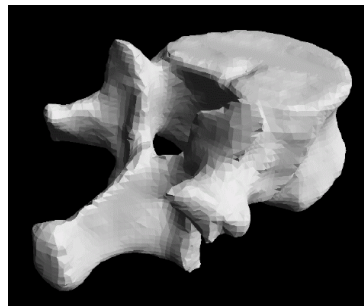
"*t_surf*" is a template that can match one or multiples surfaces. See **Appendix C.8: The Templates**.

6.1.10 The Surface Smoothing Tool

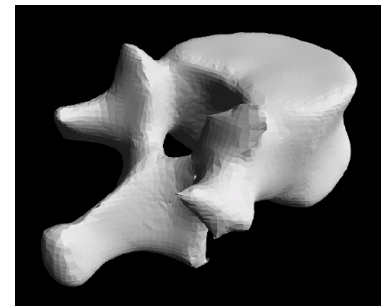
This tool enables you to smooth out any polygonal surface. Smoothing is done by computing displacement vectors that move the nodes of the geometry along the direction of their normal towards the mean value of their immediate neighbors. The nodes are only moved a fraction of the distance towards the mean value of their neighbors. Also, to prevent the surface from shrinking, a different factor is used if the nodes move outward (`fact_out`) or inward (`fact_in`). To obtain smoother surfaces, the process can be repeated multiples times (`nb_step`).



Smooth: None



Smooth: Medium



Smooth: Huge

Smoothing does not affect the nodes themselves, instead, a displacement vector is associated with each node. Smoothing is not cumulative and a smoothing of “none” will remove any smoothing.

6.1.10.1 From the Graphical Interface



None Button Remove any smoothing done to the surface.

Small to Huge Smooth out the surfaces using progressively larger values for the `fact_in`, `fact_out` and `nb_steps` parameters. By default the parameters are set to:

	<code>fact_in</code>	<code>fact_out</code>	<code>nb_steps</code>
Small	0.125	0.25	6
Medium	0.125	0.5	8
Large	0.125	1	10
Huge	0.25	2	20

6.1.10.2 From the Display area

There is no display area interaction with this tool.

6.1.10.3 From the Keyboard

There is no keyboard interface to this tool.

6.1.10.4 From the Command Line

The following commands can be used in the command line or in a script file:

Smooth: id *fact_in fact_out nb_steps*

Assign new values for the `fact_in`, `fact_out` and `nb_steps` parameters of the button number "id" (0=None, 1=Small... 4=Huge)

Smooth: compute *id*

Compute the smoothing with the parameters associated to the button "id"

Smooth: compute *fact_in fact_out nb_steps*

Compute the smoothing with the parameters "fact_in", "fact_out" and "nb_steps"

6.2 The 3D Modes

There are 4 modes associated with the 3D Module:

- The **Shell** mode,
- The **Contour Lines** mode,
- The **Volume** mode
- The **MIP** mode.



The Shell and Contour Lines modes are used to create geometries from the Tag data. The Volume and MIP modes are used to visualize the 3D data set using volume rendering techniques.

For each of the 3D modes, we will present the mode, describe the layout and function of its graphical interface, the display area manipulations that are possible in this mode, the keyboard shortcuts available for this mode as well as the command line and variables that are related to the mode.

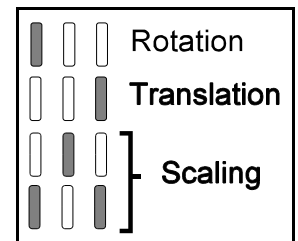
You can find a more detailed description of the keyboard shortcuts their use and their syntax in: **Appendix A: The Keyboard Shortcuts**.

A complete description of the command line syntax and its variables is presented in **Appendix C: The Command Line Syntax**

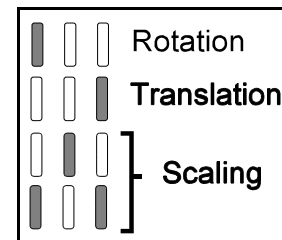
The 3D window interface.

In the 3D window, the mouse can be used to perform rotation, translation and scaling of the objects. SliceOmatic gives you a choice of 3 interaction modes:

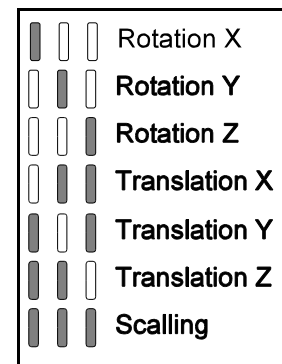
- **Trackball:** The left mouse button activates the trackball rotations. The mouse controls a point on the surface of a sphere anchored in the center of the 3D window. Moving the mouse drags the point and thus rotates the sphere around its center. The right mouse button activates the translations. The mouse motion drags the objects vertically and horizontally in the plane of the 3D window. The middle mouse button (or both the left and right) activates the scaling. The horizontal mouse motion controls the objects' scaling.



- **Classic:** The left mouse button activates the rotations. The vertical mouse motion will rotate the objects around the windows' horizontal axis. The horizontal mouse motion will rotate the objects around the window's vertical axis. The right mouse button activates the translations. The mouse motion drags the objects vertically and horizontally in the plane of the 3D window. The middle mouse button (or both the left and right) activates the scaling. The horizontal mouse motion controls the objects' scaling.



- **Patient Axis:** In this interface mode, only the horizontal mouse motion is used, and all transformations are done in the patient axis system. Thus, a “z” rotation is a rotation around the patient's head to foot axis. Each of the mouse buttons controls the rotation of the objects around one of the patient's axis. The left button activates the “x” axis rotation, the middle button the “y” axis rotation and the right button the “z” axis. Each combination of 2 buttons controls the translation of the objects along one of the patient's axis. The middle and right buttons activate the “x” translation, the left and right buttons the “y” translation and the left and middle buttons the “z” translation. Pressing all 3 mouse buttons at once activates the scaling.



By default the “Trackball” interface is selected. You can change this interaction mode with the “Preferences” menu (See **section 9.3: The 3D Module Preferences**).

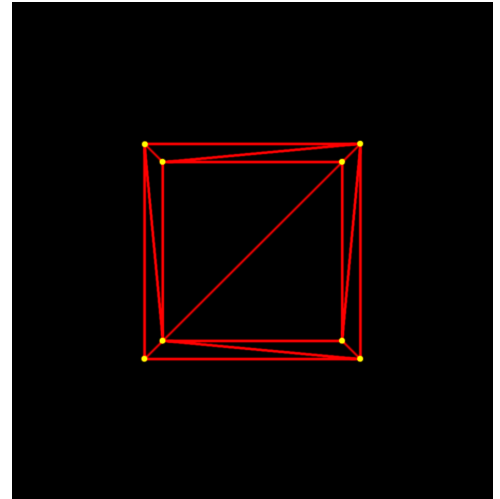
When displaying 3D surfaces or volumes, sliceOmatic will attempt to keep the refresh rate fast enough to permit a good user interaction with the 3D environment. It will do so by displaying only part of the surfaces/volumes while the objects are being moved. As soon as you stop moving the objects, the complete geometry will be drawn.

6.2.1 The Shell Mode

In this mode, you create 3D polygonal surfaces from the TAG images you created with the TAG Module.

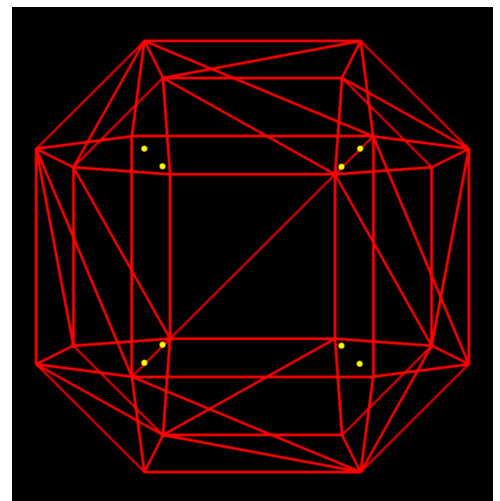
When creating the surfaces, you have a choice of 2 geometry models: TomoVision's and Lorensen's "Marching Cube".

In TomoVision's algorithm, the center of each voxel is considered as a potential node for the reconstructed surface. If this node lies on the border between 2 tag values, it will be used to anchor the surface's polygons. It is also possible to use a sub-sampling of the voxels to limit the number of polygons. When using a sub-sampling, even though the creation of the geometry uses one in N voxels, a subsequent optimization phase replace the polygons nodes close to the tag borders using all the voxels values.



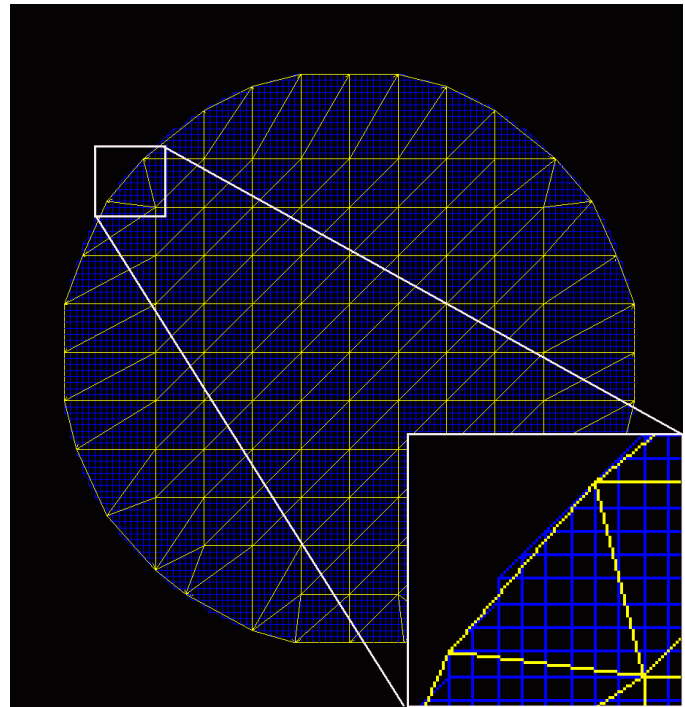
Model TomoVision: 12 polygons where created from 8 tagged voxels.

In Lorensen's algorithm, the surface will be half a pixel wider than the center of the tag voxels. The surface will be slightly larger and contain more polygons than the TomoVision model. However, the sub-sampling mode will be disabled.



Model Lorensen: 44 polygons where created from 8 tagged voxels

Using sub-sampling for the x, y or z directions will decrease the number of polygons created. One point in N will be considered. Once the polygons are created, the geometry will be expanded using all the image's voxels. The polygons' nodes will be moved on the actual border between the tags, regardless of the sub-sampling value. So even though sub-sampling reduces the polygon count, it does not affect too much the surface's contour.



2 Meshes: Using sub-sampling=1 (in blue, 14524 polygons) and sub-sampling=8 (in yellow, 444 polygons)

Note

The shell computation is only available for 3D and sorted parallel groups.

Note

The shell computation is always done in the original image's direction, regardless of the current re-slice orientations of the selected groups.

Note

The voxel sub-sampling is disabled with Lorensen's Model

6.2.1.1 From the Graphical Interface



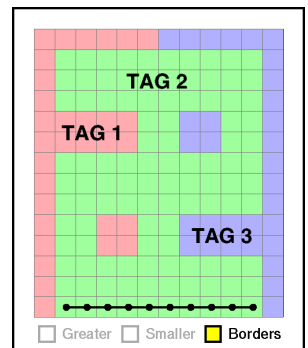
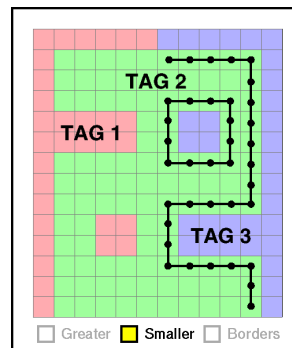
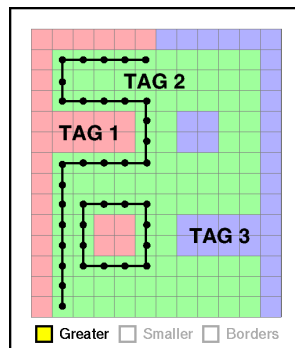
TAG List

Select which Tag is going to be used to create the 3D surfaces. A Tag must have a least 4 pixels to be enabled. The yellow indicator on the Tag's button is lit if the Tag is selected.

Conditions

These buttons control the surface creation conditions. For each selected Tag value, a surface will be created on the border of a Tag pixel if:

- The Tag value is greater than the Tag value of its neighbor
- The Tag value is smaller than the Tag value of its neighbor
- The Tag value is on the border of the volume



Voxel Sub-sampling

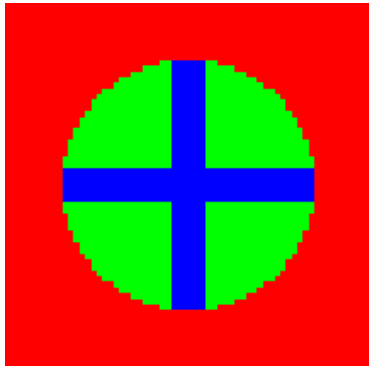
The number of polygons created is controlled by the sub-sampling, but the polygons' contour will use ALL the voxels,

Model

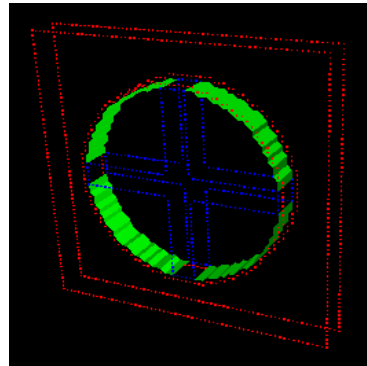
This button will toggle between the "TomoVision" model and the "Lorensen" model.

Compute Shell

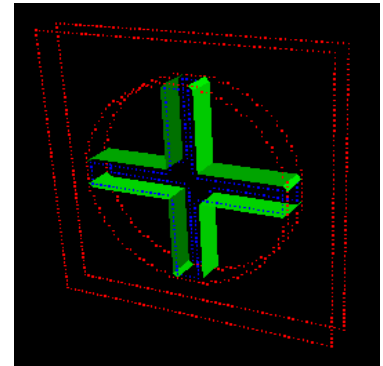
Clicking this button will cause sliceOmatic to compute the 3D shell around all the selected Tags



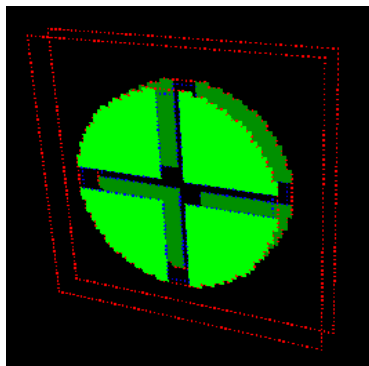
TAG image with values:
Outside=1, circle=2,
cross=3



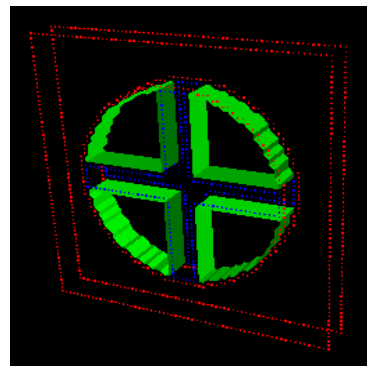
Shell of Tag-2 with:
Greater



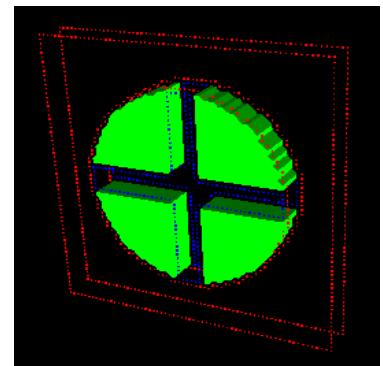
Shell of Tag-2 with:
Smaller



Shell of Tag-2 with:
Borders



Shell of Tag-2 with:
Greater and Smaller



Shell of Tag-2 with:
Greater, Smaller and
Borders

6.2.1.2 From the Display area

There is no display area interaction with this tool.

6.2.1.3 From the Keyboard

There is no keyboard interface to this mode.

6.2.1.4 From the Command Line

The following commands can be used in the command line or in a script file:

shell: conditions greater|smaller|border ON|OFF

Set the current border conditions.

shell: model TomoVision|Lorenson

Set the current polygon generation model.

shell: sampling X|Y|Z *value*

Set the current sub-sampling values (between 1 and 8).

shell: compute [TomoVision|Lorenson]

Compute the geometric shell for the selected tags using the current conditions and sub-sampling.

The following variables can also be used in script commands:

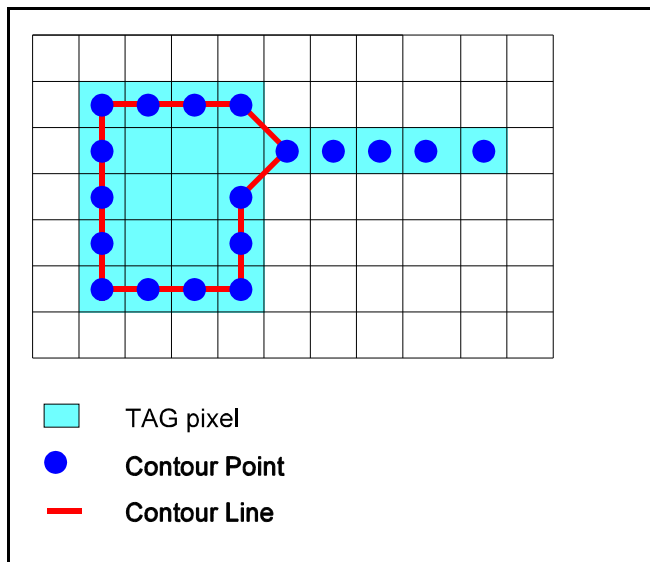
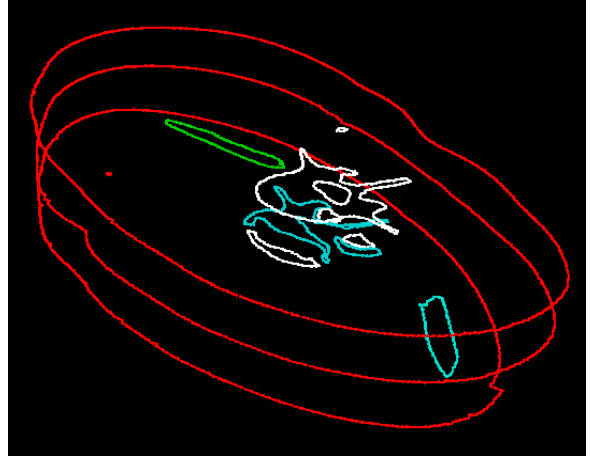
\$TAG_3D_SELECT_ALL	(Read/Write, array of strings)
\$TAG_3D_SELECT_CUR	(Read/Write, string)
\$SHELL_CONDITION	(Read/Write, bit field)
\$SHELL_MODEL	(Read/Write, string)
\$SHELL_SUB_SAMPLING	(Read/Write, array of 3 integers)

6.2.2 The Contour Mode

In this mode, you can visualize and save the contours of the Tag regions of the dataset volume. These contours can be either closed contour lines or just the points on these lines.

The line segments are ordered so that the Tag delimited by a segment is always on the right-hand side of the segment.

In the Line mode, if a Tag region is too thin, and the contour degenerates to a line (2 line segments share the same points), the degenerated segment will be eliminated. Thus, some points may appear in the Point mode but not in the Line mode. (See example below)



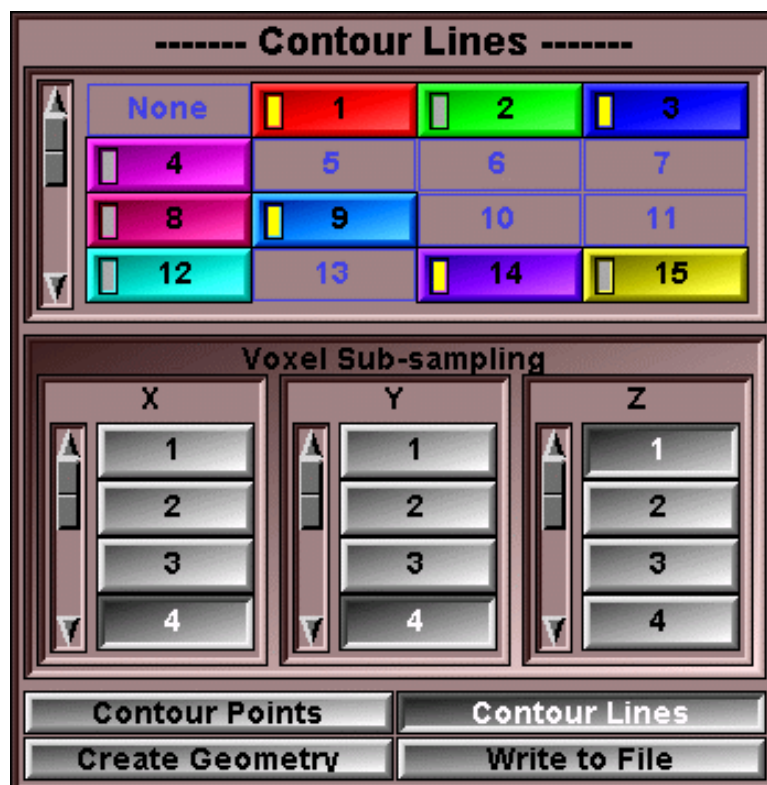
Note

There is no restriction on the groups that can be selected in the contour mode.

Note

The shell computation is done in the group's current re-slice orientations.

6.2.2.1 From the Graphical Interface



- TAG List** Select which Tag is going to be used to create the 3D surfaces. The yellow indicator on the Tag's button is lit if the Tag is selected.
- Sub-sampling** The number of points on the contours is controlled by the sub-sampling, but the polygons' contours will use ALL the voxels.
- Contour Points** Only the points on the contours of the objects will be displayed and saved.
- Contour Lines** The contours of the Tag regions will be displayed and saved as closed lines.
- Create Geometry**
A geometrical object will be created from the contours (either points or lines). These objects can be visualized in the other sliceOmatic modes, or saved to a geometry file (c.f.. **sections 2.1.9: The "Save Geometry as..." button** and **6.1.6: The Shading Tool**).
- Write To File** The contours (either points or lines) will be written to a file. The format is a simple ASCII file with the number of elements followed by the elements. (See the examples below).

```
2 closed lines for TAG 1 ****
5 points for line 1 ***
 24.000 29.000 62.000
 19.000 31.000 62.000
 32.000 29.000 62.000
 28.000 29.000 62.000
 24.000 29.000 62.000
4 points for line 2 ***
 24.000 45.000 62.000
 20.000 47.000 62.000
 28.000 45.000 62.000
 24.000 45.000 62.000
1 closed lines for TAG 2 ****
4 points for line 1 ***
 24.000 14.000 62.000
 20.000 16.000 62.000
 28.000 14.000 62.000
 24.000 14.000 62.000
```

Write to File: Line mode

```
6 points for TAG 1 *****
 19.000 31.000 62.000
 24.000 29.000 62.000
 28.000 29.000 62.000
 33.000 56.000 63.000
 43.000 56.000 63.000
 49.000 56.000 63.000
4 points for TAG 2 *****
 20.000 16.000 62.000
 24.000 14.000 62.000
 28.000 14.000 62.000
 32.000 14.000 62.000
```

Write to File: Point mode

6.2.2.2 From the Display area

There is no display area interaction with this tool.

6.2.2.3 From the Keyboard

There is no keyboard interface to this mode.

6.2.2.4 From the Command Line

The following commands can be used in the command line or in a script file:

Contour: sampling X|Y|Z value

Set the current sub-sampling values (between 1 and 8).

Contour: mode line|point

Set the contour reconstruction mode to lines or points.

Contour: compute

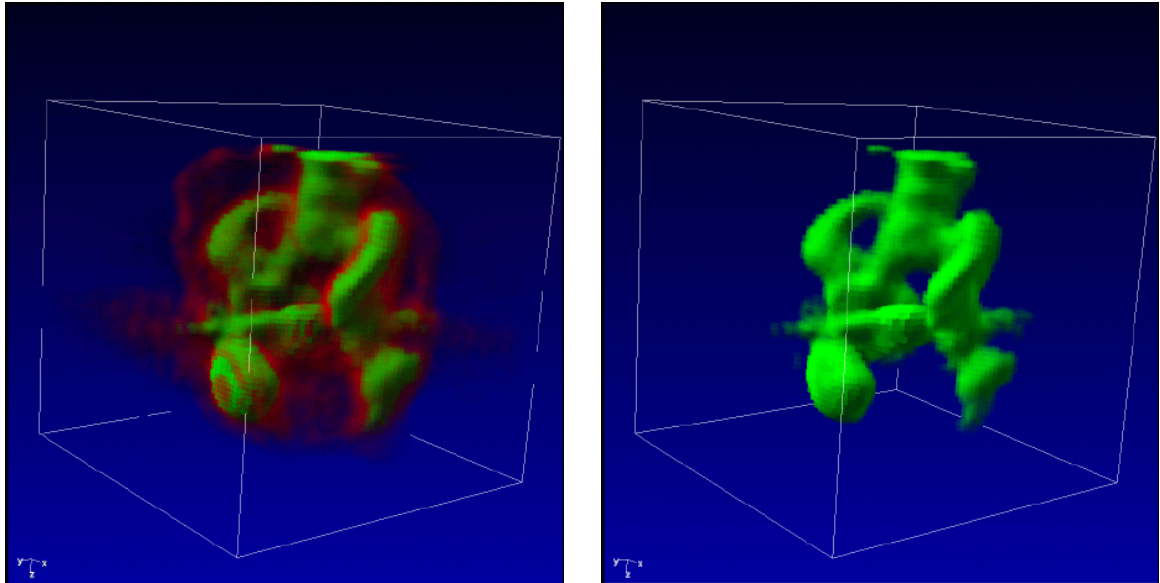
Compute the geometric contour for the selected tags using the current mode and sub-sampling.

The following variables can be used in the commands:

\$TAG_3D_SELECT_ALL	(Read/Write, array of strings)
\$TAG_3D_SELECT_CUR	(Read/Write, string)
\$CONTOUR_MODE	(Read/Write, string)
\$CONTOUR_SUB_SAMPLING	(Read/Write, array of 3 integers)

6.2.3 The Volume Mode

In this mode, you can visualize your dataset using the Volume Rendering technique. The opacity of the voxels is controlled independently for each Tag. The opacity can be a function of the voxels' gradient and/or values. Complete regions of the volume can be turned On or Off by controlling their corresponding Tags.



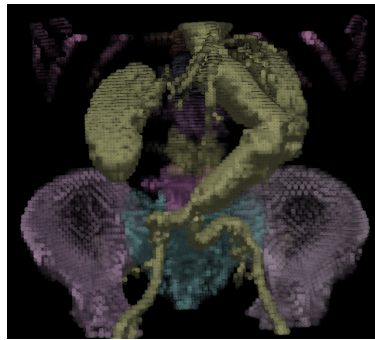
SPECT image of the pelvis, segmented with 2 threshold values. The first threshold value (Red Tag) is turned Off in the second image.

To keep the volume motion interactive, only a preview of the image is displayed. To compute the high resolution image, you need to press either "Render Volume" or "Ray-Trace Volume". With the "Render Volume" option, sliceOmatic will use OpenGL to display the volume. Depending on your graphic card, this option may be slower than the ray-tracing option.

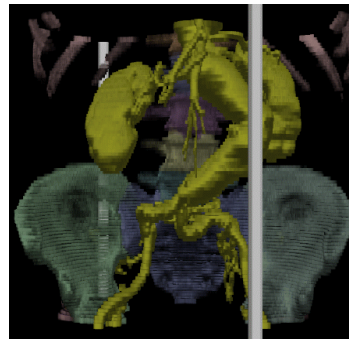
Note

In order to use ray-tracing, the images must be aligned and uniformly spaced. If this is not the case, the "Ray-Trace Volume" button will be disabled.

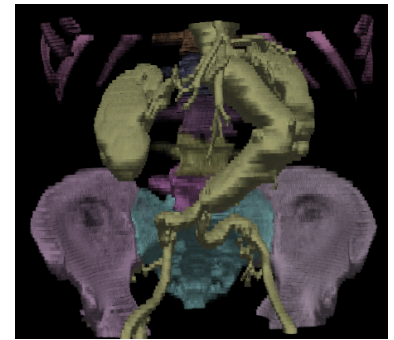
With the OpenGL option, you will be able to display volumes from slices that are non uniformly spaced, and you will be able to mix polygonal geometries with the volume.



Fast Preview

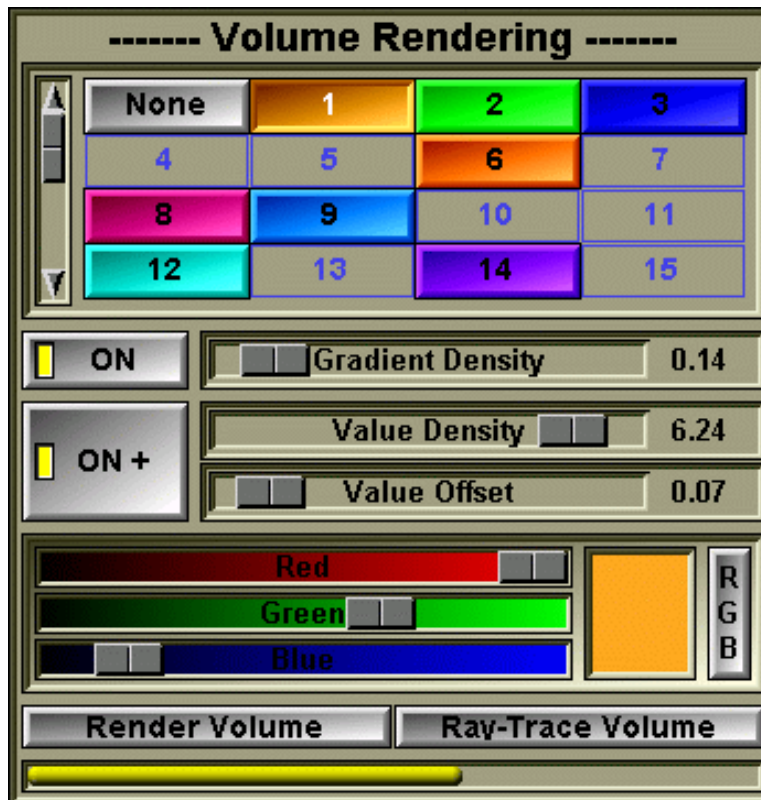


OpenGL mixed with geometries



Ray Tracing

6.2.3.1 From the Graphical Interface



TAG List

Select the current Tag. The other interface controls will modify the parameters associated with this Tag. If both the Gradient Button and the Value Button are Off, all the voxels marked with this Tag will be invisible. A Tag must have at least 4 voxels for its button to be enabled.

Gradient Button Cycle through the values "OFF" and "ON". If the value is "ON", then the voxel opacity is function of the gradient of the images.

$$\text{Opacity} \propto \text{Gradient of GLI values} * \text{Gradient Density}$$

Usually, voxel values are constant in a tissue, and change from one tissue to another. The transition from one tissue to another has high gradient due to the change in voxel values. By making the opacity a function of the gradient, we increase the visibility of the tissues' contour.

Gradient Density Fixes the gradient density. The range of this slider is from 0.1 to 10

Value Button Cycle through the values: "OFF", "ON +" and "ON -". If the value is "ON", then the voxel opacity is function either of the value of the voxels ("ON +") or of the inverse of the value of the voxels ("ON -").

$$\text{Opacity} \propto (\text{GLI value} - \text{value offset}) * \text{value density}$$

or

$$\text{Opacity} \propto ((\text{MAX value} - \text{GLI value}) - \text{value offset}) * \text{value density}$$

Value Density Fixes the value density. The range of this slider is from 0.1 to 10

Value Offset Fix the value offset. This value range between 0 and 1 where 0 is the minimum and 1 is the maximum GLI value of the images.

Color Editor Change the color of the selected Tag.

Render Volume Compute a higher resolution image using OpenGL graphic library.

Ray-Trace Vol. Compute a higher resolution image using Ray-Tracing techniques.

Progress Bar Give a graphical representation of the computation progression.



6.2.3.2 From the Display area

There is no display area interaction with this tool.

6.2.3.3 From the Keyboard

There is no keyboard interface to this mode.

6.2.3.4 From the Command Line

The following commands can be used in the command line or in a script file:

Volume: compute [OpenGL|ray]

Compute the volume image using either OpenGL (the default) or ray-tracing.

The following variables can be used in the commands:

\$VOL_TAG_GRD_MODE_ALL	(Read/Write, array of strings)
\$VOL_TAG_GRD_DENSITY_ALL	(Read/Write, array of floats)
\$VOL_TAG_VAL_MODE_ALL	(Read/Write, array of strings)
\$VOL_TAG_VAL_DENSITY_ALL	(Read/Write, array of floats)
\$VOL_TAG_VAL_OFFSET_ALL	(Read/Write, array of floats)
\$VOL_TAG_GRD_MODE_CUR	(Read/Write, string)
\$VOL_TAG_GRD_DENSITY_CUR	(Read/Write, float)
\$VOL_TAG_VAL_MODE_CUR	(Read/Write, string)
\$VOL_TAG_VAL_DENSITY_CUR	(Read/Write, float)
\$VOL_TAG_VAL_OFFSET_CUR	(Read/Write, float)

6.2.4 The MIP Mode

In this mode, you can visualize your data set using the Maximum Intensity Projection technique. The color of the voxels can be controlled independently for each Tag, or assigned by a choice of color-maps. Complete regions of the volume can be turned On or Off by controlling their corresponding Tags.

To keep the volume motion interactive, only a preview of the image is displayed. To compute the high resolution image, you need to press either "Render Volume" or "Ray-Trace Volume". With the "Render Volume" option, sliceOmatic will use OpenGL to display the volume. Depending on your graphic card, this option may be slower than the ray-tracing option.

Note

In order to use ray-tracing, the selected groups must all be of the type "3D" (the images must be aligned and uniformly spaced). If this is not the case, the "Ray-Trace Volume" button will be disabled.

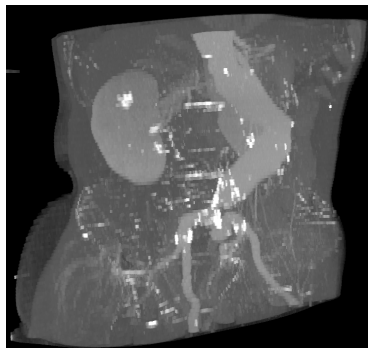
With the OpenGL option, you will be able to display volumes from slices that are non uniformly spaced, and you will be able to mix polygonal geometries with the volume.

Note

Rendering a MIP image mixed with geometries take significantly longer than just rendering the MIP image.



MIP all tissues

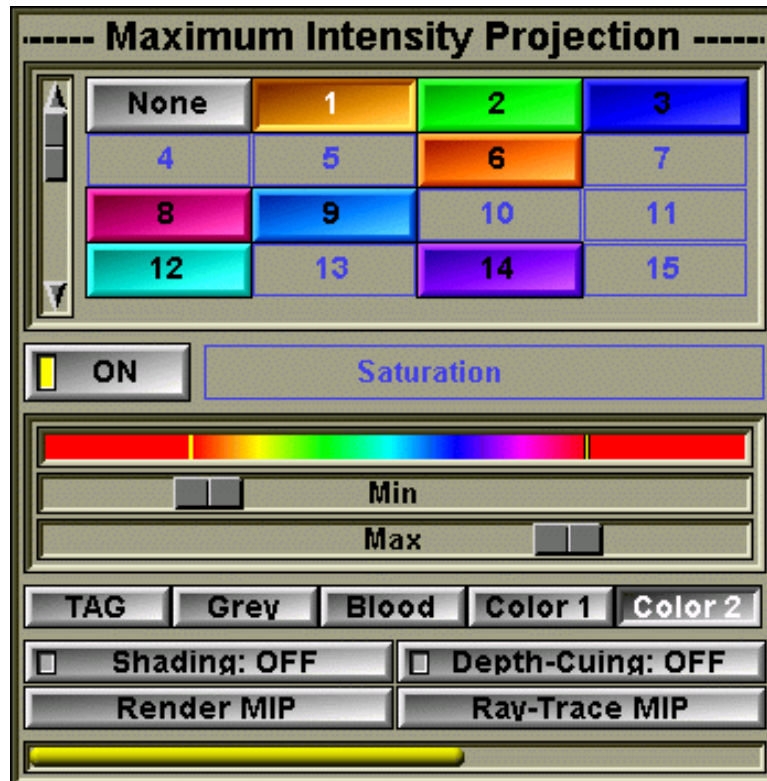


MIP removing the bones



OpenGL: Mixing MIP and geometries of the bones created in the Shell mode

6.2.4.1 From the Graphical Interface



TAG List Select the current Tag. Some of the other interface controls will modify the parameters associated with this Tag. If the Tag On/Off Button is Off, all the voxels marked with this Tag will be invisible. A Tag must have at least 4 pixels for its button to be enabled.

TAG ON/OFF Turn On or Off all the voxels marked by a Tag.

The **Saturation Slider** and **Color editor** are explained further down.

Color-map These buttons control the color scheme used to display the voxels. Changing from Tag to another Color-map will also change the appearance of the interface, disabling the saturation slider and replacing the Color Editor by a Color-map display.

Shading Shade the voxels according to their gradient and the light sources.



Depth-Cuing Attenuate the voxel colors according to their depth in the image. The color attenuation varies from the front clip-plane to the far clip-planes, so you may want to adjust the clip planes to increase the contrast.



Render MIP Compute a higher resolution image using the OpenGL graphic library.

Ray-Trace MIP Compute a higher resolution image using Ray-Tracing techniques.

Progress Bar Give a graphical representation of the computation progression.



Changing the rendering color tables

TAG In this mode, the voxels colors are taken from their Tag's colors. The color intensity can also be modulated by the voxel's GLI value with the Saturation Slider.



Saturation The color assigned to each Tag can be modulated by the GLI values of the voxels:
$$\text{Voxel's color} \propto \text{GLI value} * \text{saturation}$$

The range of this slider is from 0.1 to 100 and is controlled independently for each Tag.

Color Editor Change the color of the selected Tag.

GREY
Blood
Color 1
Color 2

With these Color maps, the voxel colors are based on their GLI values and the selected Color-map. When one of these Color-map is selected the Saturation Slider is disabled since the voxels' colors are no longer function of the Tag colors. The Tag ON/OFF button is still enabled, and you can still turn On or Off all the voxels under a Tag.



Color-map Min All GLI values smaller than the Min slider will be the same color.

Color-map Max All GLI values higher than the Max slider will be the same color. If the Min slider is higher than the Max slider, the color-map will be inverted.

6.2.4.2 From the Display area

There is no display area interaction with this tool.

6.2.4.3 From the Keyboard

There is no keyboard interface to this mode.

6.2.4.4 From the Command Line

The following commands can be used in the command line or in a script file:

MIP: compute [OpenGL|ray]

Compute the MIP image using either OpenGL (the default) or ray-tracing.

MIP: shading ON|OFF

MIP: depth ON|OFF

Enable or Disable the MIP shading and depth cuing modes

MIP: map TAG|GREY|BLOOD|COLOR1|COLOR2

Set the color map mode

MIP: min *value*

MIP: max *value*

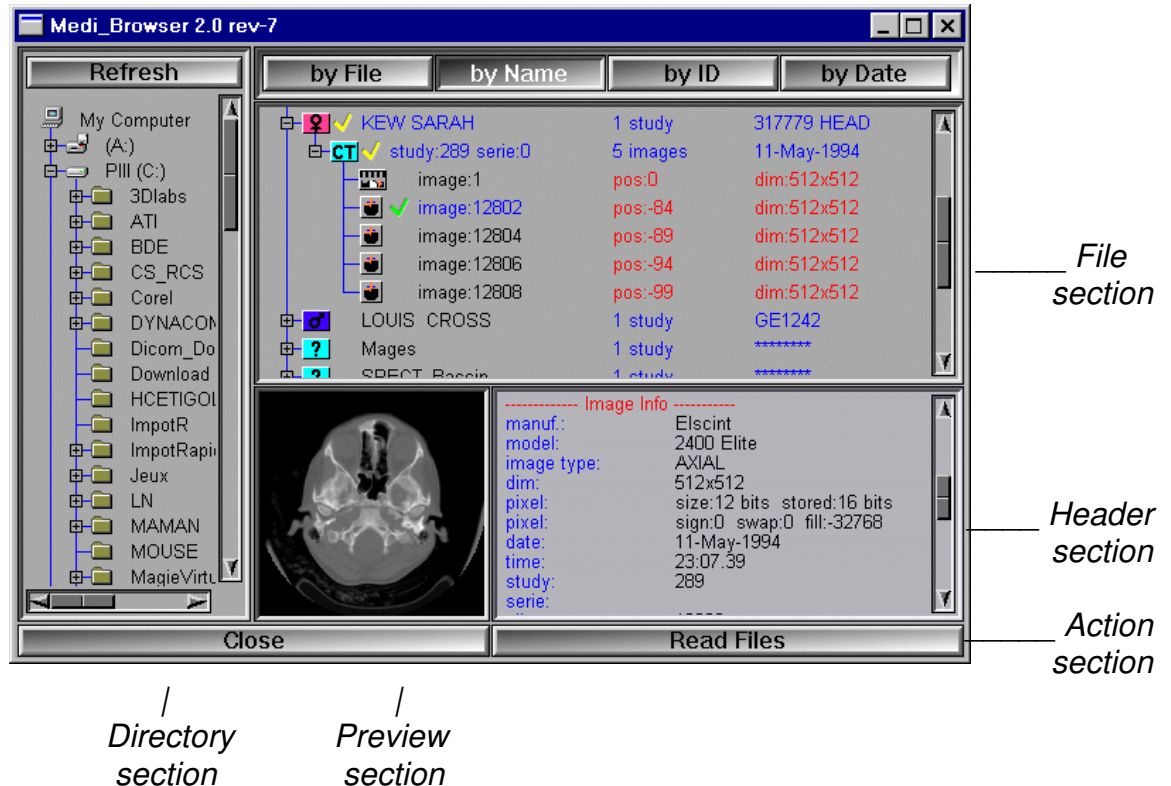
Set the color map minimum and maximum value. The value must be between 0 and 1.

The following variables can be used in the commands:

\$MIP_TAG_MODE_ALL	(Read/Write, array of strings)
\$MIP_TAG_DENSITY_ALL	(Read/Write, array of floats)
\$MIP_TAG_MODE_CUR	(Read/Write, string)
\$MIP_TAG_DENSITY_CUR	(Read/Write, float)
\$MIP_SHADING_MODE	(Read/Write, string)
\$MIP_DEPTH_MODE	(Read/Write, string)
\$MIP_MAP_MODE	(Read/Write, string)
\$MIP_MAP_MAX	(Read/Write, float)
\$MIP_MAP_MIN	(Read/Write, float)

7 The Medi_Browser Program

The Medi_Browser is an independent program, called from within sliceOmatic, to select one or several image files from the file system. The program's window is separated in 5 sections: Directory, Files, Preview, Header and Action section.








Directory You can browse through the directory tree by using the icon in the directory section. Once you have chosen a directory by clicking on its name or on its folder icon, the list of image files in this directory will appear in the file section. If there are no medical images in the directory, only the directory folder appears in the file section.

Refresh Button If the directory structure changed, you can update the browser's view of the structure with this button.





File section The 4 buttons above the file section allow you to sort the list of image files by File, Name, Patient ID or Date. All 4 sorting options will display the image files in a hierarchical tree.

Sorting by File

If the sorting is done *by File*, the tree will have 2 levels. The first level will display one icon for each file containing images. These icons will represent the type of acquisition used for the images in the file, i.e. Computed Tomography, Magnetic Resonance, Nuclear Medicine or others.




<i>Icon</i>	<i>Type of acquisition</i>
	Computed Tomography (CT) scan
	Magnetic Resonance (MR) scan
	Nuclear Medicine scan
	Ultrasound (US) images
	Other types of acquisition

The icons used for the image files at the second level of the tree represent the orientation of the image, i.e. Axial, Coronal, Sagittal or Pilot.

<i>Icon</i>	<i>Slice orientation</i>
	Axial orientation
	Coronal orientation
	Sagittal orientation
	Pilot


Sorting by Name / by ID

If the sorting is done *by Name* or *by ID*, the tree will have 3 levels. The first level will list the files according to the Patient Name or Patient ID and will display an icon representing the sex of the patient.

Icon	Sex
	Male Patient
	Female Patient
	Unknown

For each patient, the second level of the tree will display one icon per study of the patient. These icons will represent the type of acquisition of the study, i.e. Computed Tomography, Magnetic Resonance, Nuclear Medicine or others (see *Sorting by File* above for icon examples). Each study may contain one or several images. Each of these images will be listed in the third level of the tree and be marked by an icon representing the orientation of the slice (see *Sorting by File* above for icon examples).

Sorting by Date

 If the sorting is done *by Date*, the tree will have of 3 levels. The first level will display the date of creation of the image and a small calendar icon.

For each date of acquisition, the second level of the tree will display an icon per study done in that day. These icons will represent the type of acquisition of the study, i.e. Computed Tomography, Magnetic Resonance, Nuclear Medicine or others (see *Sorting by File* for icon examples). Each study contains one or several images associated with it. Each of these images will be located in the third level of the tree and the icon used for them are the slice orientations (see *Sorting by File* for icon examples).

To select an image, simply click on its icon or name in the hierarchical tree of the file section. Its name will appear in black and the image will be displayed in the Preview section at the bottom. You can select more than one image either by pressing the “shift” or “ctrl” keys while selecting, or by clicking and dragging the cursor over multiple images.

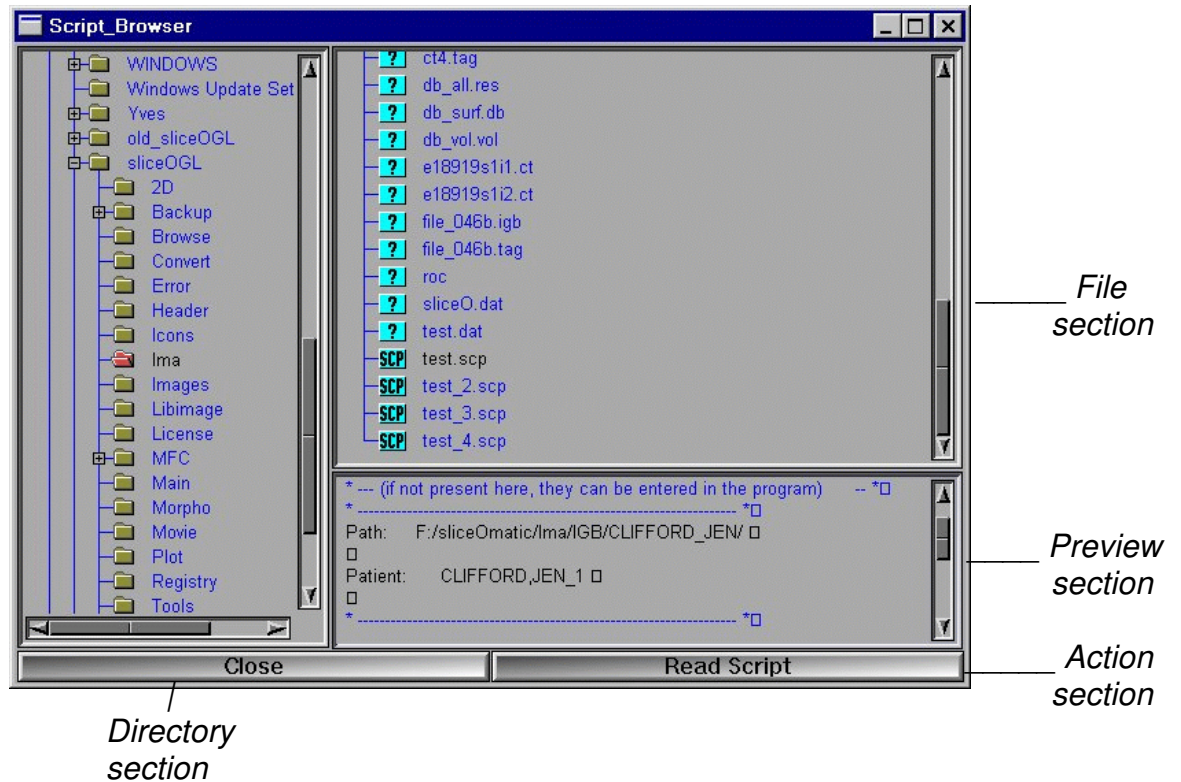
Preview

You will see a preview of the selected image in this window. If you have selected more than one image, only the first image in the file list will be displayed.

- Header** To select an image, simply click on its icon or name in the hierarchical tree of the file section. Its name will appear in black. The information contained in the header of this image will be displayed in the Header section. It is possible to scroll this window to see all the information displayed. If you have selected more than one image, the information of the first image of your selection will be displayed in the Header section.
- Action** Once you have selected all the files that you want to read in sliceOmatic, click the **Read Files** button in the action section. If you don't want to read any image, just click on **Close**. Pressing the <ESC> key will also exit the Image Browser without making any selection.

8 The Script_Browser Program

The Script_Browser is an independent program, called from within sliceOmatic, to select a script file from the file system. The program's window is separated in 4 sections: directory, files, preview, and action section.



Directory You can browse through the directory tree by using the icon in the directory section. Once you have chosen a directory by clicking on its name or on its folder icon, the list of text files in this directory will appear in the file section. If there are no text files in the directory, only the directory folder appears in the file section.

Refresh Button If the directory structure changed, you can update the browser's view of the structure with this button.

File section A list of all the text files found in the selected directory will be presented in this section. Each file is preceded by an icon. You can select the desired file by clicking on its name or its icon. Its name will appear in black.

- Preview** The text contained in the file selected in the **File section** will be displayed in this section. It is possible to scroll this window to see all the information displayed.
- Action** Once you have selected the file that you want to read in sliceOmatic, click the **Read Script** button in the action section. If you don't want to read any script, just click on **Close**. Pressing the <ESC> key will also exit the Script_Browser without making any selection.

9 The sliceOconfig Program

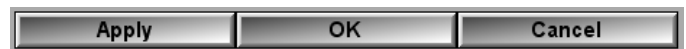
The sliceOconfig program is called through the “Preferences” button in the main menu. It is used to configure the program and its interface. The changes you make to the preferences in the “Drivers” section will be visible the next time you start sliceOmatic.

The Module Tabs



The preferences for each of sliceOmatic’s modules are grouped under a Tab.

The Apply/OK buttons



Activating the Apply or OK buttons will save the preferences in the file “sliceO.ini”.

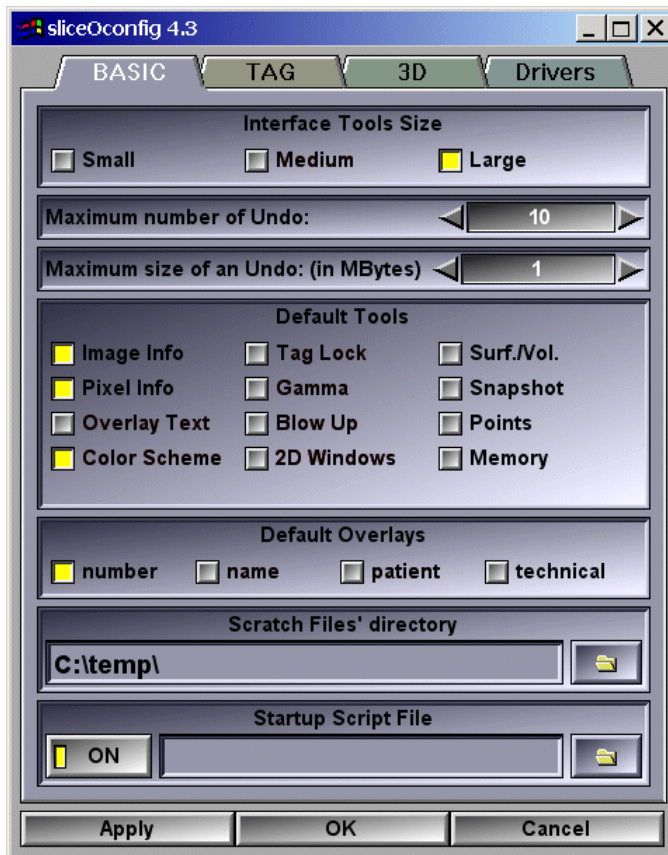
Pressing the “ESC” key, activating the “Close window” icon or the “Cancel” button will close the program without saving the preferences.

The “sliceO.ini” file

This file will be stored in the current user’s work directory (on Windows NT/2000 and XP, that directory will be: C:\Documents and Settings*user_name*\Application Data\TomoVision, where *user_name* is the name of the current user.)

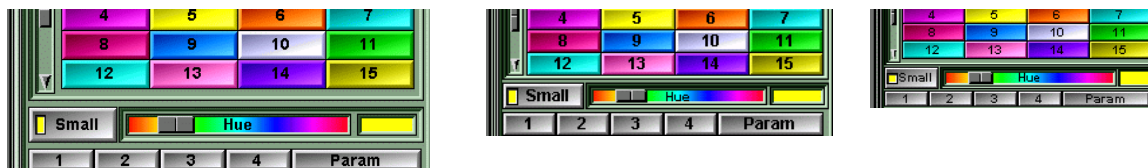
When sliceOmatic starts, it will attempt to read two “sliceO.ini” files. The first is located in the same directory as the program’s executables. This “sliceO.ini” file will give preferences that will be common to all sliceOmatic’s users. The second “sliceO.ini” file is located in the user’s work directory. It will give preferences that are individual to each user. The syntax of the sliceO.ini file is explained in Appendix C: The command syntax.

9.1 The Basic Module Preferences



Interface Tools Size

You can select the size of the interface's tools. If you are using a screen resolution of 1024x768 or less, it may be advantageous to use smaller interface tools. By default the large tools size is selected



Number of Undo

You can select the maximum number of Undo that the program keeps in memory. In order to undo most of the operations, the program has to keep a copy of the images in memory. If your system is running low on memory, it might be a good idea to reduce the number of Undos. By default the number of Undo is set to its maximum value: 10.

Maximum size of an Undo

Each individual Undo operation is limited in size. If an operation causes the associated Undo to be bigger than that size, a choice will be given to the user: cancel the operation, increase the maximum size of an Undo, or forgo the undo for the current operation (this choice will also remove the current Undo for any previous operations).

Default Tools

You can select the tools that will be displayed in the interface at startup. You can always activate and deactivate tools through the “Tools Menu”. By default the “Image Info”, “Pixel Info” and “Color Scheme” tools are selected.

Default Overlays

The Overlays display information about the image, its patient and the acquisition modality. You can select which of these are displayed by default. You can always change the overlays through the “Overlay Tool”. By default the “Name” overlay is selected.

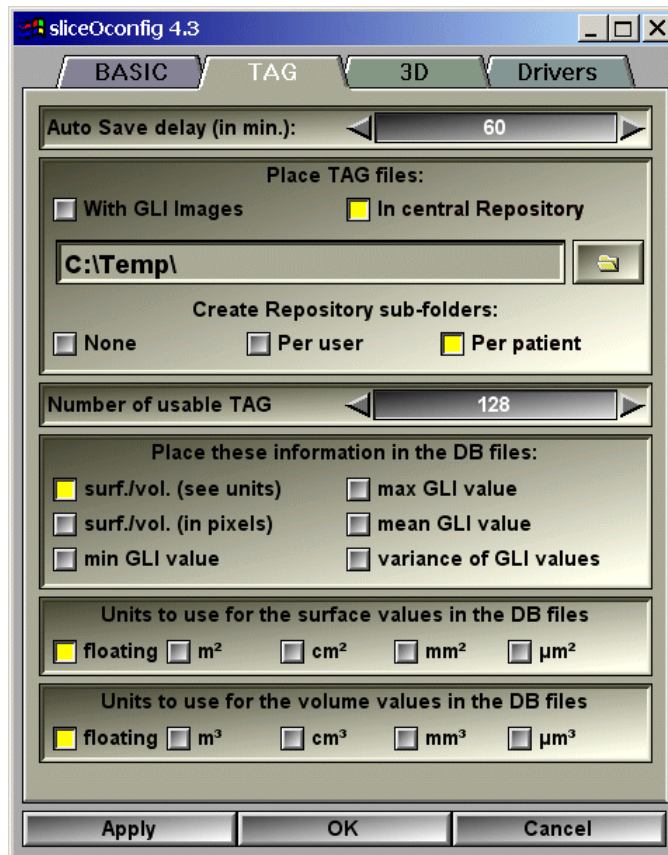
Scratch Files’ Dir.

SliceOmatic creates temporary files, error log files and image snapshot files. You can specify in which directory you want these to be created. By default the scratch directory is “C:\Temp”.

Startup Script

You can have sliceOmatic execute a script at startup. This script usually contains some of your preferences such as Tag’s labels, segmentation threshold values, 3D light positions... By default the Startup Script is disabled.

9.2 The TAG Module Preferences



Auto Save delay

All modified Tag values will be saved to file automatically at regular intervals. You have a choice of values ranging between 1 and 120 minutes. By default, this option is disabled.

Placing TAG files

These options tell the program where to place the Tag files. The Tag files can be placed either with the GLI images, or in a Repository. If they are placed in a Repository, they can be either grouped together in the repository's directory, or placed in sub-directories. You can have a sub-directory for each Windows user, and a sub-directory for each patient. By default the Tag files are placed in the central repository "C:\TAG_Repository" with one sub-directory for each patient.

Number of usable TAG

The number of Tag values that you can use in the program can be changed. You have a choice of 16, 32, 64, 128 or 256 Tag values. If you are only using a few Tag

values, decreasing the number of usable Tags will make for less crowded interfaces. The default value is 128

The Surface and volume DB files

The Surface/Volume tool can generate database files with surface and volume information for each Tag. By default these files will contain information on the surface (DB Surfaces) or volumes (DB Volumes) of each Tag. You can also add the following information to these files:

- surface or volume of each Tag in pixels
- min and maximum GLI values under each Tag
- mean GLI value under each Tag
- variance of the GLI values under each Tag

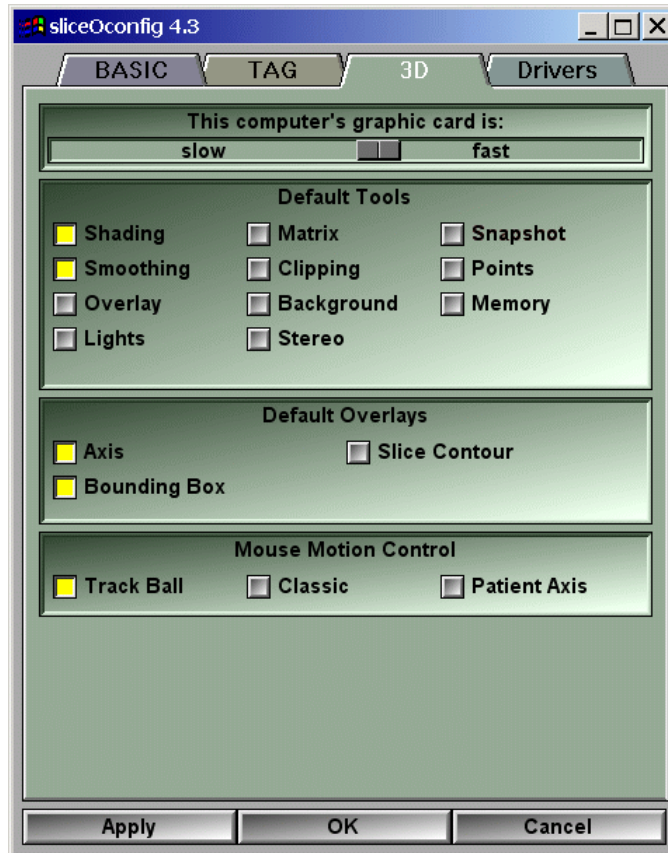
The units of the surface values in the DB files

You can select the units used to describe the surface information saved in the DB file by the Surface/Volume tool. With the “floating” option, the program will automatically select the units to provide 4 digits of significant values. However, since this may cause the units to change from slice to slice, you may prefer to force the values to be expressed in a fixed unit.

The units of the volume values in the DB files

As with the surface units, you can select the units used to describe the volumes.

9.3 The 3D Module Preferences



Graphic Speed

This slider controls the fragmentation of the 3D redraw process. Pushing this slider to the left will force the redraw to be done in multiple small fragments to help the interaction. The graphic speed can also be controlled with the command:

3d_speed: *factor* where factor range from .01 to 100

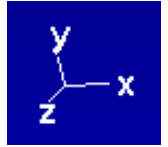
Default Tools

You can select the tools that will be displayed in the interface at startup. You can always activate and deactivate tools through the "Tools Menu". By default the "Surface Shading" and "Light Controls" tools are selected.

Default Overlays

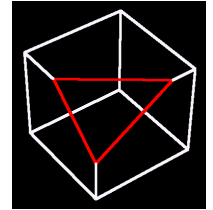
Even though these items are not exactly overlays, they are added on the 3D image and can be turned On or Off. You can also control these items with the "F9" and "F10" keys. By default the "Axis" and "Bounding Box" graphics are enabled.

- Global Axis: This enables a 3D axis system in the bottom left corner of the window. The axes are in the patient coordinates system.

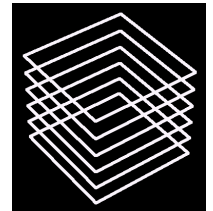


- Local Axis: This enables a local 3D axis system in the center of each object.

- Bounding Box: The exterior lines of the box containing all the images are drawn in white. If the clip planes intersect this box, the resulting clip contours are drawn in red.



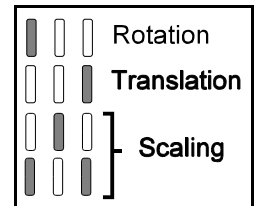
- Slice Contour: A white contour line is drawn around each image. This overlay can be combined with the Bounding Box.



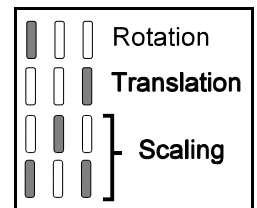
Mouse Motion Control

In the 3D window, the mouse can be used to perform rotation, translation and scaling of the objects. SliceOmatic gives you a choice of 3 interaction modes:

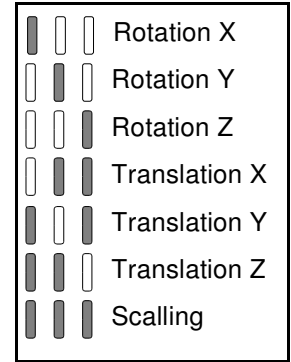
- **Trackball:** The left mouse button activates the trackball rotations. The mouse controls a point on the surface of a sphere anchored in the center of the 3D window. Moving the mouse drags the point and thus rotates the sphere around its center. The right mouse button activates the translations. The mouse motion drags the objects vertically and horizontally in the plane of the 3D window. The middle mouse button (or both the left and right) activates the scaling. The horizontal mouse motion controls the objects' scaling.



- **Classic:** The left mouse button activates the rotations. The vertical mouse motion will rotate the objects around the windows' horizontal axis. The horizontal mouse motion will rotate the objects around the window's vertical axis. The right mouse button activates the translations. The mouse motion drags the objects vertically and horizontally in the plane of the 3D window. The middle mouse button (or both the left and right) activates the scaling. The horizontal mouse motion controls the objects' scaling.



- **Patient Axis:** In this interface mode, only the horizontal mouse motion is used, and all transformations are done in the patient axis system. Thus, a “z” rotation is a rotation around the patient’s head to foot axis. Each of the mouse buttons controls the rotation of the objects around one of the patient’s axis. The left button activates the “x” axis rotation, the middle button the “y” axis rotation and the right button the “z” axis. Each combination of 2 buttons controls the translation of the objects along one of the patient’s axis. The middle and right buttons activate the “x” translation, the left and right buttons the “y” translation and the left and middle buttons the “z” translation. Pressing all 3 mouse buttons at once activates the scaling.



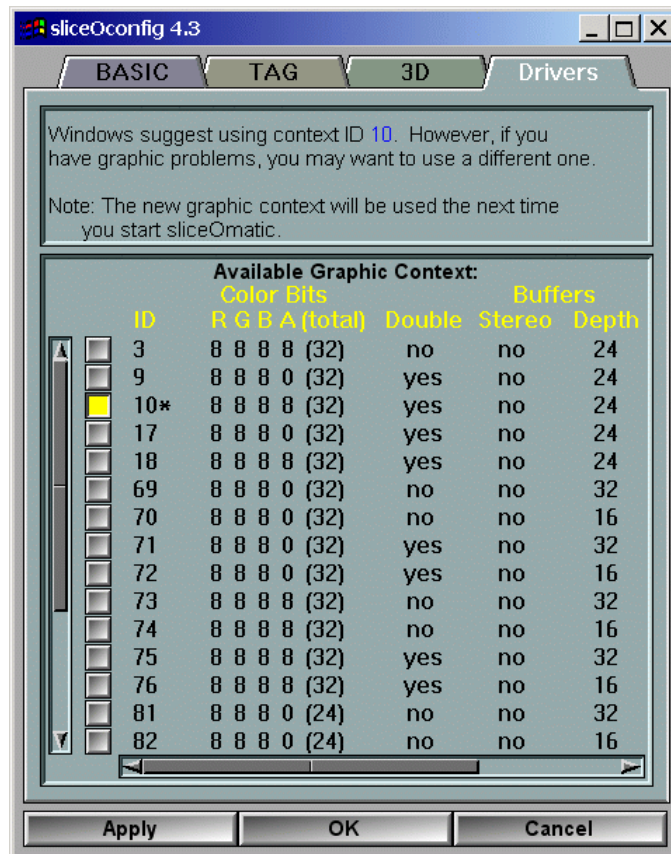
By default the “Trackball” interface is selected.

9.4 The Drivers Selection

One of the first things that sliceOmatic does is ask Windows for a graphic context to talk to your graphic card. SliceOmatic specifies its needs (at least 16 bits of colors, a depth buffer, a stencil buffer and preferably a double buffer and an overlay buffer) and Windows returns what it believe is the best context to fulfill these needs. However, sometimes the context returned by Windows is not the best choice.

If you experience graphic problems, it may be due to a bad driver. If this is the case you should:

- Download and install the latest drivers available from the manufacturer of your graphic card.
- If that didn't solve the problem, you can select a new context ID from the available contexts presented in the list.



Context ID List This is the list of all the available graphic contexts that meet the minimum requirements asked for by sliceOmatic. The list shows you the characteristics of each context. These are:

- ID** The context ID number used by Windows to identify this context. The context proposed by Windows is identified with a “*”.
- Color Bits** The number of bits used for each color components (R, G and B) the transparency (α) and the total number of bits. SliceOmatic does not really use the α buffer, so any context that has 8 bits of RGB colors would work.
- Double Buffer** Presence or absence of a double buffer. The double buffer helps reduce the image flickering when sliceOmatic redraws its screen. Select a context with a double buffer if it is available.
- Stereo Buffer** The stereo buffer is used to create 3D effect with time multiplex liquid crystal glasses (such as “Crystal eyes”). This option is rarely supported by graphic cards, so don't be disappointed if your card does not have a stereo buffer. You need to select a context with stereo buffer if you want to use the “Shutter” option in 3D viewing. If you do not have a stereo buffer, you will still be able to use the “Red/Blue” option to obtain a 3D effect with anaglyphic glasses.
- Depth Buffer** This buffer is used to compute the back-face elimination in 3D graphics. It is also used for the MIPS computation. The usual values for this buffer are 16, 24 or 32 bits. You should select a context with at least 24 bits of depth buffer.
- Stencil Buffer** This buffer is used to display information and some tools on top of the images. SliceOmatic needs at least 4 bits of stencil.
- Overlay Buffer** This buffer can also be used to display information on top of the images. It is a much better way of doing it than the stencil buffers. Unfortunately, almost no graphic cards supports the overlays anymore. So for the time being, sliceOmatic has stopped using the overlay buffers. The overlay information is still being displayed in the Context ID list, but that's more for sentimental reason than anything... You do not need any overlay planes to run sliceOmatic.

Note

If you change the graphic context, your choice will not be used until you restart sliceOmatic.

10 The Raw Header Program

The Raw Header program is called through the “Preferences” button in the main menu.

SliceOmatic can recognize most of the medical images formats. If an image is not recognized by sliceOmatic, it might still be possible to read it, provided the image data is not compressed. In order to read this image, we need to generate a new image header that will enable sliceOmatic to understand the image data. Raw_Header creates this header. The image file is not modified, a second file, with the extension “.raw”, is created instead containing the new header information.

Raw_Header can also be used to modify the information from images that can be read in sliceOmatic. If you create a new raw header for these images and access these images through the new header, the information from these new headers will be used.

The Section Tabs



The raw header is composed of 4 sections: The File Format, The Image Format, the Image Geometry and the Patient Info. The Image Format can be defined either numerically or graphically. The 4 tabs will control which of these sections you are manipulating.

The Program controls



At the bottom of the window are tools present in all sections.

Open File

Call a Window’s “File Open” interface to open one or more new images in the Raw_Header program. Alternatively, you can drag and drop files in the Raw_Header window to open new images.

Current File

Select the current image from a list of all the opened images. The image list cycles through the images that have been opened in the program. The File Format, Image Format, Image Geometry and Patient information sections enable you to change the header of the current image.

Apply to All Files

You can apply the File Format, Image Format, Image Geometry and Patient Info. of the current image to all the other images presently opened in the program. The program will assign origins to the images to create a 3D data set according to the

information provided in the Image Geometry section. Care should be taken that the images are opened in the same order as the order specified with the "Image Ordering" buttons of the Image Geometry section.

Write Headers The program will create 1 new header for each opened image. The header will have the same name as the opened image but with the ".raw" extension.

Exit Exit the program.

At typical ".raw" file look like this:

```
magic:RAW_DATA
x:512 y:512 z:1
pixel_size:16
pixel_plane:1
pixel_sign:0
pixel_swap:0
pixel_pading:-32769
file_offset:3072
image_offset:0
file_name:ct1
inc_x:0.4375
inc_y:0.4375
inc_z:5.0000
thickness:2.5000
org_x:-2.2000
org_y:-5.7254
org_z:89.8273
dir_h_x:0.0000
dir_h_y:-1.0000
dir_h_z:0.0000
dir_v_x:-1.0000
dir_v_y:0.0000
dir_v_z:0.0000
axis_syst:0
axis_trust:1
slice_orientation:Axial
serie_num:"289"
image_num:"12804"
patient_name:"Anonymous"
patient_id:"123456"
hospital:"St Glinglin Hospital"
physician:"Anonymous"
```

Sample ".raw" header file

10.1 The File Format tab

This section is split in 4 regions: Image Format, Pixel Format, Image Format Suggestions and an Image preview.

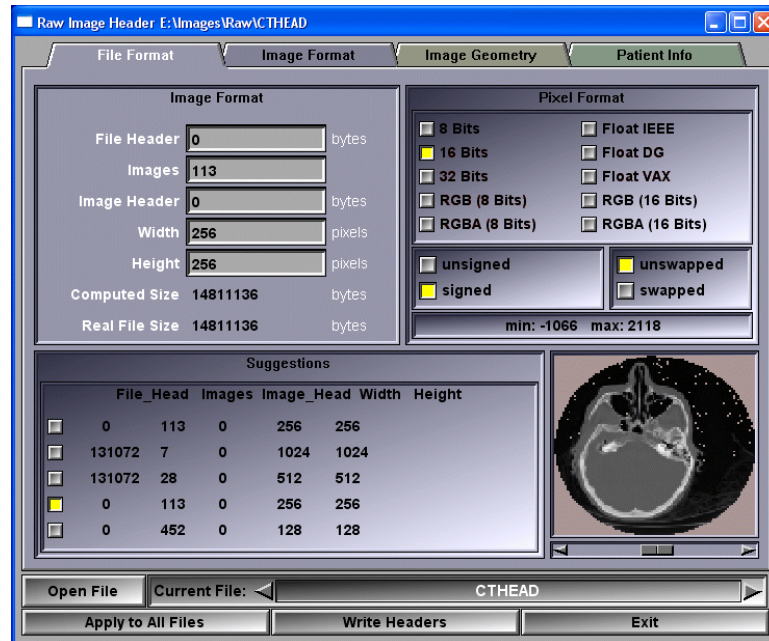
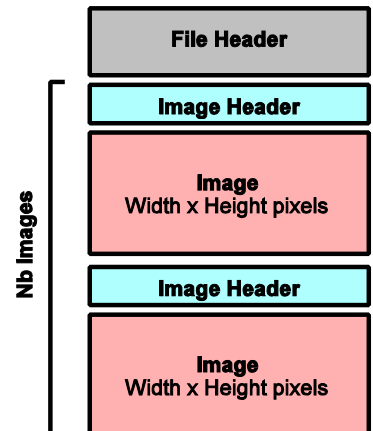


Image Format In this region, you can change the image file structure information. The image file is composed of a file header, followed by a series of images. Each of these images has an image header followed by the image itself. The image is Height by Width pixels. This region also provides information on the file size computed from the information and the actual file size.



Pixel Format In this region, you can specify how each pixel is stored in the image. Each pixel can be stored as an integer value using 8, 16 or 32 bits, or a float value using 32 bits (the program can recognize 3 float formats: IEEE, Data General or VAX), or a color value using 3 or 4 components of 8 or 16 bits each.

- For 8, 16 and 32 bit integer values, the value can be either signed or unsigned.

- If the pixel is 16 or 32 bits integer values, the bytes representing the pixel can be LITTLE ENDIAN (unswapped) or BIG ENDIAN (swapped).
- If the pixel is a float value, then the byte order of the value can be ABCD, DCBA, CDAB or BADC.
- If the pixel is created with 3 color components, then the image can be represented by Width x Height color pixels of 3 bytes each, or by 3 planes of Width x Height pixels, each plane constituting a separate color. The order of the colors components can be either RGB (unswapped) or BGR (swapped).
- If the pixel is created with 3 color components, then the image can be represented by Width x Height triplets of colors, or by 3 planes of Width x Height values, each plane constituting a separate color.
- If the pixel is created with 4 color components, then the image can be represented by Width x Height color pixels of 3 bytes each, or by 3 planes of Width x Height pixels, each plane constituting a separate color. The order of the colors components can be either RGBA (unswapped) or ABGR (swapped).
- If the pixel is created with 3 color components, then the image can be represented by Width x Height triplets of colors, or by 3 planes of Width x Height values, each plane constituting a separate color.

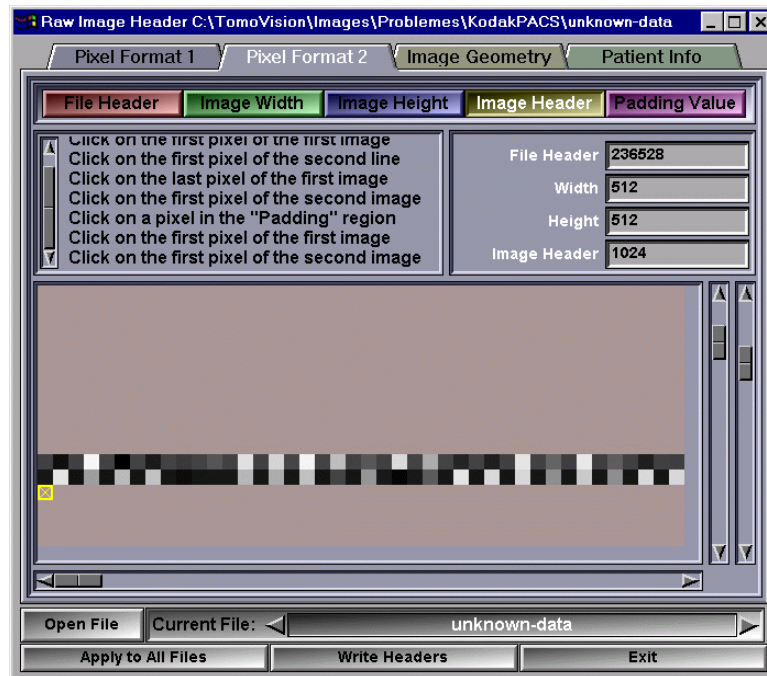
To help finding the correct combination, the minimum and maximum values of the pixels is computed. The combination that yield the lowest dynamic range is usually the correct one.

Suggestions Once the program knows the pixel format, it can make a few guesses about the image format. The program assumes that the images are square, that they have dimensions that are powers of 2 and that the images are at the end of the file. From that it creates a list of suggestions. Clicking on one of these suggestions will fill out the Image Format region with the corresponding values.

Image Preview Using the Image and Pixel Formats, the program displays a preview of the image in this region. If the file has more than 1 image, a slider at the bottom of this window will enable you to view all the images.

10.2 The Image Format tab

It is sometime difficult to find the correct image format using only a numerical interface. This section enables you to specify the image format graphically. The interface of this section is composed of: a list of buttons for the current parameter, a text feed-back region, a numerical image format input region and a graphical input region.



Current Parameters These buttons are used to specify to the program which of the parameters you want to fix.

Text Feedback The text in this region should help you fix the parameters

Numerical Input Once you fix a parameter graphically, its value will be displayed here, inversely, you can enter the numerical value of the parameter and see the results in the graphical input region. These values are shared with the Pixel Format section.

Graphical input This region is composed of a graphic window, a vertical and horizontal scroll bar, and a scale slider (extreme right). The scale slider is used to scale up or down the image in the graphic window. If the image does not fit entirely in the graphic window, the vertical and horizontal scroll bars can be used to scroll the image.

The image will show you a representation of all the pixels in the file. Each byte from the file is represented by a black & white pixel. The colors range from black for a byte of value 0 and white for a byte of value 255. If there is an uncompressed image in the file, it should be easy to discern its pattern. You then have to click on the different pixels of the image:

File Header

You click on the first pixel of the image. This will fix the size of the file header. Note that the first image actually starts after the file header and the first image header. As long as the image header is not known, it is assumed to be 0. To help in the image information identification, the pixels following the file header will be displayed using the "Pixel Format" defined in the Pixel Format section.

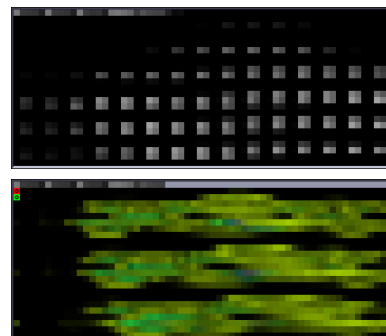


Image Width

You click on the first pixel of the second line of the image. This will fix the width of the images.

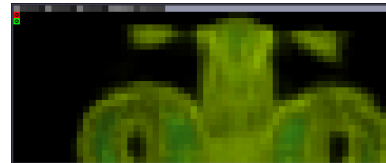


Image Height

You click on the last pixel of the image. This will fix the images height.

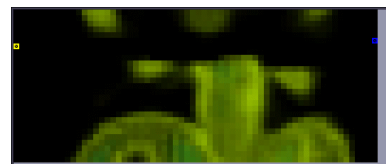
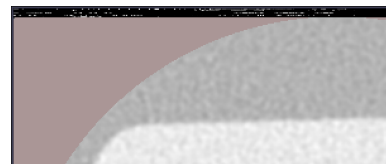


Image Header

You click on the first pixel of the second image. If your file has more than 1 image, this will fix the size of each image's header.

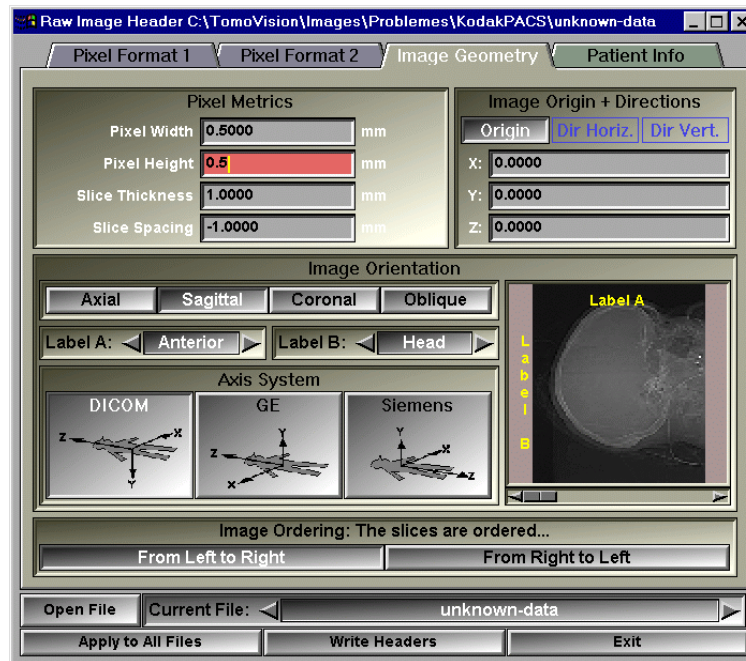
Padding value

You click on a pixel inside the padding region of the image. For some image modality like CT, the actual image is surrounded by a "padding" to make the image square. The pixels from this padding will usually mess up some image computation like histograms and dynamic range. Identifying this padding will help sliceOmatic.



10.3 The Image Geometry tab

In this section, you will be able to specify the physical dimensions and orientations of the image. This section is composed of 4 regions: the Pixel Metrics, the Image Origin, the Image Orientation and the Image Ordering.



Pixel Metrics

This region will specify the physical dimensions of a pixel in the image. We need its width and height in mm, the slice thickness, and if you want to create a 3D data-set, you need the spacing between each slice. This value will be used to fix the other image's origin if you use the "Apply to All Files" button. The sign of the slice spacing is affected by the axis system and the image ordering information.

Image Origin

This region is used to specify the position of the bottom left corner of the image. The values are specified in the patient's 3D coordinates system. If the image orientation is oblique, we will also use this region to specify the horizontal and vertical orientation of the image.

Image Orientation

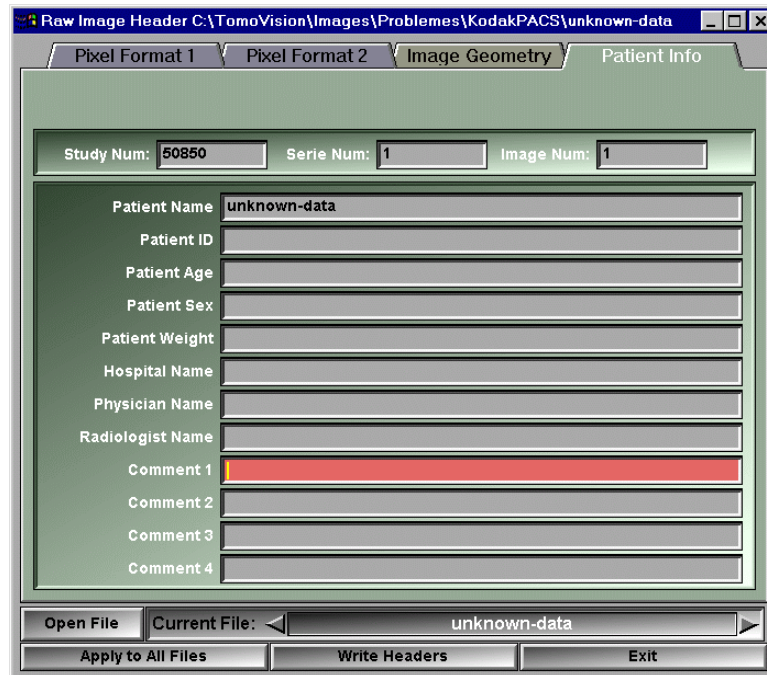
The image can be either Axial, Sagittal, Coronal or Oblique. The "Label A" is the label at the top of the image, the "Label B" is on the left side of the image. Their values can be one of: "Unknown", "Anterior", "Posterior", "Head", "Feet", "Left", "Right". You also have to select the axis system that you want to use for this image. You have a choice among the 3 most popular axis systems for medical scanners.

Image Ordering

The image ordering, in conjunction with the slice spacing, will be used to compute the image origin of the other opened images if you click on the "Apply to All Files" button.

10.4 The Patient Info

This section will enable you to add (or edit) the patient information to the image. It has 2 regions, one to enter the study, series and image numbers of this image, the other to enter the textual information associated with the image.



The screenshot shows the 'Raw Image Header' application window with the 'Patient Info' tab selected. The window title is 'Raw Image Header C:\TomoVision\Images\Problemes\KodakPACS\unknown-data'. The interface includes several input fields for patient information and a set of control buttons at the bottom.

Field	Value
Study Num:	50850
Serie Num:	1
Image Num:	1
Patient Name	unknown-data
Patient ID	
Patient Age	
Patient Sex	
Patient Weight	
Hospital Name	
Physician Name	
Radiologist Name	
Comment 1	
Comment 2	
Comment 3	
Comment 4	

Control buttons: Open File, Current File: unknown-data, Apply to All Files, Write Headers, Exit

Appendices

Appendix A: Keyboard Shortcuts

The keyboard shortcuts are defined in the file: "sliceO_key.scp". You can change these default key assignments with the syntax:

```
key: key_name map shortcut_name
```

A.1 The available key names

The available key names are (from the sliceO_key.scp):

```
"a" to "z", "A" to "Z", "ALT-A" to "ALT-Z", "CTRL-A" to "CTRL-Z"
"0" to "9", "SHIFT-0" to "SHIFT-9", "ALT-0" to "ALT-9", "CTRL-0" to "CTRL-9"
"`, "~", "!", "@", "#", "$", "^", "&", "*", "(", ")", "-", "_", "=", "+", "[", "{",
"]", "}", "\\", "|", ";", ":", "'", " ", "<", ".", ">", "/", "?", "SPACE",

"ENTER", "SHIFT-ENTER", "ALT-ENTER", "CTRL-ENTER",
"BACKSPACE", "SHIFT-BACKSPACE", "ALT-BACKSPACE",
"CTRL-BACKSPACE",

"TAB", "SHIFT-TAB", "ALT-TAB", "CTRL-TAB",
"PRINT", "SHIFT-PRINT", "ALT-PRINT", "CTRL-PRINT",
"UP", "SHIFT-UP", "ALT-UP", "CTRL-UP",
"DOWN", "SHIFT-DOWN", "ALT-DOWN", "CTRL-DOWN",
"LEFT", "SHIFT-LEFT", "ALT-LEFT", "CTRL-LEFT",
"RIGHT", "SHIFT-RIGHT", "ALT-RIGHT", "CTRL-RIGHT",
"INSERT", "SHIFT-INSERT", "ALT-INSERT", "CTRL-INSERT",
"HOME", "SHIFT-HOME", "ALT-HOME", "CTRL-HOME",
"PAGE-UP", "SHIFT-PAGE-UP", "ALT-PAGE-UP", "CTRL-PAGE-UP",
"DELETE", "SHIFT-DELETE", "ALT-DELETE", "CTRL-DELETE",
"END", "SHIFT-END", "ALT-END", "CTRL-END",
"PAGE-DOWN", "SHIFT-PAGE-DOWN", "ALT-PAGE-DOWN",
"CTRL-PAGE-DOWN",
"PAD-DIVIDE", "SHIFT-PAD-DIVIDE", "ALT-PAD-DIVIDE",
"CTRL-PAD-DIVIDE",
"PAD-MULTIPLY", "SHIFT-PAD-MULTIPLY", "ALT-PAD-MULTIPLY",
"CTRL-PAD-MULTIPLY",
"PAD-DELETE", "SHIFT-PAD-DELETE", "ALT-PAD-DELETE",
"CTRL-PAD-DELETE",
"PAD-MINUS", "SHIFT-PAD-MINUS", "ALT-PAD-MINUS",
"CTRL-PAD-MINUS",
"PAD-PLUS", "SHIFT-PAD-PLUS", "ALT-PAD-PLUS", "CTRL-PAD-PLUS",
"PAD-PERIOD", "SHIFT-PAD-PERIOD", "ALT-PAD-PERIOD",
"CTRL-PAD-PERIOD",
"PAD-0", "SHIFT-PAD-0", "ALT-PAD-0", "CTRL-PAD-0",
"PAD-1", "SHIFT-PAD-1", "ALT-PAD-1", "CTRL-PAD-1",
"PAD-2", "SHIFT-PAD-2", "ALT-PAD-2", "CTRL-PAD-2",
"PAD-3", "SHIFT-PAD-3", "ALT-PAD-3", "CTRL-PAD-3",
"PAD-4", "SHIFT-PAD-4", "ALT-PAD-4", "CTRL-PAD-4",
"PAD-5", "SHIFT-PAD-5", "ALT-PAD-5", "CTRL-PAD-5",
"PAD-6", "SHIFT-PAD-6", "ALT-PAD-6", "CTRL-PAD-6",
"PAD-7", "SHIFT-PAD-7", "ALT-PAD-7", "CTRL-PAD-7",
```

Appendices

"PAD-8",	"SHIFT-PAD-8",	"ALT-PAD-8",	"CTRL-PAD-8",
"PAD-9",	"SHIFT-PAD-9",	"ALT-PAD-9",	"CTRL-PAD-9",
"PAD-ENTER",	"SHIFT-PAD-ENTER",		"ALT-PAD-ENTER",
	"CTRL-PAD-ENTER",		
"F1",	"SHIFT-F1",	"ALT-F1",	"CTRL-F1",
"F2",	"SHIFT-F2",	"ALT-F2",	"CTRL-F2",
"F3",	"SHIFT-F3",	"ALT-F3",	"CTRL-F3",
"F4",	"SHIFT-F4",	"ALT-F4",	"CTRL-F4",
"F5",	"SHIFT-F5",	"ALT-F5",	"CTRL-F5",
"F6",	"SHIFT-F6",	"ALT-F2",	"CTRL-F6",
"F7",	"SHIFT-F7",	"ALT-F7",	"CTRL-F7",
"F8",	"SHIFT-F8",	"ALT-F8",	"CTRL-F8",
"F9",	"SHIFT-F9",	"ALT-F9",	"CTRL-F9",
"F10",	"SHIFT-F10",	"ALT-F10",	"CTRL-F10",
"F11",	"SHIFT-F11",	"ALT-F11",	"CTRL-F11",
"F12",	"SHIFT-F12",	"ALT-F11",	"CTRL-F12",

A.2 The available keyboard shortcuts

The available keyboard shortcuts are:

```
// ===== General Interface =====
UNDO, REDO, LOAD, RESTORE, SAVE, SNAPSHOT,

// --- cursor movements ---
CURSOR-LEFT, CURSOR-RIGHT, CURSOR-UP, CURSOR-DOWN,
// --- Display control ---
IMAGE-GRID-ON, IMAGE-GRID-OFF, IMAGE-GRID-TOGGLE,
IMAGE-SMOOTH-ON, IMAGE-SMOOTH-OFF, IMAGE-SMOOTH-TOGGLE,
IMAGE-PILOT-ON, IMAGE-PILOT-OFF, IMAGE-PILOT-TOGGLE,

// ===== Tools Interface =====

// --- Image Info ---
DISPLAY-MODE-ONE, DISPLAY-MODE-ALL, DISPLAY-MODE-TOGGLE,
SCALE-ONE, SCALE-PLUS, SCALE-MINUS" },

STUDY-NEXT, GROUP-NEXT, SLICE-NEXT,
STUDY-PREVIOUS, GROUP-PREVIOUS, SLICE-PREVIOUS,

// --- Color Map ---
COLOR-MAP-MONO1, COLOR-MAP-MONO2, COLOR-MAP-COL1, COLOR-MAP-COL2,

// --- Color Scheme ---
COLOR-SCHEME-GLI, COLOR-SCHEME-MIX, COLOR-SCHEME-OVER, COLOR-SCHEME-TAG,
COLOR-SCHEME-MIX-INCREASE, COLOR-SCHEME-MIX-DECREASE,

// --- memory cleanup ---
{MEMORY-CLEANUP-IMAGE, MEMORY-CLEANUP-UNDO, MEMORY-CLEANUP-GEOM,

// --- TAG lock ---
TAG-LOCK-CURSOR, TAG-LOCK-1, TAG-LOCK-2, TAG-LOCK-3, TAG-LOCK-4,
```

```

TAG-UNLOCK-CURSOR, TAG-UNLOCK-1, TAG-UNLOCK-2, TAG-UNLOCK-3, TAG-UNLOCK-4,
TAG-TOGGLE-CURSOR, TAG-TOGGLE-1, TAG-TOGGLE-2, TAG-TOGGLE-3, TAG-TOGGLE-4,

// --- Point Controls ---
POINT-ON, POINT-OFF, POINT-TOGGLE, POINT-INSERT, POINT-DELETE,

// --- 2D Overlay display ---
OVERLAY-FILE-ON, OVERLAY-FILE-OFF, OVERLAY-FILE-TOGGLE,
OVERLAY-NAME-ON, OVERLAY-NAME-OFF, OVERLAY-NAME-TOGGLE,
OVERLAY-PATIENT-ON, OVERLAY-PATIENT-OFF, OVERLAY-PATIENT-TOGGLE,
OVERLAY-TECHNICAL-ON, OVERLAY-TECHNICAL-OFF, OVERLAY-TECHNICAL-TOGGLE,

// --- 2D Window Reslice Cursors ---
WINDOW-TRACK-ON, WINDOW-TRACK-OFF, WINDOW-TRACK-TOGGLE,
WINDOW-CURSOR-MODE1. WINDOW-CURSOR-MODE2. WINDOW-CURSOR-OFF. WINDOW-CURSOR-TOGGLE,

// --- 3D Overlay display ---
OVERLAY-AXIS-ON, OVERLAY-AXIS-OFF, OVERLAY-AXIS-TOGGLE,
OVERLAY-LOCAL-AXIS-ON, OVERLAY-LOCAL-AXIS-OFF, OVERLAY-LOCAL-AXIS-TOGGLE,
OVERLAY-BOX-ON, OVERLAY-BOX-OFF, OVERLAY-BOX-TOGGLE,
OVERLAY-SLICE-ON, OVERLAY-SLICE-OFF, OVERLAY-SLICE-TOGGLE,
OVERLAY-VERTEX_NORMAL-ON, OVERLAY-VERTEX_NORMAL-OFF, OVERLAY-VERTEX_NORMAL-TOGGLE,
OVERLAY-POLYGON_NORMAL-ON, OVERLAY-POLYGON_NORMAL-OFF, OVERLAY-POLYGON_NORMAL-TOGGLE,

// --- 3D Stereo ---
STEREO-ON, STEREO-OFF, STEREO-TOGGLE, STEREO-LEFT-FRAME, STEREO-RIGHT-FRAME,

// ===== BASIC Modes Interface =====

// --- Filtering ---
FILTER-MODE-MEANS, FILTER-MODE-MEDIAN, FILTER-MODE-GAUSSIAN, FILTER-MODE-LOG,
FILTER-MODE-SHARPEN, FILTER-MODE-LAPLACE, FILTER-MODE-ROBERTS, FILTER-MODE-SOBEL,
FILTER-MODE-ANISOTROPIC,
FILTER-KERNEL-3x3, FILTER-KERNEL-5x5, FILTER-KERNEL-7x7, FILTER-KERNEL-9x9,
FILTER-KERNEL-11x11, FILTER-KERNEL-15x15, FILTER-KERNEL-19x19, FILTER-KERNEL-25x25,
FILTER-KERNEL-31x31,
FILTER-KERNEL-INCREASE, FILTER-KERNEL-DECREASE, FILTER-COMPUTE,

// --- Registration Points ---
REGISTRATION-MARKER-INSERT, REGISTRATION-MARKER-DELETE,
REGISTRATION-TRANSLATION-ON, REGISTRATION-TRANSLATION-OFF,
REGISTRATION-TRANSLATION-TOGGLE" },
REGISTRATION-SCALING-ON, REGISTRATION-SCALING-OFF, REGISTRATION-SCALING-TOGGLE,
REGISTRATION-ROTATION-ON, REGISTRATION-ROTATION-OFF, REGISTRATION-ROTATION-TOGGLE,
REGISTRATION-COMPUTE,

// --- Reslice oblique points ---
WINDOW-POINT-1-INSERT, WINDOW-POINT-2-INSERT, WINDOW-POINT-3-INSERT,
WINDOW-POINT-1-DELETE, WINDOW-POINT-2-DELETE, WINDOW-POINT-3-DELETE,
DIR-AXIAL, DIR-SAGITTAL, DIR-CORONAL, "DIR-OBLIQUE,

// ===== TAG Modes Interface =====

// ===== General Edit command =====
// --- Flood fill ---
FLOOD-3D, FLOOD-CONSTRAINED, FLOOD-2D,

```

Appendices

```
// --- current TAG value selection
TAG-0, TAG-1, TAG-2, TAG-3 TAG-4, TAG-5, TAG-6, TAG-7, TAG-8, TAG-9, TAG-GRAB,

// --- TAG Edition controls ---
BRUSH-1, BRUSH-2, BRUSH-3, BRUSH-4 BRUSH-5, BRUSH-6,

// --- Morpho controls ---
MORPHO-MERGE-1, MORPHO-MERGE-2, MORPHO-MERGE-3, MORPHO-MERGE-4,
MORPHO-LINE-OFF, MORPHO-LINE-1, MORPHO-LINE-2,
MORPHO-EROSION, MORPHO-DILATATION,
MORPHO-OPEN-1, MORPHO-OPEN-2, MORPHO-CLOSE-1, MORPHO-CLOSE-2,

// ===== 3D Modes Interface=====

// ===== Debug =====
DEBUG-IMAGE-NORMAL, DEBUG-IMAGE-FILTER, DEBUG-IMAGE-GRADIENT, DEBUG-IMAGE-GRADIENT-X,
DEBUG-IMAGE-GRADIENT-Y, DEBUG-IMAGE-GRADIENT-Z, DEBUG-IMAGE-MORPHO-WS,
DEBUG-IMAGE-MORPHO-1, DEBUG-IMAGE-MORPHO-2, DEBUG-IMAGE-MORPHO-3,
DEBUG-IMAGE-MORPHO-4,

DEBUG-TRACE-0, DEBUG-TRACE-1, DEBUG-TRACE-2, DEBUG-TRACE-3, DEBUG-TRACE-4,
DEBUG-TRACE-5, DEBUG-TRACE-6, DEBUG-TRACE-7, DEBUG-TRACE-8, DEBUG-TRACE-9,
```

A.3 The default keyboard shortcuts

By default, the key redefined in the “sliceO_key.scp” file are:

```
# -----#
# --- Undo/Redo Controls ---
# -----#
key:  CTRL-Z      map    UNDO
key:  CTRL-Y      map    REDO

# -----#
# --- Slice Controls ---
# -----#

key:  INSERT      map    STUDY-NEXT
key:  HOME        map    GROUP-NEXT
key:  PAGE-UP     map    SLICE-NEXT

key:  DELETE      map    STUDY-PREVIOUS
key:  END         map    GROUP-PREVIOUS
key:  PAGE-DOWN   map    SLICE-PREVIOUS

# -----#
# --- Display Controls ---
# -----#

key:  UP          map    CURSOR-UP
```

```

key:  DOWN          map    CURSOR-DOWN
key:  LEFT          map    CURSOR-LEFT
key:  RIGHT         map    CURSOR-RIGHT

key:  SPACE         map    DISPLAY-MODE-TOGGLE

key:  PAD-PLUS      map    SCALE-PLUS
key:  PAD-MINUS     map    SCALE-MINUS

key:  F1           map    COLOR-SCHEME-GLI
key:  F2           map    COLOR-SCHEME-MIX
key:  F3           map    COLOR-SCHEME-OVER
key:  F4           map    COLOR-SCHEME-TAG

key:  -            map    COLOR-SCHEME-MIX-DECREASE
key:  _           map    COLOR-SCHEME-MIX-DECREASE
key:  +            map    COLOR-SCHEME-MIX-INCREASE
key:  =            map    COLOR-SCHEME-MIX-INCREASE

key:  g            map    IMAGE-GRID-TOGGLE
key:  G            map    IMAGE-GRID-TOGGLE
key:  i            map    IMAGE-SMOOTH-TOGGLE
key:  I            map    IMAGE-SMOOTH-TOGGLE

# -----#
# --- Flood fill ---
# -----#
key:  SHIFT-PAD-ENTER  map    FLOOD-3D
key:  PAD-ENTER       map    FLOOD-2D
key:  CTRL-PAD-ENTER  map    FLOOD-CONSTRAINED

# -----#
# --- Point Controls ---
# -----#
key:  p            map    POINT-TOGGLE
key:  P            map    POINT-TOGGLE
key:  ENTER        map    POINT-INSERT
key:  SHIFT-ENTER  map    POINT-DELETE

# -----#
# --- current TAG value selection ---
# -----#
key:  0            map    TAG-0
key:  PAD-0       map    TAG-0
key:  1            map    TAG-1
key:  PAD-1       map    TAG-1
key:  2            map    TAG-2
key:  PAD-2       map    TAG-2
key:  3            map    TAG-3
key:  PAD-3       map    TAG-3
key:  4            map    TAG-4
key:  PAD-4       map    TAG-4
key:  5            map    TAG-5
key:  PAD-5       map    TAG-5
key:  6            map    TAG-6
key:  PAD-6       map    TAG-6

```

Appendices

```
key: 7 map TAG-7
key: PAD-7 map TAG-7
key: 8 map TAG-8
key: PAD-8 map TAG-8
key: 9 map TAG-9
key: PAD-9 map TAG-9

key: PAD-DELETE map TAG-GRAB
key: PAD-PERIOD map TAG-GRAB

# -----#
# --- Brush Size selection ---
# -----#
key: F5 map BRUSH-1
key: F6 map BRUSH-2
key: F7 map BRUSH-3
key: F8 map BRUSH-4

# -----#
# --- ReSlice controls ---
# -----#
key: F9 map DIR-AXIAL
key: F10 map DIR-SAGITTAL
key: F11 map DIR-CORONAL
key: F12 map DIR-OBLIQUE

# -----#
# --- Morpho controls ---
# -----#
key: q map MORPHO-MERGE-1
key: Q map MORPHO-MERGE-1
key: w map MORPHO-MERGE-2
key: W map MORPHO-MERGE-2
key: e map MORPHO-MERGE-3
key: E map MORPHO-MERGE-3
key: r map MORPHO-MERGE-4
key: R map MORPHO-MERGE-4

key: a map MORPHO-LINE-OFF
key: A map MORPHO-LINE-OFF
key: s map MORPHO-LINE-1
key: S map MORPHO-LINE-1
key: d map MORPHO-LINE-2
key: D map MORPHO-LINE-2

# -----#
# ---- Overlay controls
# -----#

key: SHIFT-F5 map OVERLAY-FILE-TOGGLE
key: SHIFT-F6 map OVERLAY-NAME-TOGGLE
key: SHIFT-F7 map OVERLAY-PATIENT-TOGGLE
key: SHIFT-F8 map OVERLAY-TECHNICAL-TOGGLE

key: SHIFT-F9 map OVERLAY-AXIS-TOGGLE
```



```

key:  SHIFT-F10    map    OVERLAY-LOCAL-AXIS-TOGGLE
key:  SHIFT-F11    map    OVERLAY-BOX-TOGGLE
key:  SHIFT-F12    map    OVERLAY-SLICE-TOGGLE

# -----#
# --- window reslice cursors and tracking ---
# -----#
key:  l            map    WINDOW-CURSOR-TOGGLE
key:  L            map    WINDOW-CURSOR-TOGGLE

# -----#
# --- debug keys ---
# -----#

key:  CTRL-1      map    DEBUG-TRACE-1
key:  CTRL-2      map    DEBUG-TRACE-2
key:  CTRL-3      map    DEBUG-TRACE-3
key:  CTRL-4      map    DEBUG-TRACE-4
key:  CTRL-5      map    DEBUG-TRACE-5
key:  CTRL-0      map    DEBUG-TRACE-0

# --- 3D stereoscopy ---
key:  [           map    STEREO-LEFT-FRAME
key:  ]           map    STEREO-RIGHT-FRAME

# --- debug images ---
key:  "`"         map    DEBUG-IMAGE-NORMAL
key:  "~"         map    DEBUG-IMAGE-NORMAL

key:  CTRL-F1     map    DEBUG-IMAGE-FILTER
key:  CTRL-F2     map    DEBUG-IMAGE-GRADIENT
key:  CTRL-F3     map    DEBUG-IMAGE-GRADIENT-X
key:  CTRL-F4     map    DEBUG-IMAGE-GRADIENT-Y
key:  CTRL-F5     map    DEBUG-IMAGE-GRADIENT-Z
key:  CTRL-F6     map    DEBUG-IMAGE-MORPHO-WS
key:  CTRL-F7     map    DEBUG-IMAGE-MORPHO-1
key:  CTRL-F8     map    DEBUG-IMAGE-MORPHO-2
key:  CTRL-F9     map    DEBUG-IMAGE-MORPHO-3
key:  CTRL-F10    map    DEBUG-IMAGE-MORPHO-4
key:  CTRL-F12    map    DEBUG-IMAGE-NORMAL

```

Appendix B: The TAG File Format

The TAG file format is loosely based on the university of Waterloo IM format.

The image file is composed of three sections:

- The header
- the "Z" vector
- the image binary data.

The Header

The header is entirely composed of lines of ASCII text. Each line is terminated by the characters <CR> and <LF> (0x0D and 0x0A). The header is terminated by a <FF> character (0x0C).

Everything on a line following a "*" will be considered as comments and can be disregarded by the program. However, we will place some non-critical patient information in the comments.

The header is composed of a series of keywords value pairs. The keyword and values are separated by ":". Each pair of keyword and values are separated by one or more separation characters. The recognized separators are: " " (space), ",", (comma), "\t" (tab) or "\n" (new-line).

You can use lowercase or uppercase indifferently in the keywords, the program converts all the keywords characters to uppercase before parsing the header.

The recognized keywords and their permitted values are:

- x: "x" resolution (in pixels)
- y: "y" resolution (in pixels)
- z: Number of images in the file.
- type: Gives the size of each pixel, the values supported by the program are BYTE or SHORT (BYTE for the ".tag" files)
- epais: Thickness of the images in "z".
- org_x: Position in "x" of the left side of the image.
- org_y: Position in "y" of the bottom of the image.
- org_z: Position in the "z" direction of the first image in the file.
- dim_x: Total dimension in "x" of the image (in millimeters).
- dim_y: Total dimension in "y" of the image (in millimeters)
- inc_x: Distance between 2 consecutive pixels in "x" of the image (in millimeters).
- inc_y: Distance between 2 consecutive pixels in "y" of the image (in millimeters).
- inc_z: Distance between 2 consecutive images, from center to center. If the images are not uniformly spaced, you will have to specify the "Z" vector.

epais: Slice thickness.
dir_h_x: x, y and z components of the horizontal direction vector (in patient system).
dir_h_y:
dir_h_z:
dir_v_x: x, y and z components of the vertical direction vector (in patient system).
dir_v_y:
dir_v_z:
vect_z: This value is used to signal the presence of a "Z" vector in the file. The value should be either 0 or 1
uid: Unique number used to make sure this tag is associated with the correct GLI image.
chksum:Checksum of the original GLI image.

```
x:256    y:256    z:9      type:BYTE
org_x:0.0000  org_y:0.0000
org_z:-691.1000
dim_x:480.0000  dim_y:480.0000
inc_z:-20.0000
epais:5.0000
* Hospital:                KINGSTON GENERAL
HOSPITAL
* Patient Name:            MARTEL, YVES
* Patient ID:              003
* Patient age:             3
* Patient sex:             2
* Serie number:            10
* Serie descript:          AX
* anatomical ref:          SN
* scan protocol:           ROSS-ABD
* Repetition time:         200000
* Inversion time:          0
* Echo time:               10000
* number of echos:         0
^L
```

Example

The "Z" vector

This section of the file is optional, you need it to give the "Z" position of each image in the file if they are not uniformly spaced. The value associated with the keyword "vector_z" in the header tells you if this section is present. For instance, there is no use for a "Z" vector for a file containing a single image, the value of "org_z" already gives the "z" position of the image.

This section is composed of a series of floats written in binary. The number of values is the number of images in the file. Each float takes 4 bytes. The values start immediately after the <FF> of the header.

The Image Data

The image data is written in binary form. There are $X \times Y \times Z$ pixels in the image data. The values for X , Y and Z come from the header. Each pixel takes 1 or 2 bytes according to the value associated with the "type" keyword. The pixels are written using the algorithm:

```
for each image k
  for each line j (starting at the top)
    for each pixel i (starting at the left)
      write pixel [k][j][i] ;
```

Appendix C: The Command line Syntax

The command line is used to control the program. Command lines can be typed in the input line of the text window or placed in a script file and read into the program with the script file mechanism.

Script file have the “.**scp**” extension.

A script file is composed of a number of command lines.

C.1 The syntax of the command line is:

Everything on a line following a “#” is a comments and is discarded by the program.

The command lines are used to input statements.

Statements are composed of works, keywords and operators separated from each other by spaces, tabs or end of lines. They MUST be separated from each other to be recognized. If a word contains a space or a special character, it should be protected with double quotes.

ex: `Read: path C:\Program Files\toto` is invalid
`Read: path "C:\Program Files\toto"` is valid

Each statement should be on a line by itself.

Multiple statements can be grouped together with the {} syntax. All the statements between the opening bracket “{” and the closing bracket “}” are considered as 1 statement.

ex: `echo: Bonjour` is 1 statement.

```
{  
    Echo: 1  
    Echo: 2  
    Echo: 3  
}
```

 is also 1 statement.

The order of operations inside a statement can be changed with the uses of “()”.
Example: `$a = 1 + (2 * 3)` is different than `$a = (1 + 2) * 3`

C.2 The variables

Variables can be used anywhere in a script instead of an actual value. The first character of a variable must be “\$”. A value is assigned to a variable with the “=” character

```
ex:  $a = Bonjour    will assign the string “Bonjour” to the variable $a
     echo: $a        will echo the string “Bonjour”
```

Variables values can be either a character string, an integer value, a float value or a vector of values.

```
ex:  $a = Bonjour
     $b = 124
     $c = 3.1416
     $d = 1 2 3.25 126
```

Variables can be used in mathematical expressions. The following operators can be used: “+”, “-”, “/”, “*”. Each operator and its operand must be separated from the others by spaces.

```
ex:  $b = ( $a + 3 ) * 2
```

There are 2 kind of variables: system variables and user variables.

System variables are already defined by the program. They can be used both to access a system value or to change a system value. Some system variables are read-only, and some are only defined under certain conditions.

For example, the variable \$TAG is used to represent the TAG value of the pixel under the cursor. This variable is only defined when the cursor is over an image. You can use: “echo: \$TAG” to get the pixel’s TAG value, or “\$TAG = 1” to assign the value 1 to the TAG value. And “\$TAG = \$TAG + 1” will increment the tag value.

If the user attempts to assign a value to a read-only variable, a warning message will be displayed.

The name of all system variables are in uppercase characters. We suggest that you use lowercase characters for the names of your local variables.

A list of all the defined system variables is given further down.

C.3 The macros

A statement can be assigned to a macro. The syntax is:

```
@macro_name = statement
```

The first character of a macro must be “@”. A macro is executed simply by entering its name.

ex: `@toto = echo: Bonjour` will assign the statement “echo: Bonjour” to the macro @toto

`@toto` will execute the macro @toto

C.4 The commands statements

A command statement is composed of a command keyword followed by its associated values. Command keywords are terminated by a “:” character. The syntax is:

```
keyword: value_1 [...]
```

The identification of keywords is not case sensitive. The number of values associated with a keyword depends on the keyword.

A list of all the available command statements and their associated templates is given further down.

C.5 The control statements

The “for” loop

```
for variable in ( value [...] )  
    statement
```

ex: `for $a in (1 2 3 4 5)
 echo: $a`

will echo the successive values taken by the variable \$a, these are: 1, 2, 3, 4 and 5

ex: `for $IMAGE_CUR in ($IMAGE_ALL)`

```
snapshot: c:\temp\snap_$IMAGE_CUR
```

will take a snapshot of the screen for of all the images in the current group and name these snapshot C:\temp\snap_1 to c:\temp\snap_n (where n is the last image). In this example, `$ALL_IMAGES` is a vector of values, and `$IMAGE_CUR` will successively be assigned each of these values. Each time, the assignment will cause the current image to be changed and the window to be redrawn to reflect these changes. (Also see system variable assignment.)

The “if” statement

```
if ( expression )  
    statement
```

If the value of *expression* is evaluated to a value different than “0” then the test is valid and the statement is executed.

A number of comparison operators are available for the tests: “=”, “<”, “>”, “<=” and “>=”. These operators will be evaluated to “0” if the test fails and “1” otherwise.

Adding “else” to the “if” statement

```
if ( expression )  
    statement1  
else  
    statement2
```

```
ex:  if ( $a >= 1 )  
      echo: a  
      else  
      echo: b
```

will only echo “a” if the value of the variable `$a` is greater or equal to 1, otherwise it will echo “b”.

C.6 Keyboard mapping

You can assign predefined operations to a keyboard key with the command statement: “**Key: key_def map action**”. The available “actions” are listed after each tool and modes in this manual and in **Appendix A.2: The available keyboard shortcuts**.

But also, you can assign a statement or a macro to a keyboard key with the syntax:

key: *key_def* macro *statement*

ex: **key:** a macro flood: \$TAG + 1

will cause the TAG value under the cursor to be incremented when the key “a” is pressed.

Or:

key: *key_def* macro *macro_name*

ex: **key:** b macro @toto

Will cause the macro @toto to be execute when the key “b” is pressed.

C.7 The system variables

For each system variables, we give:

- **The name of the variable**
- **The read and write properties of the variable**
 - R for Read only variable.
 - R/W for Read and Write variable
- **The type of the variable**
 - Char for character string variables
 - Int for integer variables
 - Float for floating point value variables
 - Bits for bit filed variables where each bit of an integer value is used as On/Off indicator
 - RGB for a color value with 3 components, each ranging from 0 to 255.
 - V-Char for an array of character strings
 - V-Int for an array of integer values
 - V-Float for an array of floating point values.
- A description of the variable.
- **The possible values of the variable or its range.**

Study/Group/Images variables

\$STUDY_CUR	R/W Int	Current study number. Between 1 and STUDY_MAX.
\$STUDY_CUR_PATIENT_NAME	R Char	Name of the patient of the current study
\$STUDY_CUR_PATIENT_ID	R Char	ID of the patient of the current study
\$STUDY_CUR_STUDY_ID	R Char	ID of the current study
\$STUDY_MAX	R Int	Numbers loaded studies in memory.
\$STUDY_ALL	R V-Int	Enumeration of all the studies numbers loaded in memory, from 1 to STUDY_MAX.
\$GROUP_CUR	R/W Int	Current group number. Between 1 and GROUP_MAX.
\$GROUP_CUR_ID	R Char	
\$GROUP_MAX	R Int	Numbers of groups in the current study.
\$GROUP_ALL	R V-Int	Enumeration of all the groups numbers for this study, from 1 to GROUP_MAX.
\$DIRECTION_CUR	R/W Int	Current direction. Between 1 and DIRECTION_MAX.
\$DIRECTION_MAX	R Int	Maximum number of directions (=4).
\$DIRECTION_ALL	R V-Int	Enumeration of all the directions that are available for this group, from 1 to DIRECTION_MAX.
\$IMAGE_CUR	R/W Int	Current image number. Between 1 and IMAGE_MAX.
\$IMAGE_CUR_DIR_H	R/W V-Float	Current image horizontal direction. X, Y and Z components.
\$IMAGE_CUR_DIR_V	R/W V-Float	Current image number. X, Y and Z components.
\$IMAGE_CUR_ORG	R/W V-Float	Current image origin. X, Y and Z.
\$IMAGE_CUR_PIX_DIM	R/W V-Float	Current image pixel's dimensions. Horiz., Vert. and Depth.
\$IMAGE_CUR_RES	R V-Int	Current image resolution. Horiz. and Vertical.

\$IMAGE_MAX	R Int	Numbers of images in the current direction of the current group.
\$IMAGE_ALL	R V-Int	Enumeration of all the images numbers for this direction of this group, from 1 to IMAGE_MAX .

Brushes variables

\$BRUSH_MAX	R Int	Maximum number of brush. (=6)
\$BRUSH_CUR	R/W Int	Current brush number. Between 1 to BRUSH_MAX
\$BRUSH_ALL	R V-Int	All the brush numbers. Iterate all values from 1 to BRUSH_MAX
\$BRUSH_RADIUS_MAX	R Int	Maximum brush radius. (=25)
\$BRUSH_RADIUS_CUR	R/W Int	Current brush radius. Between 1 to BRUSH_MAX_RADIUS
\$BRUSH_RADIUS_ALL	R V-Int	All the brush radius. BRUSH_MAX values between 1 to BRUSH_MAX_RADIUS .

Color Map & Color Schemes variables

\$COLOR_MAP_MODE	R/W Char	Current color map. "MONO1", "MONO2", "COLOR1" or "COLOR2"
\$COLOR_MAP_SIZE	R Int	Number of entries in the color map. (=4096)
\$COLOR_SCHEME_MODE	R/W Char	Current color scheme mode. "GLI", "MIX", "OVER" or "TAG"
\$COLOR_SCHEME_MIX	R/W Float	"Mix" value used in color mode MIX. between 0.1 and 1.0 .

3D Contour mode variables

\$CONTOUR_MODE	R/W Char	Contour mode. "LINE" or "POINT" .
\$CONTOUR_SUB_SAMPLING	R/W V-Int	Sub sampling values used in the contour reconstruction.

Cursor Positions variables

\$CURSOR_2D_POS_X	R/W Float	2D coordinate of the cursor (horizontal, in pixel)
\$CURSOR_2D_POS_Y	R/W Float	2D coordinate of the cursor (vertical, in pixel)
\$CURSOR_2D_POS_Z	R/W Float	2D coordinate of the cursor (slice number in 3D data set)
\$CURSOR_2D_POS	R/W V-Float	2D coordinate of the cursor (horizontal, vertical and slice number)
\$CURSOR_3D_POS_X	R/W Float	3D coordinates of the cursor (in patient coord.)
\$CURSOR_3D_POS_Y	R/W Float	3D coord of the cursor (in patient coord.)
\$CURSOR_3D_POS_Z	R/W Float	3D coord of the cursor (in patient coord.)
\$CURSOR_3D_POS	R/W V-Float	3D coordinate of the cursor (X, Y and Z) <ul style="list-style-type: none"> • X increase from right to left • Y increase from back to front • Z increase from feet to head

Display State variables

Appendices

\$DISPLAY_2D_GRID	R/W Char	“Grid” state variable for the current display window. “ON” or “OFF”.
\$DISPLAY_2D_GRID_ALL	R/W V-Char	“Grid” state variable for the all the display windows. WINDOW_2D_MAX strings “ON” or “OFF”.
\$DISPLAY_2D_MODE	R/W Char	Display mode for the current window. “ONE” or “ALL”.
\$DISPLAY_2D_MODE_ALL	R/W V-Char	Display mode for the all the display windows. WINDOW_2D_MAX strings “ONE” or “ALL”.
\$DISPLAY_2D_PILOT	R/W Char	“Pilot” state variable for the current display window. “ON” or “OFF”.
\$DISPLAY_2D_PILOT_ALL	R/W V-Char	“Pilot” state variable for the all the display windows. WINDOW_2D_MAX strings “ON” or “OFF”.
\$DISPLAY_2D_POINTS	R/W Char	“Point” state variable for the current display window. “ON” or “OFF”.
\$DISPLAY_2D_POINTS_ALL	R/W V-Char	“Point” state variable for the all the display windows. WINDOW_2D_MAX strings “ON” or “OFF”.
\$DISPLAY_2D_SMOOTH	R/W Char	“Interpolation” state variable for the current display window. “ON” or “OFF”.
\$DISPLAY_2D_SMOOTH_ALL	R/W V-Char	“Interpolation” state variable for the all the display windows. WINDOW_2D_MAX strings “ON” or “OFF”.
\$DISPLAY_3D_POINTS	R/W Char	“Point” state variable for the current 3D window. “ON” or “OFF”.
\$DISPLAY_3D_POINTS_ALL	R/W V-Char	“Point” state variable for the all the display windows. WINDOW_3D_MAX strings “ON” or “OFF”.
\$DISPLAY_2D_OVERLAY_FLAG	R/W Bits	2D Overlay bit field value. <ul style="list-style-type: none">• bit 1 (x01) is for the file overlay• bit 2 (x02) for the name overlay• bit 3 (x04) for the patient overlay• bit 4 (0x08) for the technical overlay.
\$DISPLAY_3D_OVERLAY_FLAG	R/W Bits	3D Overlay bit field value. <ul style="list-style-type: none">• bit 1 (x01) is for the global axis• bit 2 (x02) for the local axis• bit 3 (x04) for the bounding box• bit 4 (0x08) for the slice outlines• bit 6 (0x10) for the polygon’s normals• bit 7 (0x20) for the vertex normals.

Gamma tool variables

\$GAMMA	R/W Float	Read/write the gamma value. Between 0.5 and 5.0.
----------------	-----------	---

GLI variables

\$GLI_MAX	R Float	The largest GLI value of the selected groups
\$GLI_MIN	R Float	The smallest GLI value of the selected groups
\$GLI_VALUE	R/W Int	Grey level value of the pixel under the cursor (this value is undefined if the cursor is not over an image)

Memory Manager variables

\$MEMORY_MANAGER	R/W Char	Enable or disable the memory manager. "ON" or "OFF".
\$MEMORY_HIGH WATER	R/W Int	High Water mark (in MBytes).

The Command line and Script File Syntax

\$MEMORY_LOW_WATER	R/W Int	Low Water mark (in MBytes).
\$MEMORY_SLICEOMATIC	R/W Int	Estimated size of the program without any images (in Mbytes).
\$MEMORY_SYSTEM	R/W Int	Estimate of the RAM memory used by Windows (in MBytes).
\$MEMORY_IMAGES	R Int	Amount of memory used by the images
\$MEMORY_GEOM	R Int	Amount of memory used by the geometries
\$MEMORY_UNDO	R Int	Amount of memory used by the Undos
\$MEMORY_RAM	R Int	Total amount of RAM memory in your computer (in MBytes).
\$MEMORY_TOTAL	R Int	Total addressable memory space that the program can use (In Mbytes).

3D MIP mode variables

\$MIP_SHADING_MODE	R/W Char	MIP shading mode. "ON" or "OFF".
\$MIP_DEPTH_MODE	R/W Char	Read/write the MIP depth cuing mode. "ON" or "OFF".
\$MIP_MAP_MODE	R/W Char	Read/write the MIP color map mode. "TAG", "GREY", "BLOOD", "COLOR1" or "COLOR2".
\$MIP_MAP_MAX	R/W Float	MIP color map maximum value. Between 0 and 1.
\$MIP_MAP_MIN	R/W Float	MIP color map minimum value. Between 0 and 1.
\$MIP_TAG_MODE_ALL	R/W V-Char	MIP mode of all the Tag values. TAG_MAX strings "ON" or "OFF".
\$MIP_TAG_DENSITY_ALL	R/W V-Float	MIP density of all the Tag values. TAG_MAX floats between 0.1 and 10.
\$MIP_TAG_MODE_CUR	R/W Char	MIP mode of the current Tag. "ON" or "OFF".
\$MIP_TAG_DENSITY_CUR	R/W Float	MIP density of the current Tag. Between 0.1 and 10.

Morpho mode variables

\$MORPHO_LINES_COLOR	R/W RGB	Color of the lwater parting lines
\$MORPHO_LINES_MODE	R/W Char	Water parting line style. Between "OFF", "THIN" or "THICK"

File Reading variables

\$PATH	R/W Char	Starting path used in the file read script command
\$PATIENT	R/W Char	Default patient used in the file read script command

3D Shell mode variables

\$SHELL_MODE	R/W Bits	Shell reconstruction conditions bit field. <ul style="list-style-type: none"> • Bit 1 is the "greater" condition value • bit 2 is the "smaller" condition value • bit 3 is the "border" condition value.
\$SHELL_SUB_SAMPLING	R/W V-Int	Sub sampling values used in the shell reconstruction.

System Information variables

\$SYSTEM_DEFAULT_PATH	R/W Char	Starting path used by all the field open and save interfaces
-----------------------	----------	--

Appendices

\$SYSTEM_DATE	R Char	Current date (dd-mmm-yy)
\$SYSTEM_TIME	R Char	Current time (hh:mm:ss)

Tag variables

\$TAG_ALL	R V-Int	Give all the tag numbers. From 1 to TAG_MAX.
\$TAG_CUR	R/W Int	Current Tag value. Between 0 and 255.
\$TAG_CUR_COLOR	R/W RGB	Current Tag color.
\$TAG_MAX	R/W Int	Maximum number of accessible Tags. Between 16 and 256.
\$TAG_VALUE	R/W Int	Tag value of the pixel under the cursor. Between 0 and TAG_MAX.
\$TAG_3D_SELECT_ALL	R/W V-Char	Selection state of all the Tag values. TAG_MAX strings "ON" or "OFF".
\$TAG_3D_SELECT_CUR	R/W Char	Selection state of the current Tag value. "ON" or "OFF".

3D Volume mode variables

\$VOL_TAG_GRD_MODE_ALL	R/W V-Char	Gradient mode of all the Tag values. TAG_MAX strings "ON" or "OFF".
\$VOL_TAG_GRD_DENSITY_ALL	R/W V-Float	Gradient density of all the Tag values. TAG_MAX floats between 0.1 and 10.
\$VOL_TAG_VAL_MODE_ALL	R/W V-Char	Value mode of all the Tag values. TAG_MAX strings "ON" or "OFF".
\$VOL_TAG_VAL_DENSITY_ALL	R/W V-Float	Value density of all the Tag values. TAG_MAX floats between 0.1 and 10.
\$VOL_TAG_VAL_OFFSET_ALL	R/W V-Float	Value offset of all the Tag values. TAG_MAX floats between 0 and 1.
\$VOL_TAG_GRD_MODE_CUR	R/W Char	Gradient mode of the current Tag. "ON" or "OFF".
\$VOL_TAG_GRD_DENSITY_CUR	R/W Float	Gradient density of the current Tag. Between 0.1 and 10.
\$VOL_TAG_VAL_MODE_CUR	R/W Char	Value mode of the current Tag. "ON" or "OFF".
\$VOL_TAG_VAL_DENSITY_CUR	R/W Float	Value density of the current Tag. Between 0.1 and 10.
\$VOL_TAG_VAL_OFFSET_CUR	R/W Float	Value offset of the current Tag. Between 0 and 1.

2D Window variables

\$WINDOW_2D_ALL	R V-Int	Enumeration of all the windows numbers, from 1 to WINDOW_2D_MAX
\$WINDOW_2D_CUR	R/W Int	Current window number. Between 0 and WINDOW_2D_MAX.
\$WINDOW_2D_CUR_COLOR	R/W RGB	Current window's color.
\$WINDOW_2D_CURSOR_MODE	R/W Char	Window's cursor mode for the current window. "OFF", "MODE1" or "MODE2".
\$WINDOW_2D_MAX	R Int	Maximum number of 2D windows. (=4)

C.8 The templates

Some command can accept templates to match one or multiple entities. They use a “wild cards” syntax similar to the one used by UNIX:

- ?** replaces one character
ex: `toto_?` Will match `toto_1`, `toto_a` but not `toto` or `toto_12`
- *** replaces 0 to many characters
ex: `toto_*` Will match `toto_1`, `toto_a`, `toto_12` but not `toto`
- [abc]** replace one character by a, b or c
ex: `toto_[12]` Will match `toto_1`, `toto_2` but not `toto_a` or `toto_12`
- [!abc]** replace one character by any character but a, b or c
ex: `toto_[!12]` Will match `toto_1` but not `toto_1` or `toto_2`
- [a-c]** replace one character by a character from a to c
ex: `toto_[0-9]` Will match `toto_1` and `toto_2` but not `toto_a` or `toto_12`

So if, for example, you to delete all the Tags between 20 and 59 on the presently selected images, you could replace the “**t_tag**” in the following command:

```
Tag: t_tag del
by the string “[2-5]?”
Tag: [2-5]? del
```

The templates used in sliceOmatic’s command statements are:

- “**t_group**” stand for “group template”, this template is used to identify one or more image groups.

The group are identified by their ordering number. Thus the third group of a study will be “3”.

- “**t_ima**” stand for “image template”, this template is used to identify one or more images.

By default, an image is identified by its ordering number. Thus the third image of a group will be “3”.

Patient name, series number and slice number can also be used to identify an image. To locate an image by its patient name, the characters “**p=**” must precede the template. To locate an image by its series number, the characters “**s=**” must precede the template, and to locate an image by the manufacturer’s image number, the characters “**i=**” must precede the template.

`p="[Tt]oto*` will match all images with patient name starting with toto or Toto
`S=12?` Will match all images from series 120 to 129
`I=10*` will match all image with image number starting with 10.

The “image template” can also be a boolean combination of other templates. The characters “**&**” (for “and”) and “**|**” (for “or”) are used for this. Parenthesis can also be used to group the operations.

`(p="toto*"&s=12?) | (p=anonymous)`

will match all images from the series 120 to 129 of the patients with name starting with toto and all the images from the patient with name anonymous.

If “**t_ima**” is optional and is present, the command will be applied to the images matching the template. Otherwise, the command will be applied to all the currently selected images.

- “**t_light**” stand for “light template” The valid light names are: “ambient”, “1”, “2”, “3” and “4”.
- “**t_marker**” stand for “marker template”, this template is used to identify one or more alinement markers in the Registration mode. A marker name can be either it’s number (from 1 to 64) or its name if one has been associated with the marker.
- “**t_mask**” stand for “mask template”, this template is used to identify one or more geometries in the Geometrical Mask mode.
- “**t_merge**” stand for “merge template”, this template is used to identify one or more merge values in the Morpho mode. A merge value is a number between 1 and 4.
- “**t_point**” stand for “point template”, this template is used to identify one or more points.
- “**t_surf**” stand for “surface template”
- “**t_tag**” stand for “tag template”, this template is used to identify one or more tags. A tag name can be either it’s number (from 1 to TAG_MAX) or its name if one has been associated with the tag through a “tag: label” command.

C.9 The commands statements list

C.9.1 General commands, File and Image manipulations

Echo: write string [string ...]

Write the strings in the text window.

File: append *file_name*

Open an existing file. The “file: write” commands will append text at the end of the file

File: close

Save and close a file opened with “file: open” or “file: append”.

File: open *file_name*

Create a new file, or open an existing file but delete it’s previous content. The “file: write” commands will append text at the end of the file

File: write string [string ...]

Write the strings to the opened file.

Example:

```
File: open C:\temp\test.dat
File: write Bonjour world
File: write "$SYSTEM_TIME = " $SYSTEM_TIME
File: close
```

Will create the file:

```
Bonjour world
$SYSTEM_TIME = 09:14:52
```

File c:\temp\test.dat

Undo:

Undo the last keystroke.

Redo:

Redo the last Undo.

Load:

Load the selected Tag images in their Restore buffers.

Restore:

Overwrite the selected Tag images with the content of their Restore buffer.

Read: path *path_name* (old syntax)

Assign "path_name" to the system variable \$PATH.

Read: patient *patient_name*

Assign "patient_name" to the system variable \$NAME

Read: file *file_name* [t=*value*] [i=*val*[-*val*]]

Specifies a file to read.

The syntax for the file name is: **[\$PATH][\$NAME]string.ext.**

The optional "t=value" parameter is used to offset the "t" position of the images in the file. The t direction is orthogonal to the image plane. For example, t=Z for axial images, t=Y for coronal images and t=X for sagittal images.

- If the "value" string contains a "+" sign, that value will be added to the image's "t" value.
- If the "value" string contains a "-" sign, the value will be subtracted from the image's "t" value.
- If the "value" string does not contain a sign, that value will replaced the image's "t" value.

The optional "i=value[-value]" parameter is used to read selected images from a multi-image file. "value" ranges from 0 to the number of images in the file. If only one value is given, that image will be read, if two values are given, the images from the first value to the second will be read. (The first value can be higher than the second. This will reverse the order of the images in the file.)

Example 1: *The optional Z=value*

`File: toto.gli Z=+5.0` will add 5.0 mm to the "Z" values of the images from toto.gli.

Example 2: *The optional i=value*

`File: toto.gli i=3` will read the third image from the file toto.gli.

`File: toto.gli i=7-3` will read the images 7, 6, 5, 4 and 3 from the file toto.gli

Refresh:

Redraw all the images on the screen.

Select: t_ima [t_ima ...]

The images specified will be selected.

Example:

<code>select: 1 2 4 5 6 7</code>	will select images 1, 2 and 4 to 7
<code>Select: 1[2-5] 2[2-5]</code>	will select images 12 to 14 and 22 to 25
<code>select *</code>	will select all the images
<code>select 0</code>	will select no image

Write: calc type file_name

Write the surface or volume measurement of the Surface/Volume tool for all the selected images to a text file. The file created will be either a db surface file (type = "surface"), a db volume file (type = "volume") or an ASCII result file (type = "ASCII").

Write: contour type file_name

Write a all the contours of the selected images to an ASCII text file. The contour will be either a polyline if type="line" or a set of points if type = "point".

Write: geom t_surf format file_name

Write a all surfaces matching the template t_surf to a 3D geometry file of the format "format". Format can be on of the following: "obj", "mov", "dxf", "wrk", "stl", or "stl_ascii".

Write: mask t_mask file_name

Write a script file with the necessary information to re-create all the geometrical masks matching the template t_mask.

Write: measure t_measure file_name

Write the measurement tools results of the Measurement mode matching the template "t_measure" to an ASCII text file.

Write: point t_point file_name

Create a script file with the necessary information to re-create all the points matching the template t_point.

Write: registration t_marker file_name

Create a script file with the necessary information to re-read all the registration markers matching the template `t_marker`.

Write: script *file_name*

Create a script file with the necessary information to re-read all the currently opened images.

License

The write operations are only permitted if you have the appropriate licenses.:

- **BASIC** for the script, measurement, registration and point write operations.
- **TAG** for the calc and mask write operations.
- **3D** for the geom and contour write operations.

C.9.2 Interface commands

License:

Re-scan the HASP dongle for your licenses..

Key: list

List all the mapped keys.

Key: *name map function*

Map a function to the keyboard key “name”. (See **Appendix A: The keyboard shortcuts** for a list of the available key names and function names.)

Key: *name macro statement*

Map a command statement to the keyboard key “name”. (See **Appendix A: The keyboard shortcuts** for a list of the available key names.)

Variable: list [user|system]

List all the variables. You can list either the user defined variables (default) or the system variables.

Variable: print *name*

Write the value of the variable “name” in the text window.

Macro: list

List all the defined macros.

Macro: print *name*

Write the macro “name” to the text window.

C.9.3 Set commands

Set: interface_size *value*

Set the size of the interface tools. Value must be between 0 and 2

Set: undo_nb *value*

Set the current number of accessible Undos. Value must be between 0 (disabled) and 20.

Set: undo_size *value*

Set the maximum size of each Undo operations value is in Mbytes

Set: scratch_dir *path*

Define the path to the temporary files.

Set: start_script *path*

If set, give the path to a script file that will be read at startup.

Set: default_dir *path*

Define the default path used by the program (\$SYSTEM_DEFAULT_PATH).

Set: start_2D_tools *flag*

Set the tools that will be displayed at startup

Set: start_2D_overlays *flag*

Set the state of the default 2D overlays

Set: TAG_nb *value* (16<=value<=256)

Set the number of accessible Tag values. (Value must be a power of 2 between 16 and 256 (16, 32, 64, 128 or 256)

Set: TAG_placement_mode *flag*

Define where the Tag files are saved. The options are:

- 0 With the GLI images
- 1 Directly in the Tag Repository
- 3 In a sub-directory per patient in the Tag Repository
- 5 In a sub-directory per user in the Tag Repository
- 7 In a sub-directory per user and per patient in the Tag Repository.

Set: TAG_repository path

Define the Tag Repository path.

Set: TAG_autosave value

Set the delay (in minutes) for the autosave option (0 disable the autosave). Value must be between 0 and 240 minutes.

Set: DB_surf_export flag

Define the information that will be saved in the surface db files.

Set: DB_vol_export flag

Define the information that will be saved in the volume db files.

Set: units_dist flag

Specify the units used for distances measurements. The options are:

- 0 Floating. The program will assign what it evaluate to be the best units
- 1 m
- 2 cm
- 3 mm
- 4 μm .

Set: units_surf flag

Specify the units used for surface measures in the Surface/Volume tool. The options are:

- 0 Floating. The program will assign what it evaluate to be the best units
- 1 m^2
- 2 cm^2
- 3 mm^2
- 4 μm^2 .

Set: units_vol flag

Specify the units used for volume measures in the Surface/Volume tool. The options are:

- 0 Floating. The program will assign what it evaluate to be the best units
- 1 m^3
- 2 cm^3
- 3 mm^3
- 4 μm^3 .

Set: graphic_speed value

Set the speed factor used in computing the polygon decimation for re-draw operations. Value can be between ? (a slow graphic card) and y (a fast graphic card)

Set: start_3D_tools *flag*

Set the tools that will be displayed at startup

Set: start_3D_overlays *flag*

Set the state of the default 3D overlays

Set: mouse_control *flag*

Specify mouse interface used in the 3D window. The options are:

- 0 Track Ball
- 1 Classic
- 2 Patient Axis.

Set: graphic_context *val*

Change the default graphic context used to talk to the graphic card. This value can only be changed by the sliceOmatic.ini files.

Note

The “**set**” commands are used by the sliceOmatic.ini file.

C.9.4 BASIC Mode commands

Admin: select *t_ima* [*t_ima* ...]

The images specified will be selected.

Example:

`Admin: select 1[2-5] 22` will select images 12 to 14 and 22

Admin: [*t_ima*] close

Delete the images.

Admin: [*t_ima*] group

Group together the images.

Admin: [*t_ima*] sort

Sort the images. The images are sorted according to their “t” value. (“t” is the direction of the slices’ acquisition. For axial slices, where the image is in the “x” - “y” plane, “t” would be the “z” axis).

Admin: [t_ima] fill val

Change the pixel fill value associated to this image.

Admin: [t_ima] dim x y z

Change the dimensions of the images matching t_ima. The values of x, y and z can be preceded by a + or - sign.

Admin: [t_ima] inc x y z

Change the pixel increment (distance between pixel centers) of the images matching t_ima. The values of x, y and z can be preceded by a + or - sign.

Admin: [t_ima] org x y z

Change the origin of the images matching t_ima. The values of x, y and z can be preceded by a + or - sign.

Note

For the **dim**, **inc** and **org** commands:

- If the "value" string contains a "+" sign, that value will be added to the image's original value.
- If the "value" string contains a "-" sign, the value will be subtracted from the image's original value.
- If the "value" string does not contain a sign, that value will replaced the image's original value.

Filter: a_kern value

Fix the kernel size for the anisotropic filter.

Filter: a_grad value

Fix the gradient influence for the anisotropic filter.

Filter: a_conv value

Fix the convergence criteria for the anisotropic filter.

Filter: kernel size

Fix the kernel size for the convolution filters. The accepted values are 1, 3, 5... 31.

Filter: mix value

Fix the “mix” value for the convolution filters. “Value” must be between 0.0 and 1.0.

Filter: *t_ima* (mean|median|gaussian|log|sharpen) [*mix* [*kern_size*]]

Filter the images with the selected filter. If “mix” is present, it will supersede the value fixed by the interface. “Mix” must be between 0.0 and 1.0. If Kern_size is present it will supersede the value fixed by the interface. “Kern_size” must be one of: 1, 3, 5, 7... 31.

Filter: *t_ima* (roberts|laplace|sobel) [*mix*]

Filter the images with the selected filter. If “mix” is present, it will supersede the value fixed by the interface. “Mix” must be between 0.0 and 1.0.

Filter: *t_ima* anisotropic [*a_kern a_grad a_conv*]

Filter the images with an anisotropic filter. If the a_kern, a_grad and a_conv values are present, they will supersede the values fixed by the interface.

Measurement: *t_measure* write *file_name*

Create a script file to re-create all the measurements matching the t_measure template.

Measurement: *t_measure* data *file_name*

Create a data file with all the measurements matching the t_measure template.

Measurement: *t_ima* dist *name a.x a.y b.x b.y*

Create distance measurement tool named “name” between points “a” and “b” on the image matching “t_ima”.

Measurement: *t_ima* ruler *name a.x a.y b.x b.y*

Create ruler measurement tool named “name” between points “a” and “b” on the image matching “t_ima”.

Measurement: *t_ima* profile *name a.x a.y b.x b.y*

Create profile measurement tool named “name” between points “a” and “b” on the image matching “t_ima”.

Measurement: *t_ima* angle *name a.x a.y b.x b.y c.x c.y*

Create protractor measurement tool named “name” between points “a” “b” and “b” on the image matching “t_ima”.

Measurement: *t_ima* caliper *name a.x a.y b.x b.y left.x left.y right.x right.y*

Create caliper measurement tool named “name” between points “a”, “b”, “left” and “right” on the image matching “t_ima”.

Measurement: *t_ima ROI name nb pt_1.x pt_1.y ... pt_n.x pt_n.y*

Create ROI measurement tool with “nb” points, “1” to “n”, on the image matching “t_ima”.

C.9.5 TAG Mode commands

Edit: *t_ima erosion*

Edit: *t_ima dilatation*

Compute erosion and dilatation operation on the TAG images.

Edit: *t_ima open size*

Edit: *t_ima close size*

Compute opening and closing operation on the TAG images. “Size” controls the size of the features that are affected by the operation.

Mask: *name create rectangle x1 y1 x2 y2*

Mask: *name create circle x1 y1 x2 y2*

Mask: *name create polygon n x1 y1 ... xn yn*

Mask: *name create spline n x1 y1 ... xn yn*

Create a new mask, named “name” and defined by it’s coordinates x,y. There is 2 sets of x,y for rectangles and circles and “n” for the polygon and the spline.

Mask: *t_mask tag tag_num*

Assign the value “tag_num” to the mask matching the *t_mask* template.

Mask: *t_mask mode [global|local|outline|filled]*

Change the mode of the mask matching the *t_mask* template.

Mask: *t_mask delete*

Delete the mask matching the *t_mask* template.

Mask: *stamp (replace|add|subtract)*

Stamp all the masks to the Tag image using the specified 3 stamp mode.

Morpho: *param t_merge surf diff*

Fix the watershed merge parameters surface to “surf” and mean difference to “diff” for the merge value matching “t_merge”.

Morpho: *t_ima compute t_merge*

Compute the watershed and merge for the images matching “t_ima” and the merge value matching “t_merge”

Example:

`Morpho: * compute *` will compute all merge value for all images.

Morpho: *t_ima* erosion

Morpho: *t_ima* dilatation

Compute erosion and dilatation operation on the TAG images.

Morpho: *t_ima* open size

Morpho: *t_ima* close size

Compute opening and closing operation on the TAG images. "Size" controls the size of the features that are affected by the operation.

Region: color *r g b* (0 <= r,g,b <= 255)

Change the color of the preview.

Region: *tag* max (OFF|ABS|REL) *val* (1 <= tag <= TAG_MAX)

Assign a value and a mode to the upper threshold for the Tag "id".

Region: *tag* min (OFF|ABS|REL) *val* (1 <= tag <= TAG_MAX)

Assign a value and a mode to the lower threshold for the Tag "id".

Region: (all|*tag*) slider (all|min|max) (Lock|Unlock|Toggle)

Lock or Unlock the sliders.

Region: preview (ON|OFF|TOGGLE)

Enable/disable the displaying of the preview color for Paint and Grow 2D.

Region: wheel (OFF|Upper|Lower)

Assign the mouse wheel to the upper or lower threshold values.

Segment: threshold *id value*

Fix the interface threshold number "id" to the value "value". "id" is a number between 1 and 4. "Value" is limited by the dynamic range of the image.

Example:

`Segment: threshold 2 256`

Segment: *t_ima* compute [*value ...*]

Compute the segmentation for the desired images (either those matching the "t_ima" template, or the currently selected images). If threshold values are given, they will be used for the segmentation, otherwise, the values fixed by the interface are used. The number of "values" is not limited to 4, but to TAG_MAX.

Example:

```
Segment: * compute -40 10 30 65 128 256 1024
```

Snake: [t_ima] t_tag radius value

Assign the radius “value” to all the points of all the Snakes associated with the TAG matching the “t_tag” template on the images matching the “t_ima” template.

Snake: [t_ima] t_tag capture value

Assign the capture range “value” to all the Snakes associated with the TAG matching the “t_tag” template on the images matching the “t_ima” template. The capture range determines how much the Snake can move to latch on the best gradient.

Snake: [t_ima] t_tag delete

Delete all the Snakes associated with the TAG matching the “t_tag” template on the images matching the “t_ima” template.

C.9.6 3D Mode commands

Shell: condition (greater|smaller|border) (ON|OFF)

Set the values of the different condition flags for the polygon shell creation.

Example:

```
Shell: condition border OFF
```

Shell: sampling (X|Y|Z) value

Set the sub-sampling value (1 to 8) for the X, Y or Z direction.

Example:

```
Shell: sampling X 2
```

Shell: model (TomoVision|Lorensen)

Set the default model used to create the polygon shell.

Shell: compute [TomoVision|Lorensen]

Compute the polygon shell for the enabled tags. If the model is omitted, the default model is used.

Contour: mode (point| line)

Set the geometry type created by this module.

Contour: sampling (X|Y|Z) *value*

Set the sub-sampling value (1 to 8) for the X, Y or Z direction.

Contour: compute [line|point]

Compute the geometry for the enabled tags. If the mode is omitted, the default mode is used.

MIP: shading (ON|OFF)

Set the shading mode. If on, the gradient vector of the voxels are used to shade the voxel's color.

MIP: depth (ON|OFF)

Set the depth cuing mode. Voxel further from the eye are darker.

MIP: map (TAB|GREY|BLOOD|COLOR1|COLOR2)

Set the colormap used to assign colors to the voxels.

MIP: min *value***MIP: max *value***

Set the minimum and maximum values used by the colormap to assign colors to the voxels.

MIP: compute [OpenGL|ray]

Compute the MIP image. If the mode is omitted, the default mode is used.

Volume: compute [OpenGL|ray]

Compute the volume image. If the mode is omitted, the default mode is used.

C.9.7 BASIC & TAG Tools commands

Color: grey**Color: mix [*value*]****Color: over****Color: tag**

Will select the color scheme used to display the images. In addition, if "value" is present for the "mix" scheme, it will be used for TAG density. The accepted range for "value" is from 0.1 to 0.9.

Gamma: *value*

Fix the gamma correction value.

Mode: all**Mode: one [image_number]**

Place the display area in “mode one” or “mode all”. If “image_number” is present, this image will be the one displayed in mode one.

Mode: current *image_number*

The specified image will be the current image.

Mode: scale *value*

Change the display scale factor

Point: *name create x y z*

This command is used to create a new point. The point will be labeled "name" and is placed at x, y, z.

Point: *t_point color R G B*

Change the color of all the points matching the template name t_name.

Point: *t_point delete*

Delete all points matching the template

Point: *t_point pos x y z*

Change the coord. of all points matching the template to x y z

Point: *t_point size value*

Change the size of all points matching the template (size=0 for 1 pixel wide points)

Point: *t_point surf surface_name*

Attach all points matching the template to the surface. Any transformation of the surface will also move the points.

Snapshot: [*file_name*]

Save the content of the Display Area window to a file in the scratch directory. If “file_name” is present, it will be used, otherwise the file name is “sliceO_xx.ext”.

Tag: *t_tag delete*

Delete all occurrence of the specified tags in all the selected images.

Tag: *t_tag color R G B*

Change the color of the tag identified by “tag_num” to the color specified. The R,G,B component must have values between 0 and 255.

Tag: *t_tag* label *abbreviation* [*long_name*]

Use the labels to identify the tags in the interface and in the result files.

The abbreviation will be used in the interface of the “Edit”, “Morpho”, “Surface/Volume” and “Shell” modes. It should be limited to 7 characters.

The second argument is optional, it is a longer name that will be used instead of the TAG number in the 3 output files of the Surface and Volume Computation Mode. Otherwise, the ID will be used if present. By default, the label “TAG x”, where x is the TAG number, will be used.

Example:

```
TAG: label 1      SAT      "Saturated Fat"  
TAG: label 3      B+O      Bone+Organ  
TAG: label 10    Lung
```

C.9.8 3D Tools commands

Light: *t_light* on

Light: *t_light* off

Switch the desired lights on or off

Light: *t_light* dir *x y z*

Orient the desired lights into the direction defined by the “x”, “y” and “z” vector.

Light: *t_light* color *R G B*

Change the light’s color. (R,G and B should be between 0 and 255).

Matrix: restore

Restore the matrix to identity and re-center all the currently visible surfaces. (A surface is visible if its shading is either line, flat or smooth.)

Matrix: trans *x y z*

Translate all surfaces by “x”, “y” and “z” units along the main axes.

Matrix: rot *x y z*

Rotate all surfaces “x” degrees around the x axis, “y” degrees around the “y” axis and “z” degrees around the “z” axis.

Matrix: scale x [y z]

Scale all surfaces. If the scaling factor for “y” and “z” are not present, the scaling factor “x” will be applied to all axes.

Matrix: pivot angle dir_x dir_y dir_z

Rotate all surfaces “angle” degrees around the vector defined by “dir_x”, “dir_y” and “dir_z”.

Matrix: matrix a11 a12 a13 a14 a21 a22 ... a44

Directly set the matrix elements. The 16 parameters of this command will be inserted in the 4x4 transformation matrix.

Matrix: fov angle

Change the camera Field Of View. Accepted values for “angle” range from 0.0 to 179.0 degrees. A value of 0 will yield an orthogonal projection. The default Camera has a FOV of 27 degrees.

Matrix: view (pa|ap|front|back|left|right|head|feet|up|down|coronal|sagittal)

Change the camera position to yield the desired view.

Point: See the 2D Point command.

Smooth: id fact_in fact_out nb_step

Assign new values for the fact_in, fact_out and nb_step parameters of the button number “id” (0=None, 1=Small... 4=Huge)

Smooth: compute id

Compute the smoothing with the parameters associated to the button “id”

Smooth: compute fact_in fact_out nb_step

Compute the smoothing with the parameters “fact_in”, “fact_out” and “nb_step”

Snapshot: [file_name]

Save the content of the Display Area window to a file in the scratch directory. If “file_name” is present, it will be used, otherwise the file name is “sliceO_xx.ext”.

Surface: t_surf delete

Delete all surfaces that match the template name.

Surface: t_surf shade (off|line|flat|smooth)

Set the shading mode of all the surfaces that match the template name to the specified mode.

Surface: *t_surf* color R G B

Change the specified surface's colors.

Surface: *t_surf* restore

Restore the surfaces' transformation matrices to identity.

Surface: *t_surf* trans x y z

Translate the surfaces by "x", "y" and "z" units along the main axes.

Surface: *t_surf* rot x y z

Rotate the surfaces "x" degrees around the x axis, "y" degrees around the "y" axis and "z" degrees around the "z" axis.

Surface: *t_surf* scale x [y z]

Scale the surfaces. If the scaling factor for "y" and "z" are not present, the scaling factor "x" will be applied to all axes.

Surface: *t_surf* pivot angle dir_x dir_y dir_z

Rotate the surfaces "angle" degrees around the vector defined by "dir_x", "dir_y" and "dir_z".

Surface: *t_surf* matrix a11 a12 a13 a14 a21 a22 ... a44

Directly set the matrix elements. The 16 parameters of this command will be inserted in the 4x4 transformation matrix.

