



# MANUAL

## User's Guide to HeaDSET

An introduction to modeling, recording and playing back

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PathCreator



PathRecorder



PathPlayer

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# Chapter 1

## Introduction

Welcome to the HeaDSET User Manual. Here you will find any information needed to effectively use the HeaDSET system. This manual is divided into six sections concerning the installation procedure; camera and view ports options; usage of each of the three HeaDSET subprograms and a section about troubleshooting.

# Chapter 2

## Installation

Before you can start using the HeadSET system, you need to follow one of the following installation procedures.

### 2.1 Windows XP

The following section describes installation on a Microsoft Windows XP system.

#### 2.1.1 Programming language Python

- Locate the Python installer on the cd: [drive letter]:/dependencies/python-2.5.2.msi
- Double click the file to start the installation procedure.
- Follow the steps in the installation wizard to completely install Python.

#### 2.1.2 User Interface library wxPython

- Locate the WxPython installer on the cd: [drive letter]:/dependencies/wxPython2.8-win32-unicode-2.8.9.1-py25.exe
- Double click the file to start the installation procedure.
- Follow the steps in the installation wizard to completely install the wxPython library.

#### 2.1.3 Graphics library VTK

- Locate the VTK binary on the cd: [drive letter]:/dependencies/vtk-5.2.0-win32-python.exe
- Double click the file to start the installation procedure.
- Select `C:\Program Files\` as installation directory.
- Add vtk to your PATH by:
  - clicking Start ► System ► Advanced ► Environment Variables
  - Adding `;C:\Program Files\vtk\` to the end of the `path` variable under 'System variables' (See fig. 2.1.3)

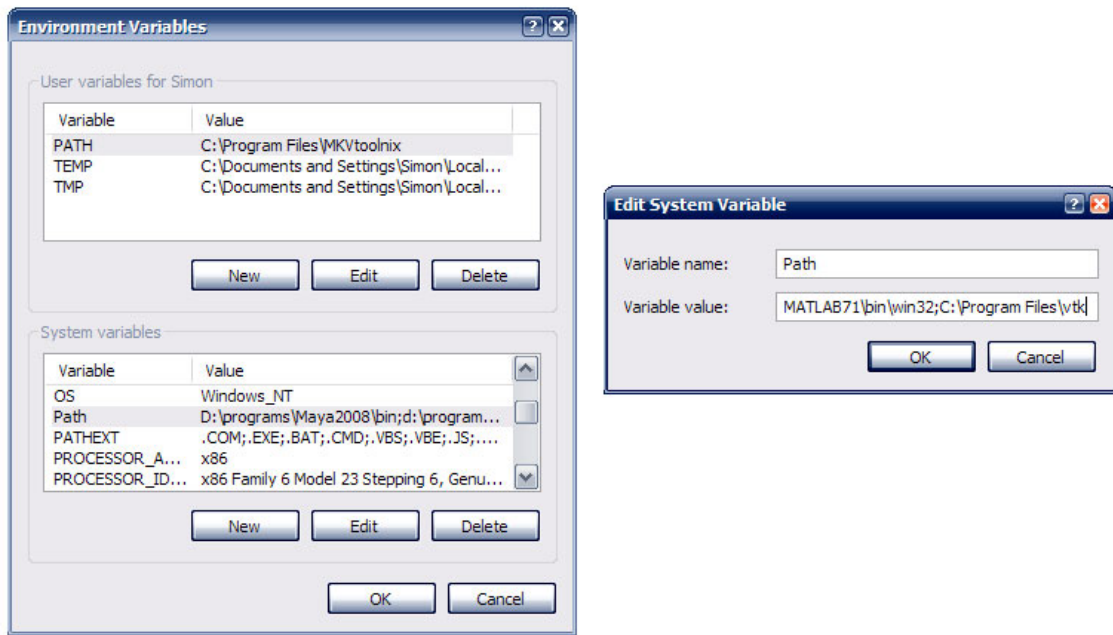


Figure 2.1: Setting the path variable

#### 2.1.4 HeaDSET

- Locate the HeaDSET on the cd: [drive letter]:/headset/installer/headset.exe
- Double click the file to start the installation procedure.
- Select C:\Program Files\ as installation directory.

You can now start HeaDSET by browsing to C:\Program Files\headset\ and open the file HeaDSET.bat.

## Chapter 3

# Camera and view ports

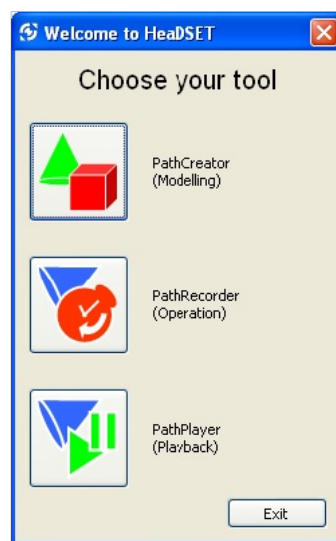


Figure 3.1: The HeaDSET start-up screen

This section will first describe the usage of the camera and view ports in HeaDSET . These functions work the same in all three HeaDSET applications.

### 3.1 Camera

In order to work comfortably with the 3D area, several controls are available to manipulate the camera viewpoint.

**Zooming** To zoom in or out in the screen, scroll the mouse wheel up or down. Alternatively you can zoom by holding the right mouse button down and drag the mouse up or down.

**Rotating** To rotate the camera around the origin, hold the left mouse button down and drag the mouse in any direction.

**Panning** In order to pan the camera, hold the middle mouse button down and drag the mouse in any direction. Alternatively you can pan by holding SHIFT + left mouse button down and drag the mouse in any direction.

**Reset camera** In order to reset the camera viewpoint to such a position that all objects fit inside the view, press the **R** key (on the keyboard).

## 3.2 View ports

HeadSET supports both a single view port and a setup with four smaller view ports. You can switch between both modes in the **Viewports** menu. All view ports can be configured using the **Configure Viewports...** option under the mentioned menu. The configuration dialog contains the following options:

**Dropdown boxes** The dropdown menus can be used to select which kind of view is selected in each of the view ports. 3D View (P) represents the perspective viewpoint, while 3D View (O) is an orthogonal viewpoint.

**Double buffering** This is a rendering technique used to increase the performance. It is recommended to leave this option enabled.

**Depth peeling** When this option is enabled, the part of the model that is currently not directly visible will not be drawn on the screen. This option may have no effect on certain hardware configurations.

**Anti-aliasing** This option enables a rendering technique that smoothes out rugged edges. This can decrease performance.

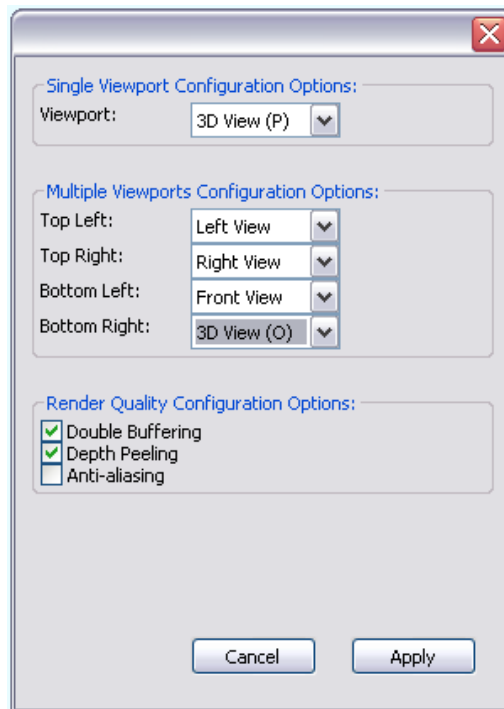


Figure 3.2: The Viewport configuration window

## Chapter 4

# The HeaDSET PathCreator

The PathCreator application is used to visualize medical data from DICOM images in 3D, and to specify the areas within the generated model that indicate a tumour and a safe area for surgery. Its main tools are importing DICOM information and specifying areas by adding and modifying 3D primitives.

### 4.1 Importing medical DICOM data

To import medical data from the DICOM file format, choose **File -> Import DICOM Image...** or press **CTRL + I** (Mac users should use **Command + I**). If a folder was selected that contains valid DICOM data, a window will be displayed where import settings can be altered. These settings will be explained below:

**Extract** This value determines how hard a material has to be before it is visualized in the 3D model. High values will show harder materials, low values show only softer materials.

**Reduction** This value determines the amount of detail in the generated 3D model. With reduction set to 0, all information that can be extracted from the DICOM data will be shown. With reduction set to higher values, the amount of polygons in the generated model will be reduced to improve performance. A high reduction value still provides good results.

**Smoother iterations** This value determines how many times the generated model will be smoothened when generated. More iterations will generate a model with smoother surfaces and less ragged edges. It is advisable to use a high number of smoother iterations when using a high reduction value.

**Colour** This option sets the colour of the generated model.

**Opacity** This value determines the opacity of the generated model. In order to see primitives placed inside the model, at least some degree of transparency is advisable.

When the OK button is pressed, the model will be generated. This can take up to a few minutes on slower systems.

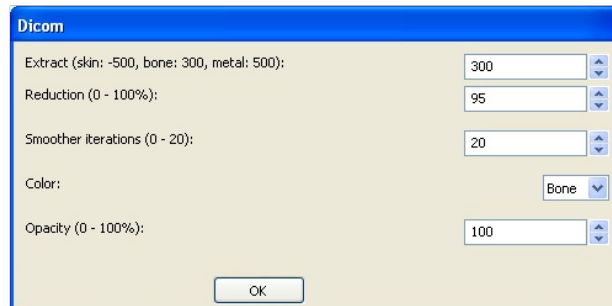


Figure 4.1: The DICOM import window

## 4.2 Modeling

In order to indicate the areas belonging to either a tumour or a safe path, HeaDSET allows you to place and manipulate primitive 3D shapes. These shapes are box, ellipsoid, cylinder and cone.

### Adding primitives

In order to add a primitive, in the **Adding primitives** section, select the tab for either tumour or safe path and select the desired shape by clicking the corresponding button. The selected shape will be placed in the centre of the current 3D space. Shapes belonging to the tumour category will be displayed in red, those belonging to the safe path category will be displayed in green.

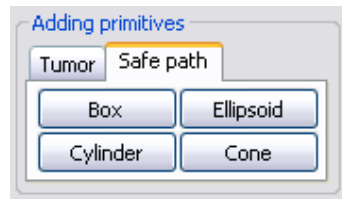


Figure 4.2: Adding primitives

### Selecting primitives

In order to select a primitive, there are two options. The first option is to left-click the primitive directly in the 3D view. The second option is to find the primitive in the **Model Information** tab, and left-click on its name. Once a primitive is selected, a manipulation tool is drawn around it in the 3D view and the controls in the **Positioning primitives** section are enabled.

In order to deselect the current primitive, either left-click in an empty area in the 3D view or click the **Clear selection** button in the bottom of the screen.

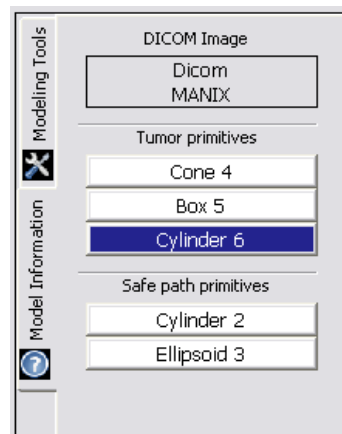


Figure 4.3: The Model Information tab

### Modifying primitives

In order to make the primitives suit your needs, they can be manipulated in several ways. These are described here:

**Scaling** The easiest way to change the scale of a primitive is to drag the circular handles on the manipulation tool in the 3D view. It is also possible to change the scale by using the **Scale** tab in the **Positioning primitives** section. For the first option one has to left-click and hold the right mouse button down on the selected primitive and move the mouse in order to scale it equally in all directions.

**Moving** This can be done by clicking and dragging the middle mouse button on the selected primitive. It is also possible to click and drag the centre handle of the manipulation tool in the 3D view. Another way is to use the **Move To** tab in the **Positioning primitives** section and change the values.

**Rotating** In order to rotate a primitive, left-click and drag one of the sides of the manipulation tool in the 3D view. Alternatively the **Rotate** tab of the **Positioning primitives** section can be used.

**Cloning** The currently selected primitive can be cloned by using the **Clone selection** button in the bottom of the screen. The cloned primitive will appear in the same location with the same attributes.

**Deleting** In order to delete a selected primitive, either use the **Delete selection** button in the bottom of the screen, or press the **Delete** key on the keyboard.

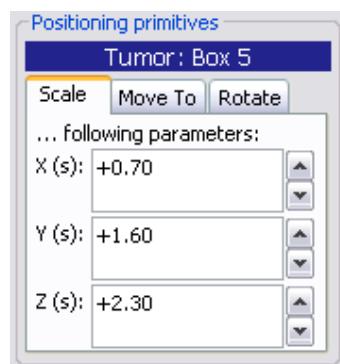


Figure 4.4: The Positioning primitives section

## Chapter 5

# The HeaDSET PathRecorder

The PathRecorder is the application used to view and record the position of an external tool in relation to a previously created project. Typical usage of the PathRecorder would be to open a project created in the PathCreator, followed by recording the input from an external device.

### 5.1 Visibility

Within the PathRecorder it is possible to toggle the visibility of certain objects in the 3D view. By (un)checking the corresponding boxes in the **Visible objects** section, it is possible to make head, tumour, safe path and tool (in)visible.

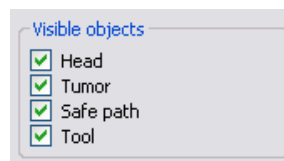


Figure 5.1: The visibility section

### 5.2 Input tool

The PathRecorder can read input data from a variety of input tools. The **Input tool** menu can be used to select which tool will be used in the 3D view and recordings.

### 5.3 Recording

Once an input tool has been selected, its movements can be recorded by pressing the **Start recording** button. Once this button is pressed, the **Recording** section will show the name of the current recording and the duration so far. To finish the recording, press the **Stop recording** button in the same section.

All finished recordings will appear in the **Recordings Information** tab. This tab displays the recordings in the current project and their duration in seconds. When the project is saved in the PathRecorder, any recordings present will be saved along with it.

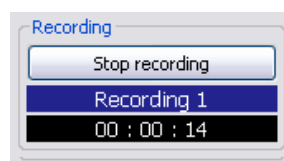


Figure 5.2: The start/stop recording section

## Chapter 6

# The HeaDSET PathPlayer

The PathPlayer application is used to view recordings that were saved in the PathRecorder. In order for the PathPlayer to do anything, a project must be opened that includes at least one recording.

### 6.1 Visibility

Within the PathPlayer it is possible to toggle the visibility of certain objects in the 3D view. By (un)checking the corresponding boxes in the **Visible objects** section, it is possible to make head, tumour and safe path (in)visible.

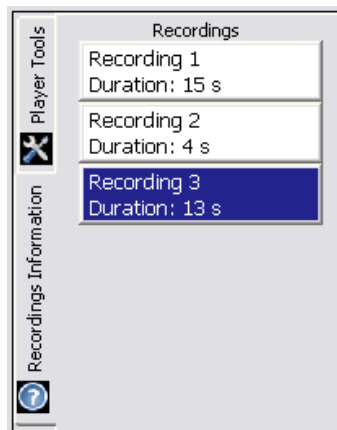


Figure 6.1: The Recordings Information tab

### 6.2 Playback

To play one of the recordings from an opened project, first it must be selected from the Recordings Information tab. Once a recording has been selected, the playback controls in the bottom of the screen can be used to start and pause the playback. The timeline can also be used to skip back or ahead in the recording and resume playback from a certain point.

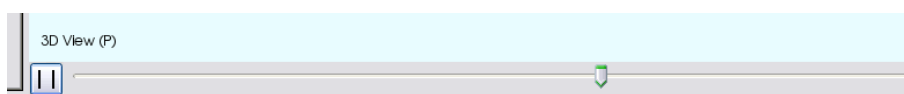


Figure 6.2: The playback controls

# Chapter 7

## Troubleshooting

In this section we will address several known problems with the HeaDSET system.

### 7.1 Performance

HeaDSET is a relatively heavy application to run, and on some hardware configurations, performance can be a problem. The following steps may help to improve performance when necessary.

- Make sure Anti-aliasing is disabled in the view port options (Viewports -  $\hookrightarrow$  Configure Viewports...).
- Make sure Double Buffering is enabled in the view port options (Viewports -  $\hookrightarrow$  Configure Viewports...).
- Use a single view port instead of multiple view ports where possible.
- When using DICOM data, make sure to use a high Reduction value (95 or higher).

### 7.2 Known problems

The following problems are known to occur within the HeaDSET system. Where available, workarounds will be provided.

- When running HeaDSET on OS X, the .hdt extension is not appended to saved project files.
- When loading a file containing both tumour and safe path primitives, both appear in the same category in the Model Information list.
- Using transparency can cause the model to appear "inside out" from certain angles.
- View port names (left, right, etc.) do not necessarily correspond with the view they deliver.
- Rotating a primitive by exactly 90 degrees using the numeric controls can cause unexpected effects.