ORTHOPEDIC SURGERY 3D PLANNER - MODULE: BONE EXTRACTOR

User manual

1.7.2.239

CE 0197

Cracow
December 1, 2014

Contents

1. Information about the manufacturer

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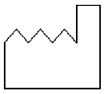

2014

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2. Introduction

Orthopedic Surgery 3D Planner - Module: Bone Extractor is a medical software supporting preoperative planning for orthopaedic surgical interventions in hip region. It allows loading of 3D DICOM image of patient's hip and a three-dimensional femur and hip bone model creation. It may be subsequently printed using 3D printing technology to obtain a physical model.

The application was designed for professional user and should be applied only in health care facilities.

3. Application’s main window

Figure 3.1 shows the main window divided into several regions.

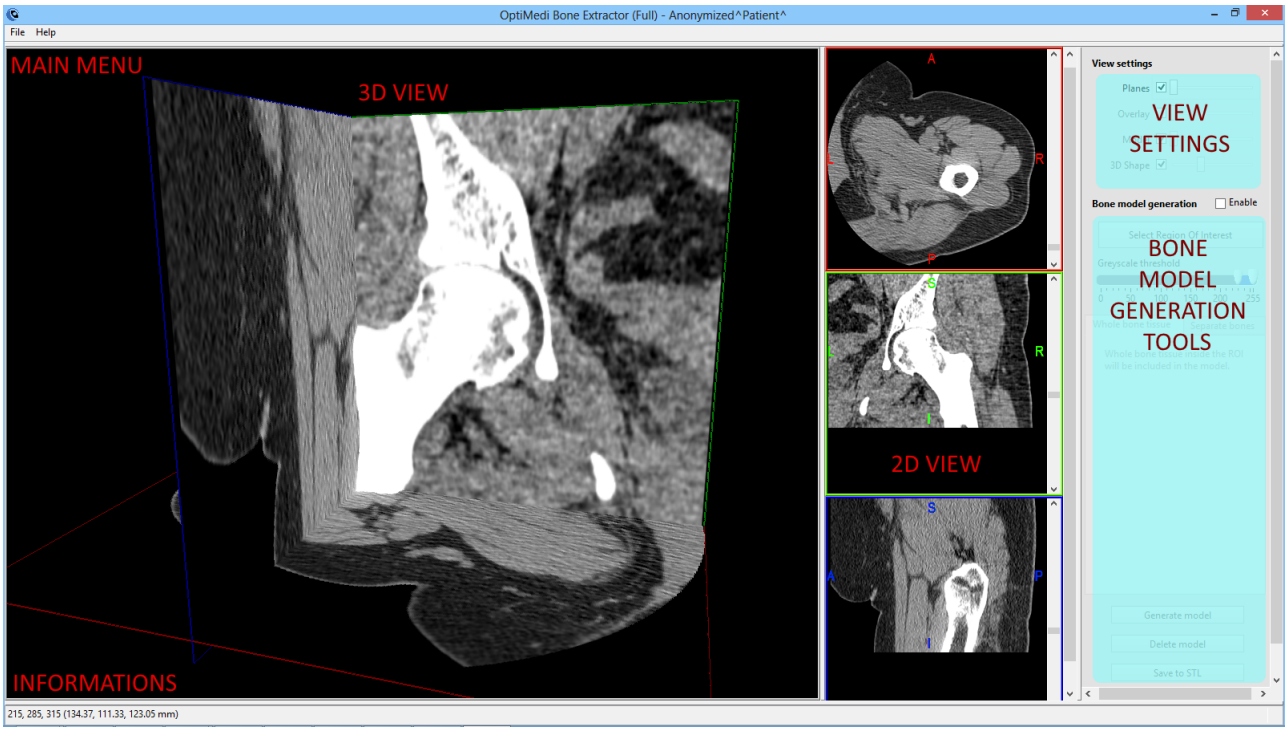

Figure 3.1: Application’s main window

3.1. Main menu

Contains principal application commands.

3.2. 3D View

Displays DICOM data in 3D view.

3.3. 2D View

Displays DICOM data as a set of 2D slices representing three perpendicular planes.

3.4. View settings

A set of properties that can be used to modify object's display. Each object can be independently set to be displayed or hidden (show/hide) and it's transparency setting can be modified with use of slider.

3.5. Bone model generation

A set of tools allowing bone model creation.

3.6. Information

A bar displaying informations concerning position of slices and tools for bone model creation.

3.7. Separators

Vertical window fields separators are movable and can be rearranged to best respond to customer's needs as shown on Figure 3.2).

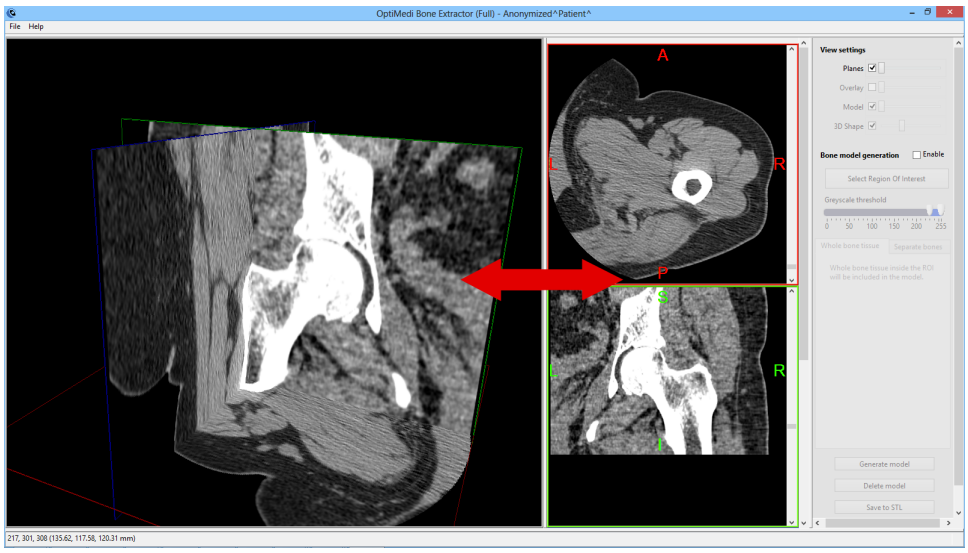

Figure 3.2: Window appearance with displaced separator

4. Loading and displaying DICOM images

In order to open a three-dimensional DICOM image: in *File* menu choose option *Open*, then navigate to the folder containing DICOM series, choose one file and select *OK*.

A window will be displayed to allow for choosing DICOM series to be used in the program (see Figure 4.1). After choosing appropriate series and setting windowing parameters (size and position of window) select *Open*.

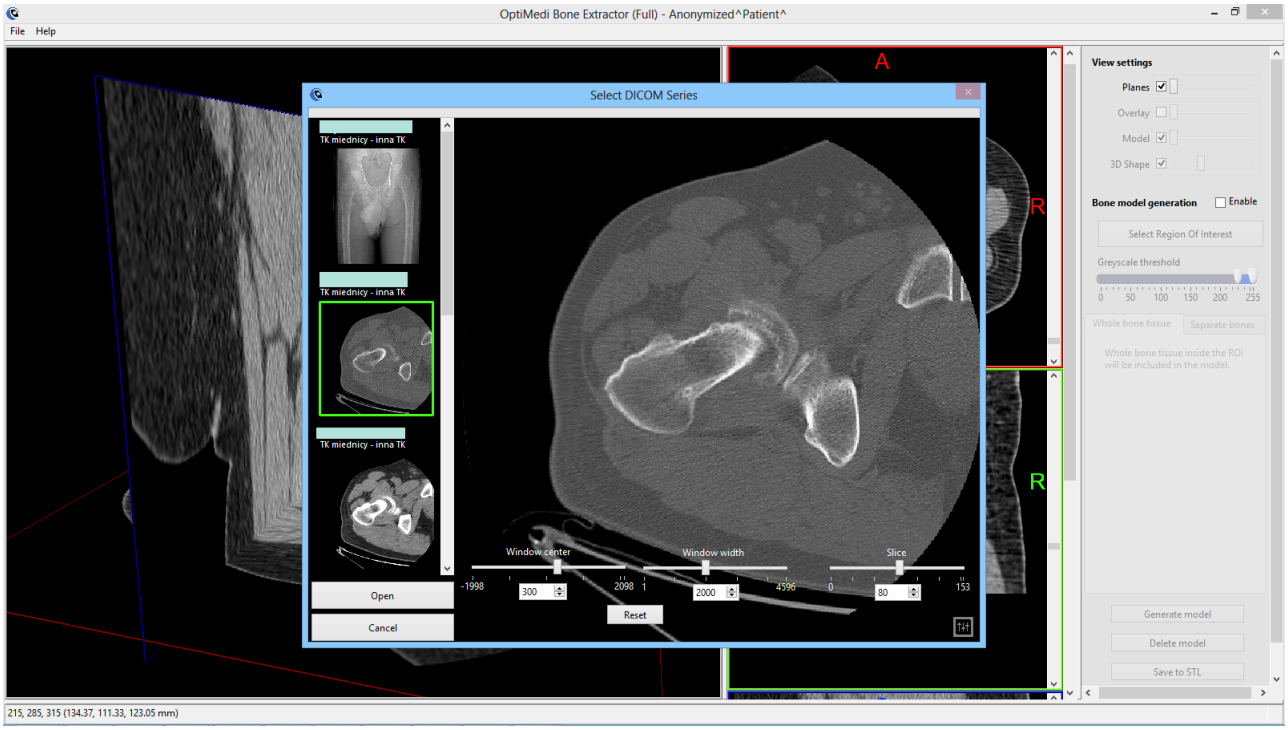

Figure 4.1: DICOM series selection

When loaded, the image will be displayed as three intersecting slices. Using scrollbars in section *2D View* allows for independent repositioning of the slices. Mouse controller can be used in *3D View* section for rotating, moving (click and hold Control key) and zooming (click and hold Shift key).

Hiding and showing the slices, as well as changes to their transparency in *3D View* can be accessed through *View settings* menu for object *Planes*.

To restore default settings for display of *3D View* use right mouse button in *3D View* section and select *Default view*.

5. Bone model generation

To begin model generation, select option *Enable* in section *Bone model generation*. A set of options shown on Figure 5.1 will be displayed.

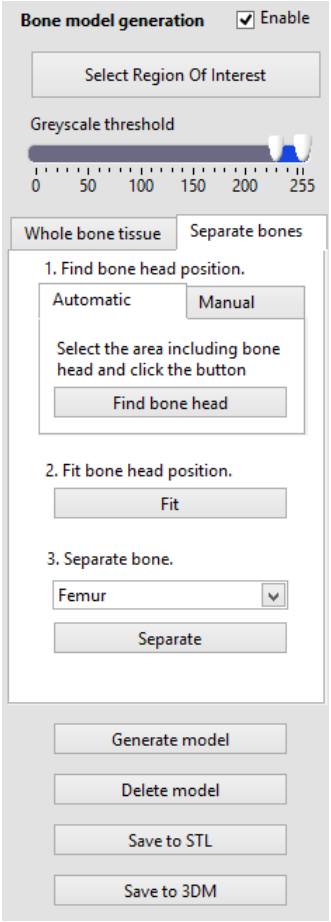

Figure 5.1: Options for bone model generation

A yellow overlay will be displayed on the image indicating image points which will be included in the model. Display of the overlay can be modified using *View settings* menu for object entitled *Overlay*.

Model generation process is divided into set of easy steps described below.

5.1. Region of interest selection

First step consists of selecting a region that includes targeted section of bone. Select *Select Region Of Interest*, then on the image select area that includes femur (see Figure 5.2), select *OK*.

The overlay region will be limited to the selected region of interest.

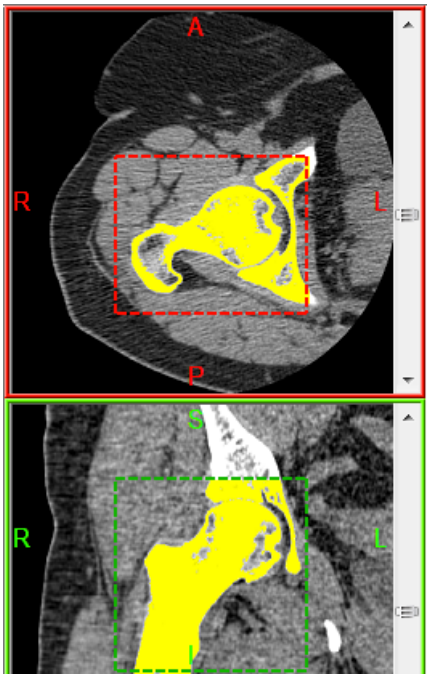

Figure 5.2: Region of interest selection

Important aspect of region of interest selection is application's efficiency. The smaller the region, the lower memory usage and better performance.

5.2. Greyscale spectrum selection

Next step is to set greyscale interval in a way that extracts only the targeted tissue regions. Use *Greyscale threshold* sliders. The overlay display is synchronised with the slider.

5.3. Model type selection

Choose type of the model to be generated by selecting corresponding option *Whole bone tissue* or *Separate bones*.

In case of *Whole bone tissue* selection the model can be directly generated by pressing *Generate model* button. The model will contain all bone tissue detected in the selected region of interest.

To generate the model of femur or hip bone select *Separate bones* option and proceed to the next step.

5.4. Bone extraction

Femur or hip bone extraction can be divided into three steps: pre-selection of a femur head, exact adjustment of the head position and bone separation.

5.4.1. Femur head pre-selection

To pre-select femur's head, position a sphere in *3D View* in a way that it approximately indicates head location. Selection of *Automatic* or *Manual* options switches between corresponding ways of executing this process.

To use automatic femur head location, select *Automatic* option, surround with cuboid in *3D View* (and with rectangles in *2D View*) the area containing femur's head and select *Find bone head*. Detected position of the head will be marked with a sphere and it will be possible to manually refine sphere's position (see Figure 5.3). The smaller the region selected the faster and more precise the head detection.

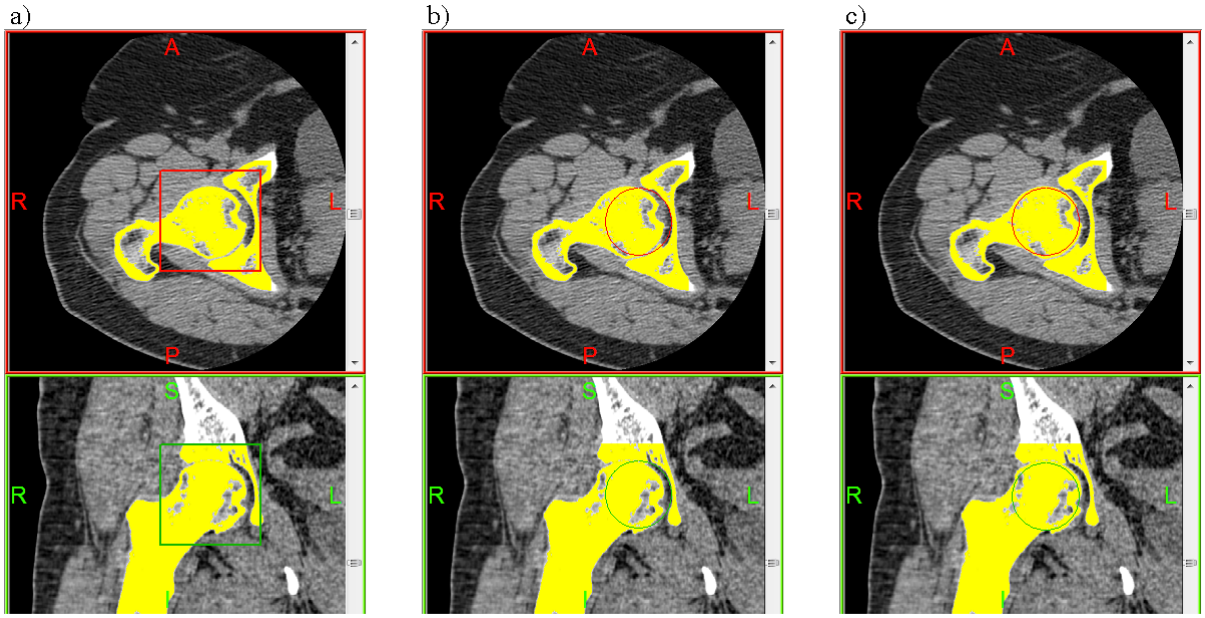

Figure 5.3: Preliminary selection of head location site: a) selection of area that contains the head b) automatic detection of head position c) selected position after manual refinement

With option *Manual* selected, the sphere can be moved freely and it's radius can be modified with use of circles displayed in *2D View*.

5.4.2. Adjusting position of femur head

Next step is to adjust the approximate head position to the image. To do this, ensure that the head has already been surrounded by the sphere. Select *Fit*. The sphere will be repositioned to the best spot (see Figure 5.4).

Verify the accurateness of adjustment. The surface of the sphere must cover the surface of the head in the most exact way possible (see Figure 5.5).

5.4.3. Bone extraction

The last step is to extract desired bone. After the correct fit, this step requires only selection of the bone (femur or hip bone) and clicking *Separate* button. When the extraction is successful, the overlay is indicating only the selected bone (see Figure 5.6 showing separation of femur). Verify the accurateness of extraction.

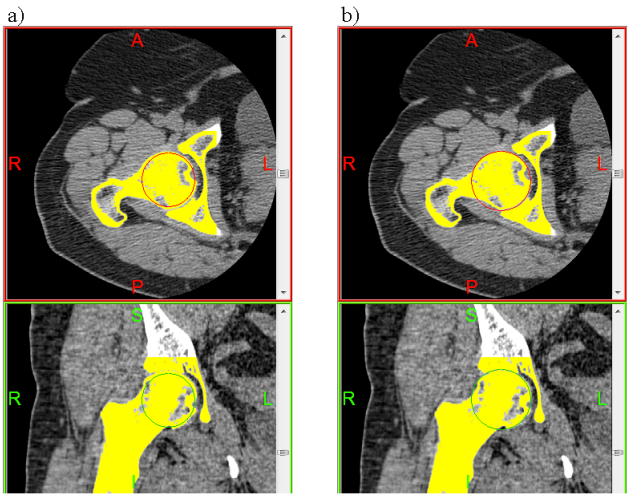

Figure 5.4: Adjusting position of femur head: a) before adjustment b) after adjustment

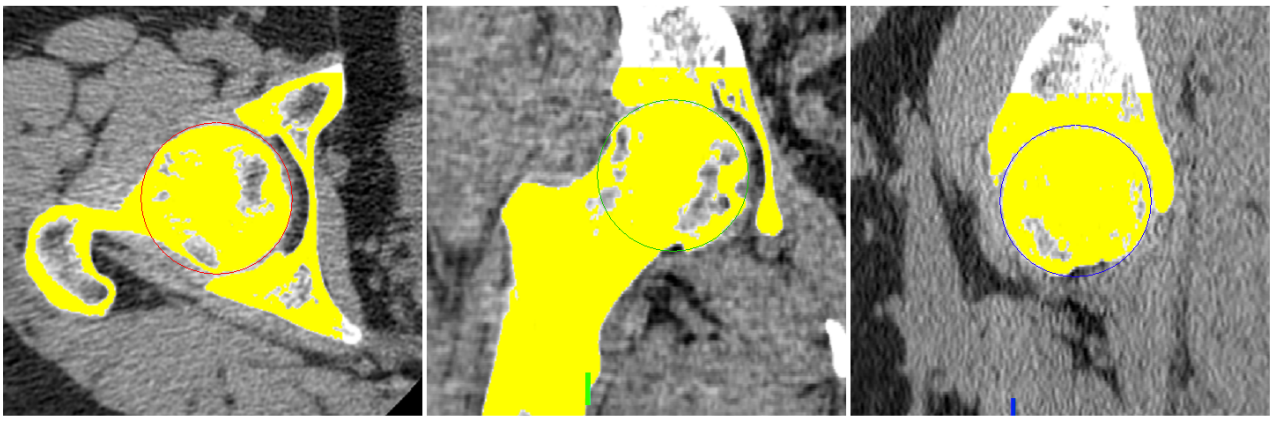

Figure 5.5: Femur head position after adjustment

Figure 5.6: The result of femur extraction

6. Generating and saving the model

In order to generate three-dimensional bone model (of the entire bone tissue or separated bone) select *Generate model* button. The model will be created basing on the overlay area and will be displayed in *3D View* (see Figure 6.1). Display mode can be modified (hide/show, set transparency) using *View settings* menu for object entitled *Model*.

Generated model can be exported as STL file by selecting *Save model* button - option available only with full license. You can also save your model to proprietary 3DM file format. 3DM files can be send to info@optimedi.pl for our company to print your model in 3D technology.

The model can be deleted by selection of *Delete model* button.

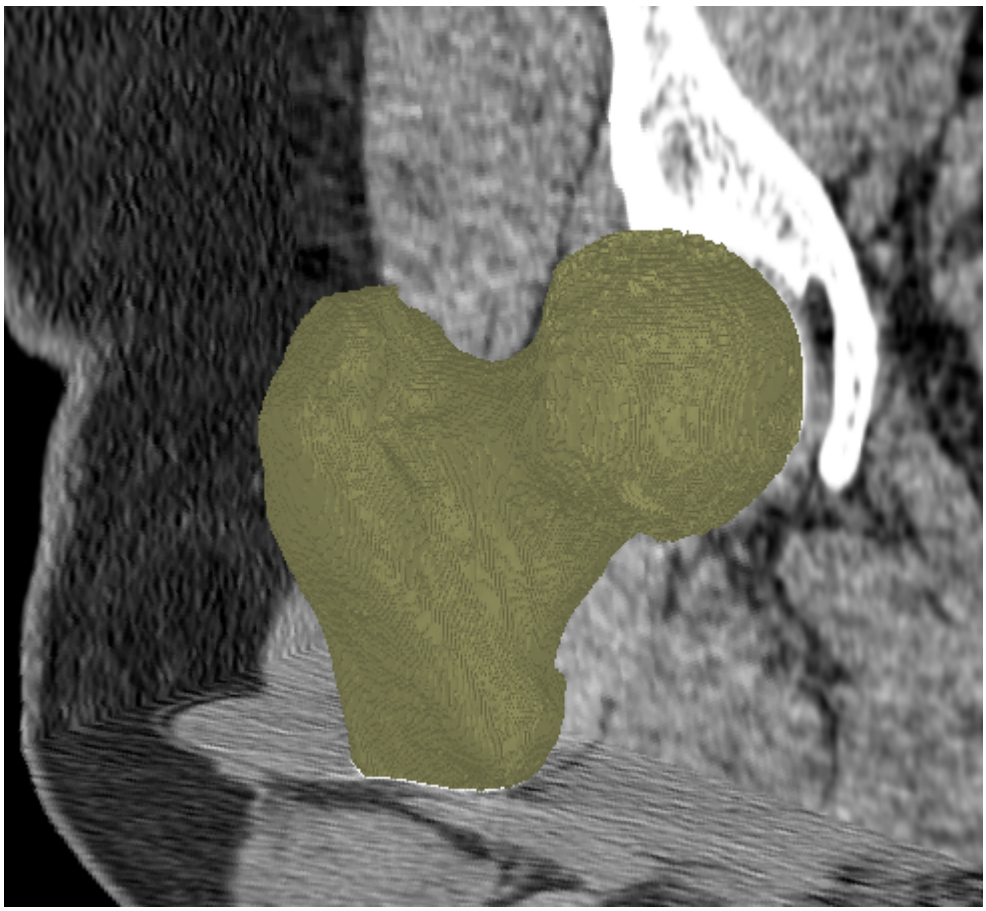

Figure 6.1: The final model of femur

7. System requirements

Minimum:

CPU: Intel Core i3 (2.5 GHz)

RAM: 8GB

Graphics card: NVIDIA GeForce GT 610, 512 MB

OS: 64-bit Windows 7

.NET Framework 4.0

Recommended:

CPU: Intel Core i7 (2.5 GHz)

RAM: 16GB

Graphics card: NVIDIA GeForce GTX 660, 1024 MB

OS: 64-bit Windows 7

.NET Framework 4.0

8. Additional information

Customer can be provided with free paper edition of the manual. To make an order, contact us by e-mail: info@optimedi.pl. Delivery time never exceeds 10 working days, starting from the order day. Manuals are available in English and Polish.

To view the digital edition of manual one must have a PDF viewer. If you do not have one download for example free Adobe Reader using following link: http://get.adobe.com/uk/reader.