High School workshop: Scientific visualization

Universitat de Barcelona

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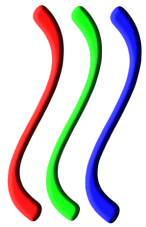
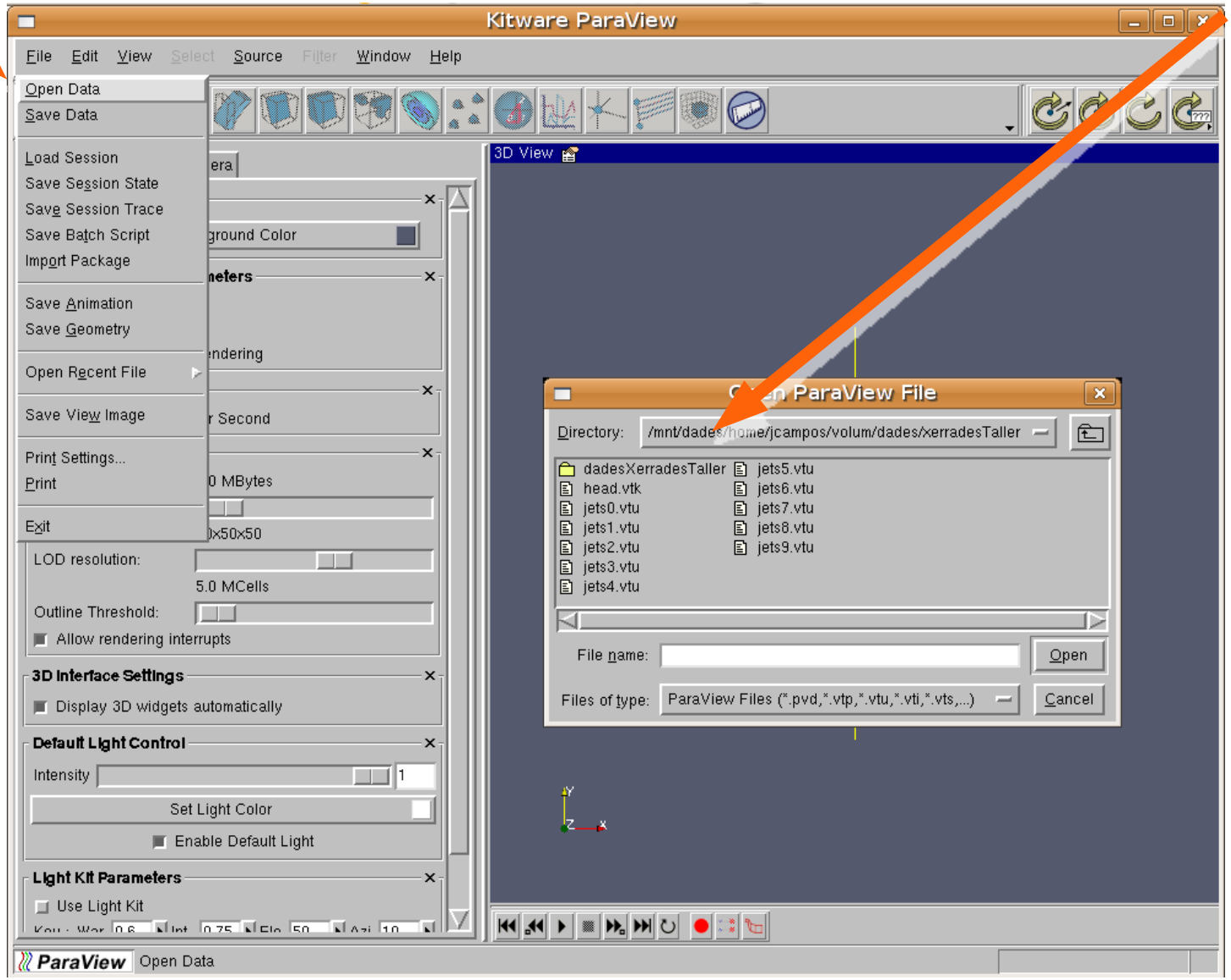
Introduction

- We are going to explore the data from a Magnetic Resonance of a person's head.
- Program: ParaView, free software, multiplatform (Linux, Mac, Windows...)
  - Log in the system
  - Execute the program ParaView with 1 click over the icon placed on the desktop:



Open a data file

1. Menu
File
Open Data

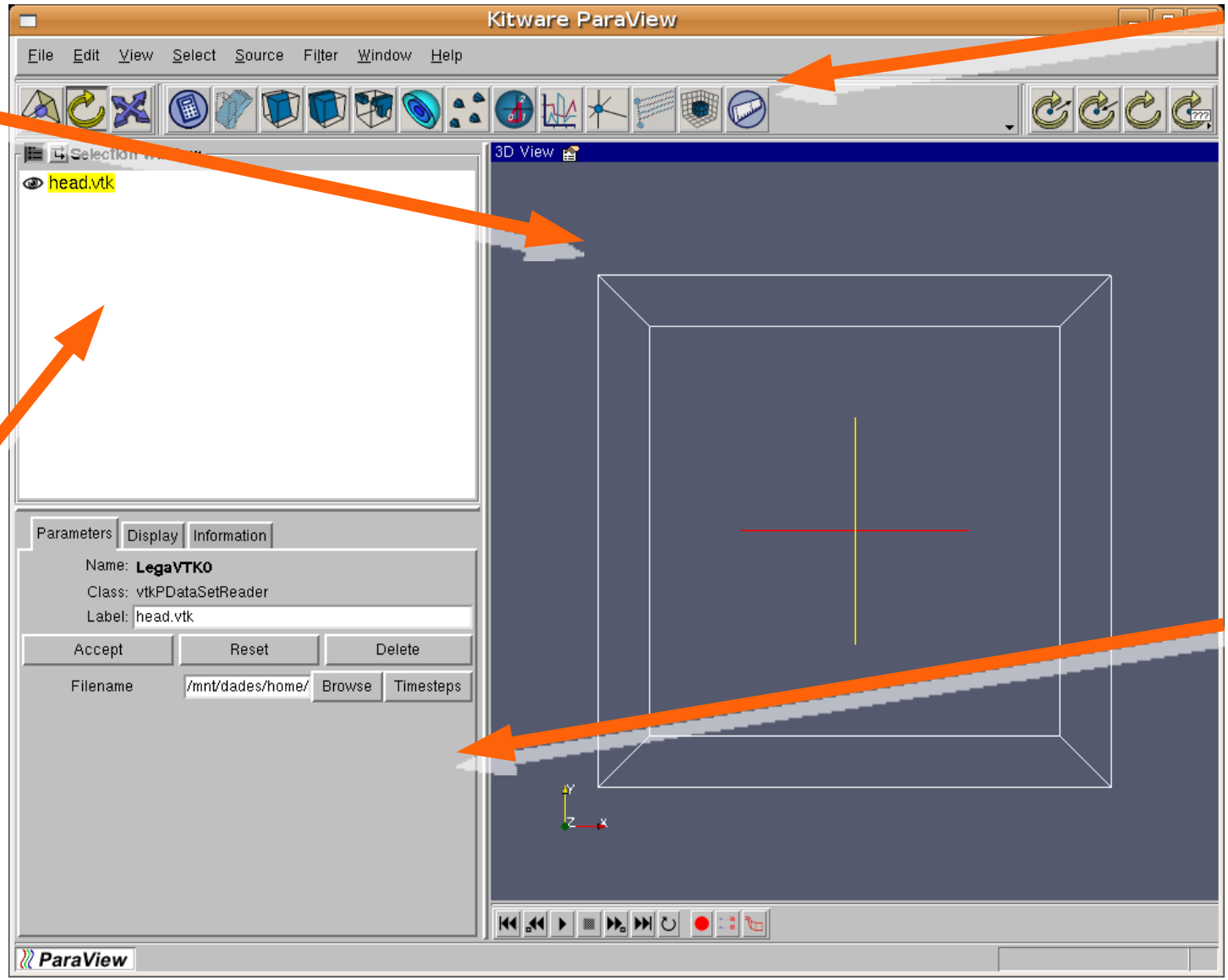


2. choose
head.vtk
and press
Open
button.

Application areas

1. Display area (empty because we have no pointed what to render).

2. Modules list (we will build a module pipeline to transfer data from module to module).



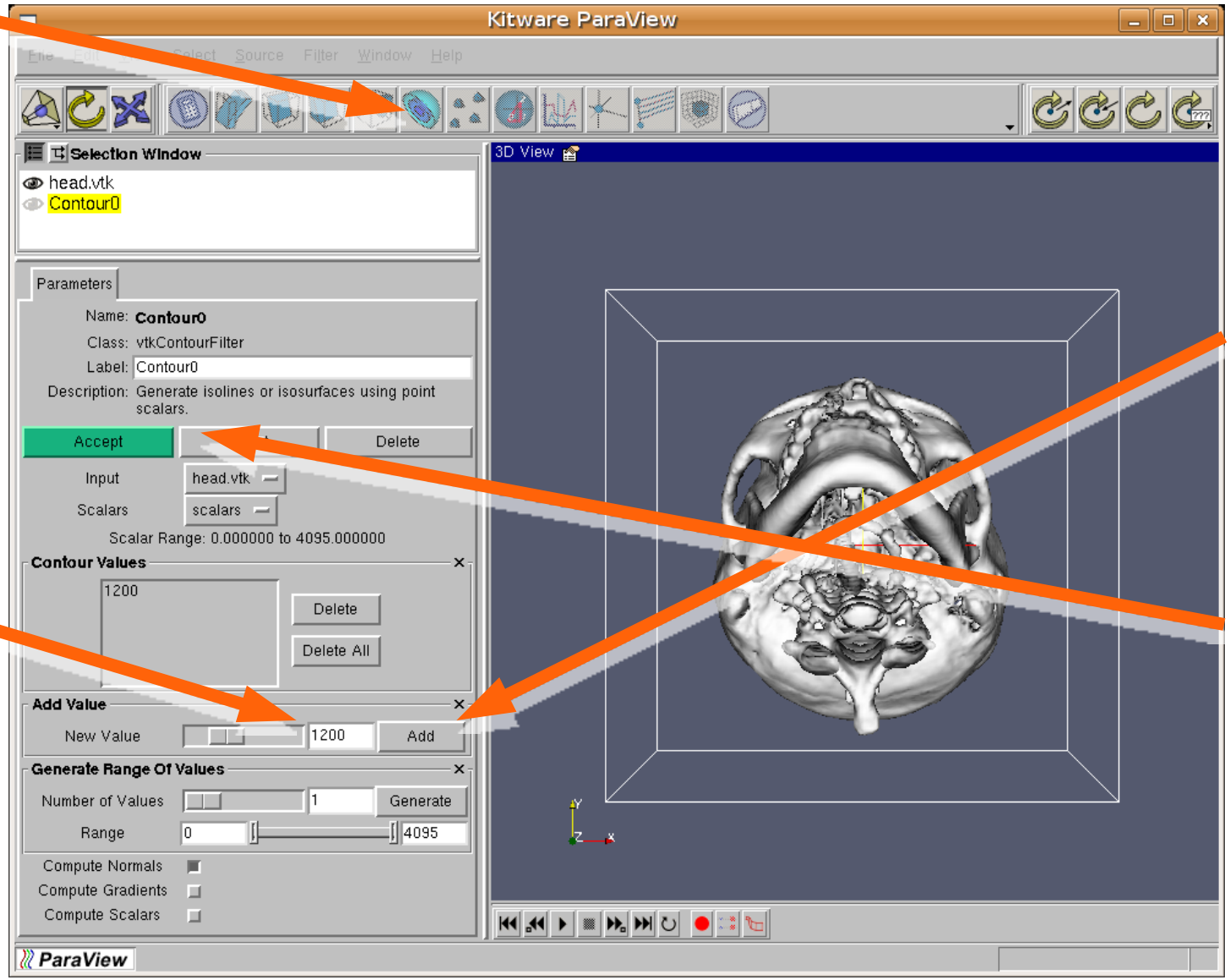
3. Module buttons (to access the common ones; we can find more in Menu Filter)

4. Parameters area (where we can modify the module parameters)

Surface extraction

1. press surface extraction button.

2. choose 1200 as the surface value (it is a high density value correspon ding to bones)



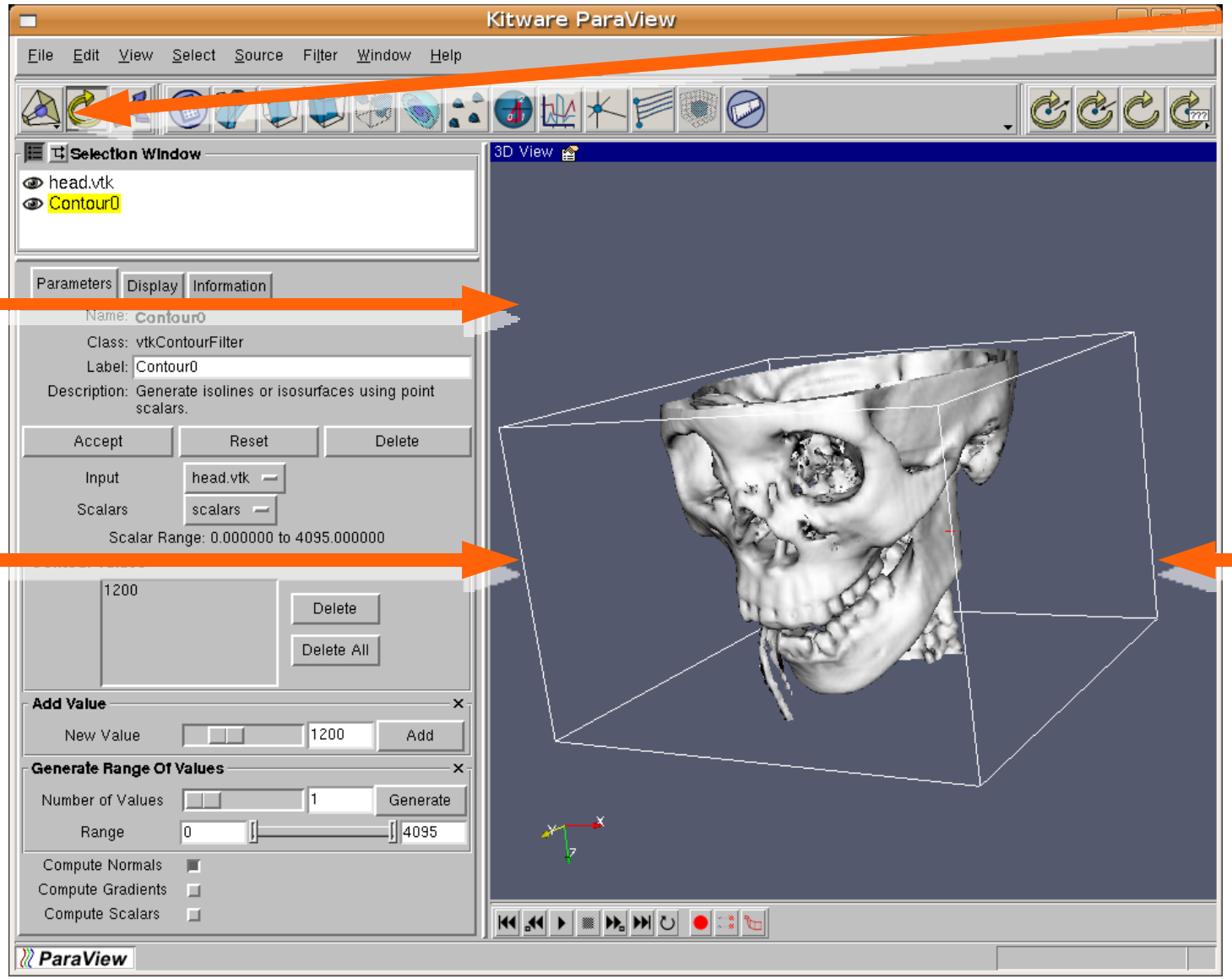
3. press Add button (to add the value to the contour values list).

4. press the Accept button (to let the module process the data).

Camera movements

1. press the Left mouse button to change camera's point of view.

2. press the Right mouse button to change camera's zoom.



3. press the Reset button to retrieve the default camera parameters.

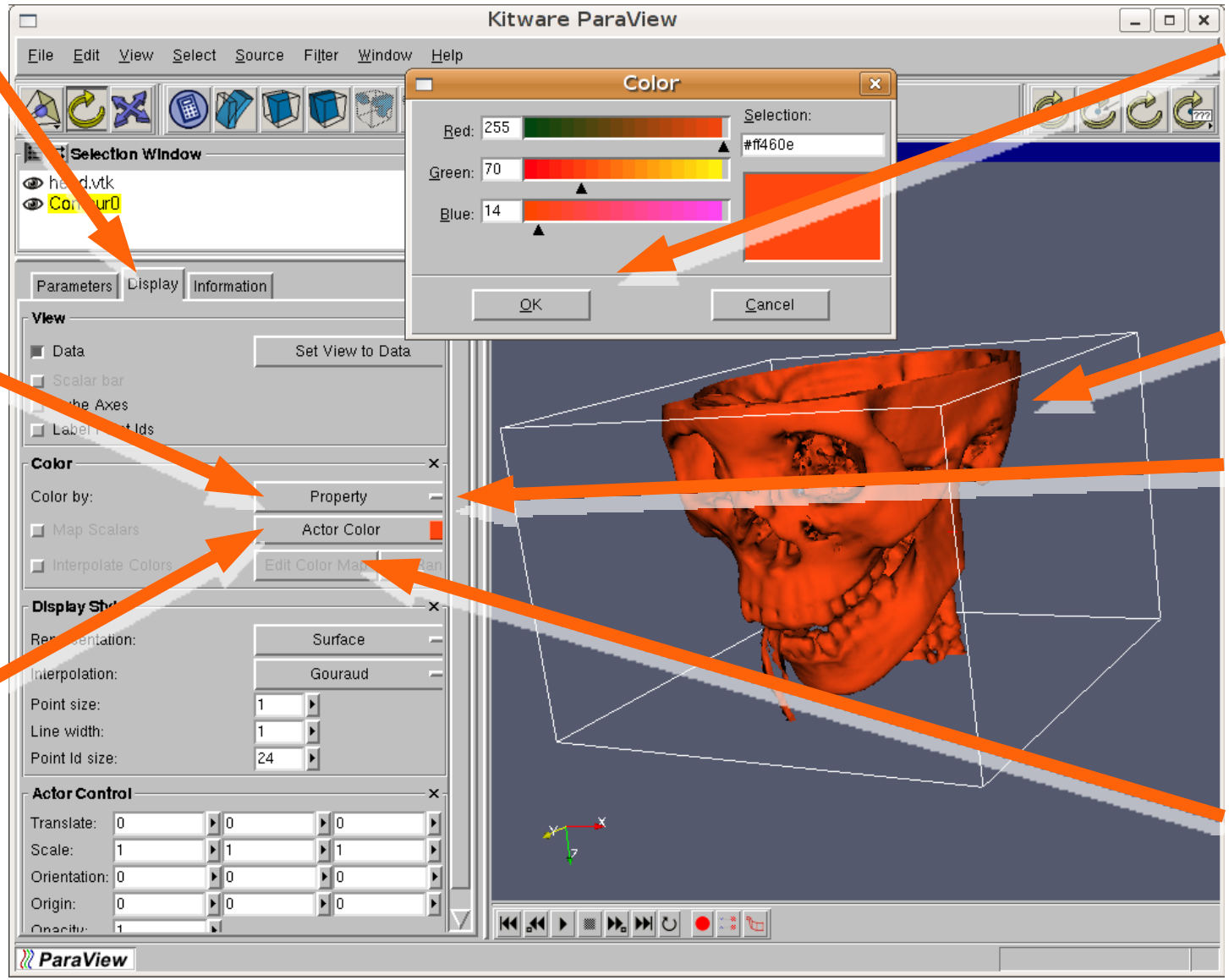
4. press the Middle mouse button to drag the camera.

Choosing a desired color

1. press Display tab.

2. choose the Color by Property option.

3. press the Actor Color button



4. choose the desird color and press OK button.

5. observe the results.

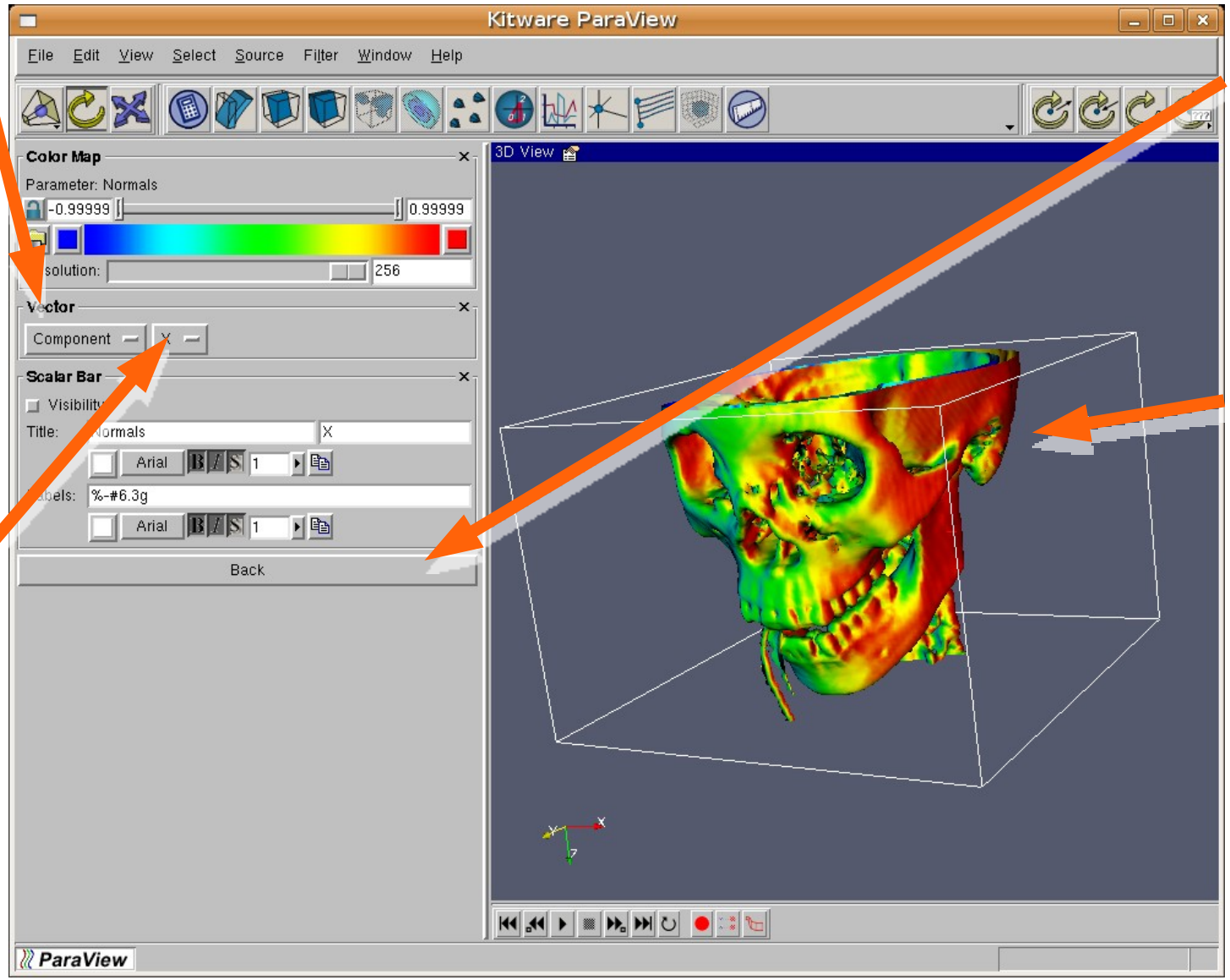
6. before next slide choose Color by Point Normals.

7. press Edit Color Map.

Choosing a set of colors

1. choose Vector Compon. option.

2. select X compon.



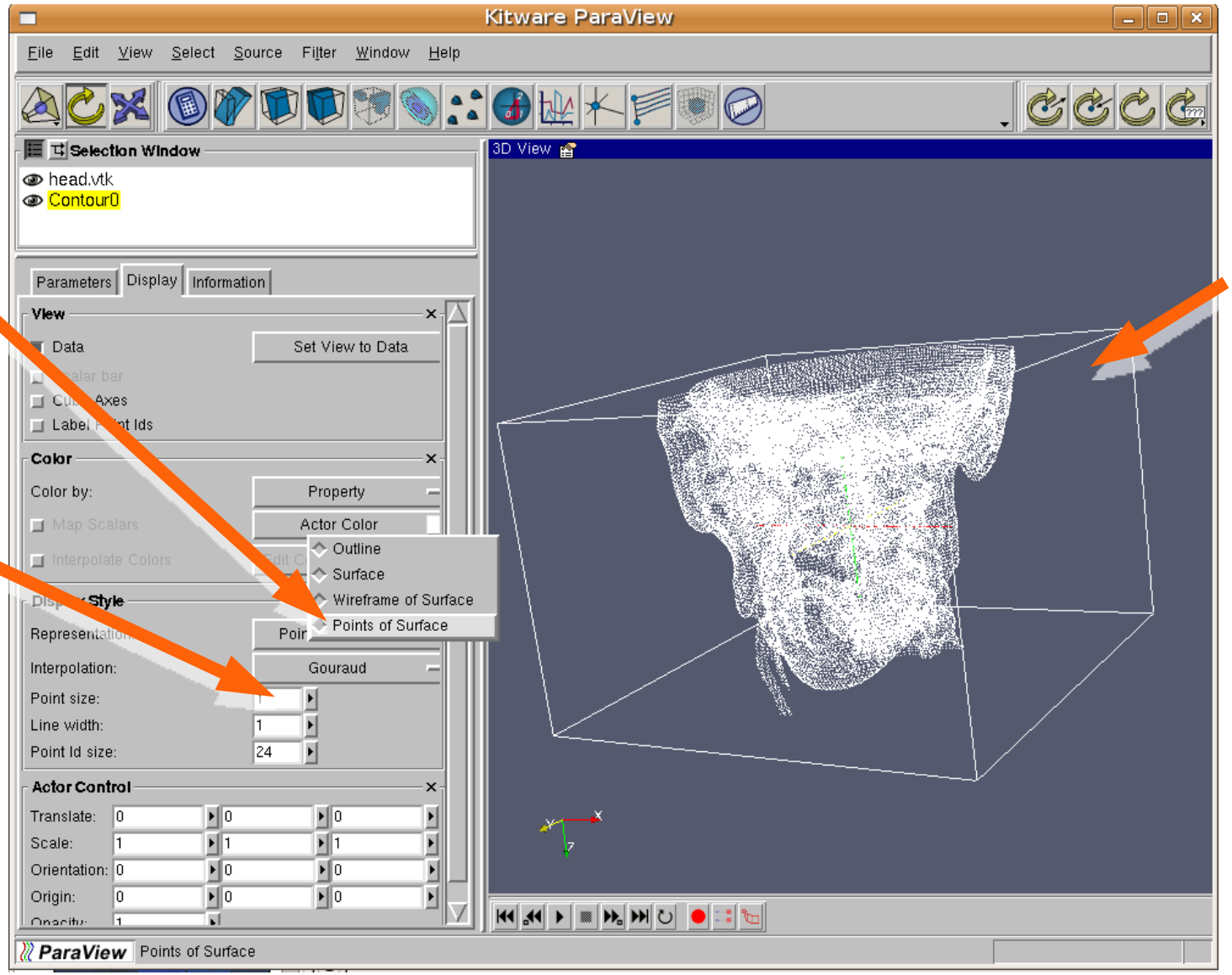
3. press Back button to return to Display tab.

4. observe the colors: why are they different?

5. review previous slides to leave a white color again.

Representation styles

1. check Points of surface options as Repres.



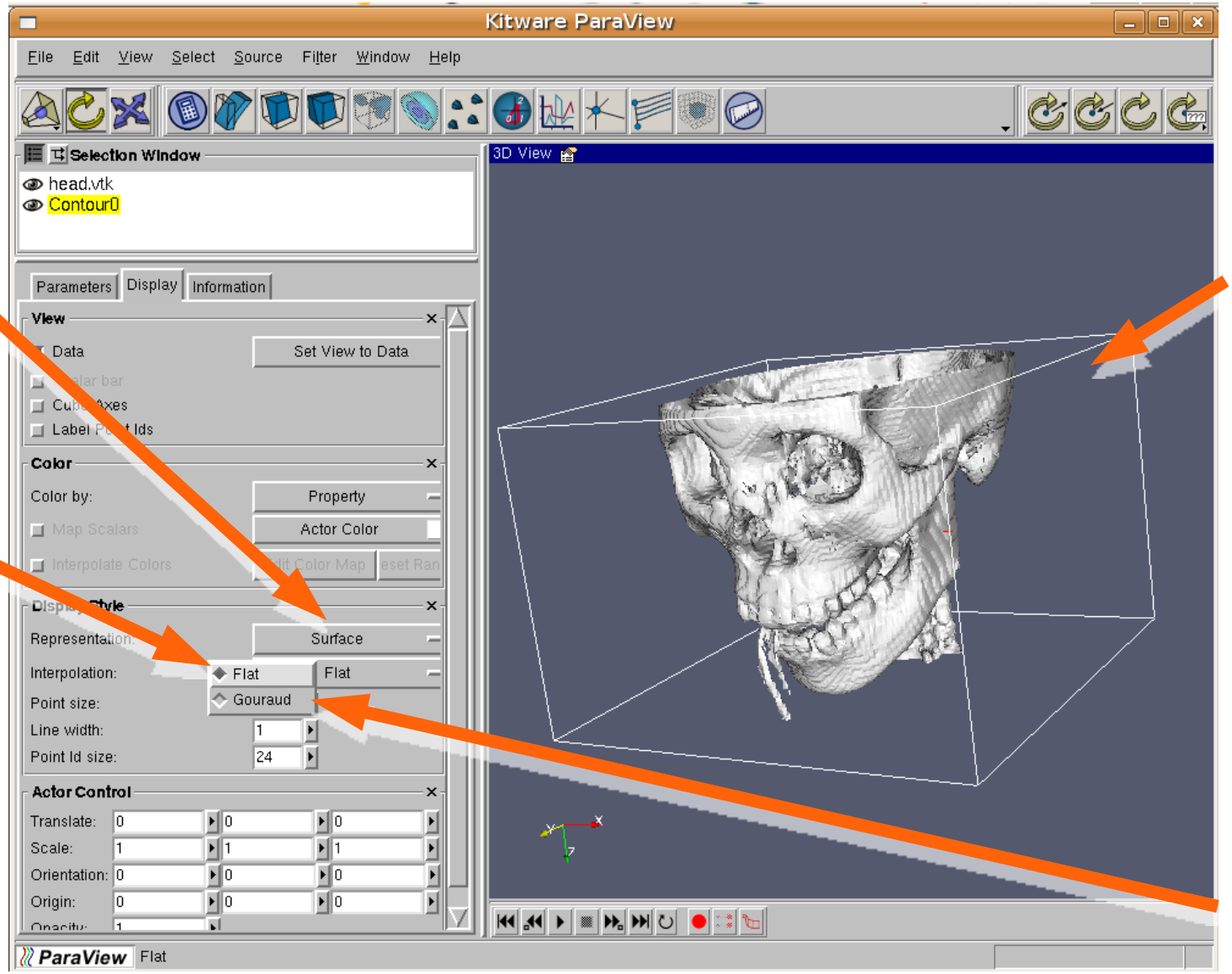
2. try to change the Point size to 2 (finally, leave a 1 again)

3. observe that instead of the surface, a set of points belonging to the surface are rendered.

Interpolation styles

1. choose Surfaces as Represen.

2. tag Flat interpolat. (= no interpol.)of the normal vectors.

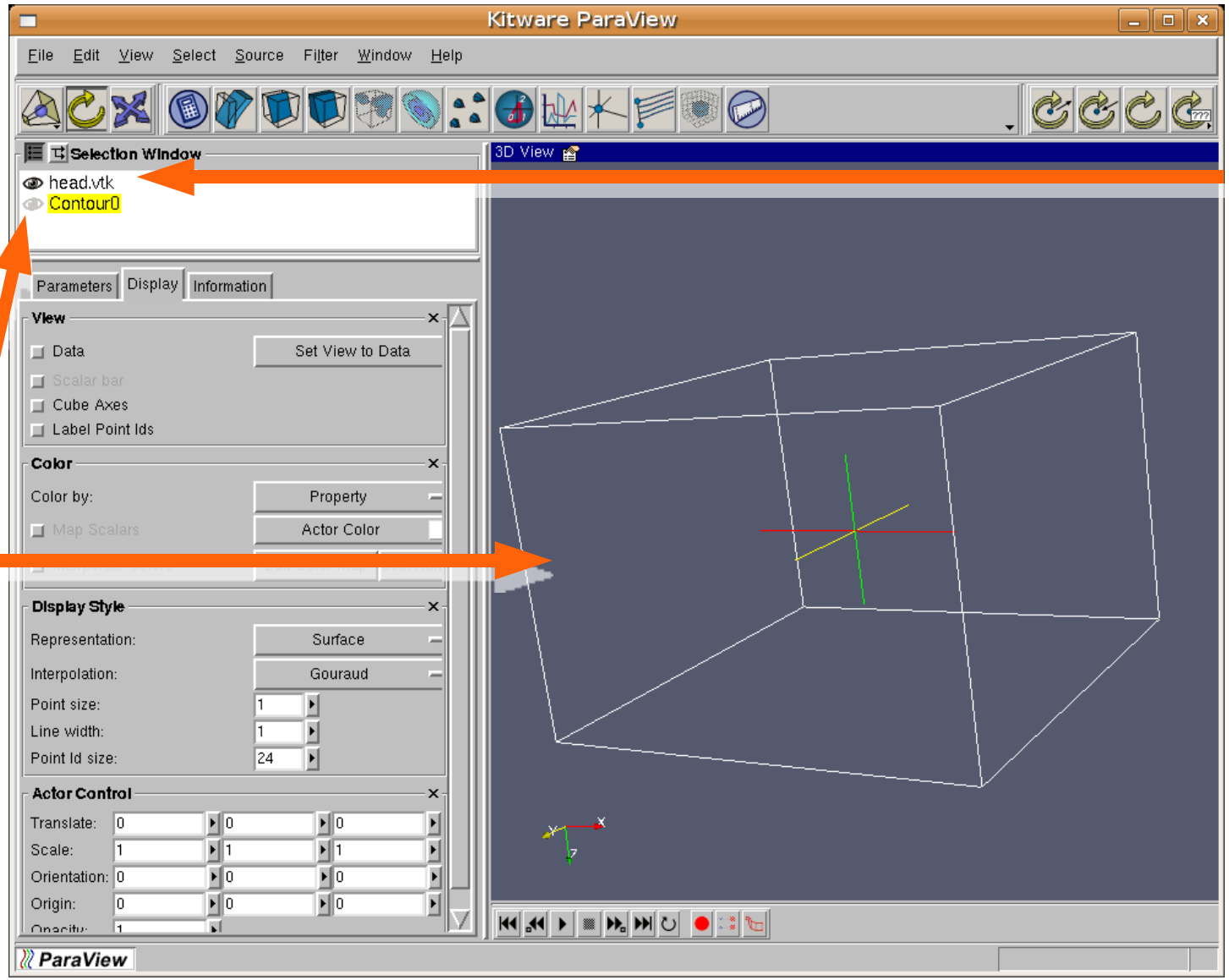


3. observe that now you can distinguish every polygon used to render the surface.

4. leave Gouraud interpolation again.

Show/Hide each module

1. press the eye icon before the Contour0 module.



2. observe that the bone is no longer displayed.

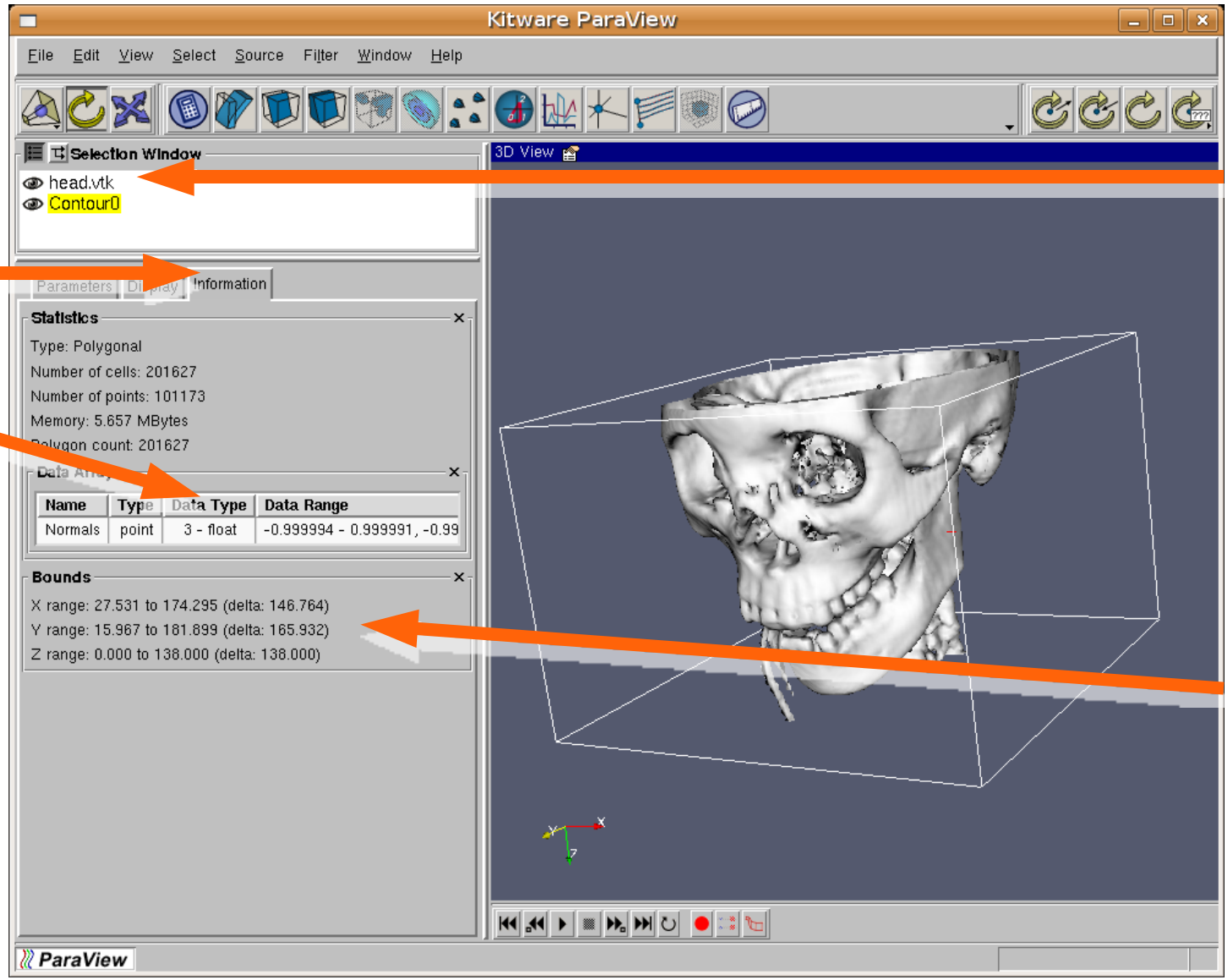
3. try to show/hide the other modules.

4. show all modules again.

Module information

1. press Informat. tab.

2. observe that the module produces an array of vectors (3 floats) with a range [-1..1]



3. choose the input data module (head.vtk) and observe that the data are scalar values [0..4095]

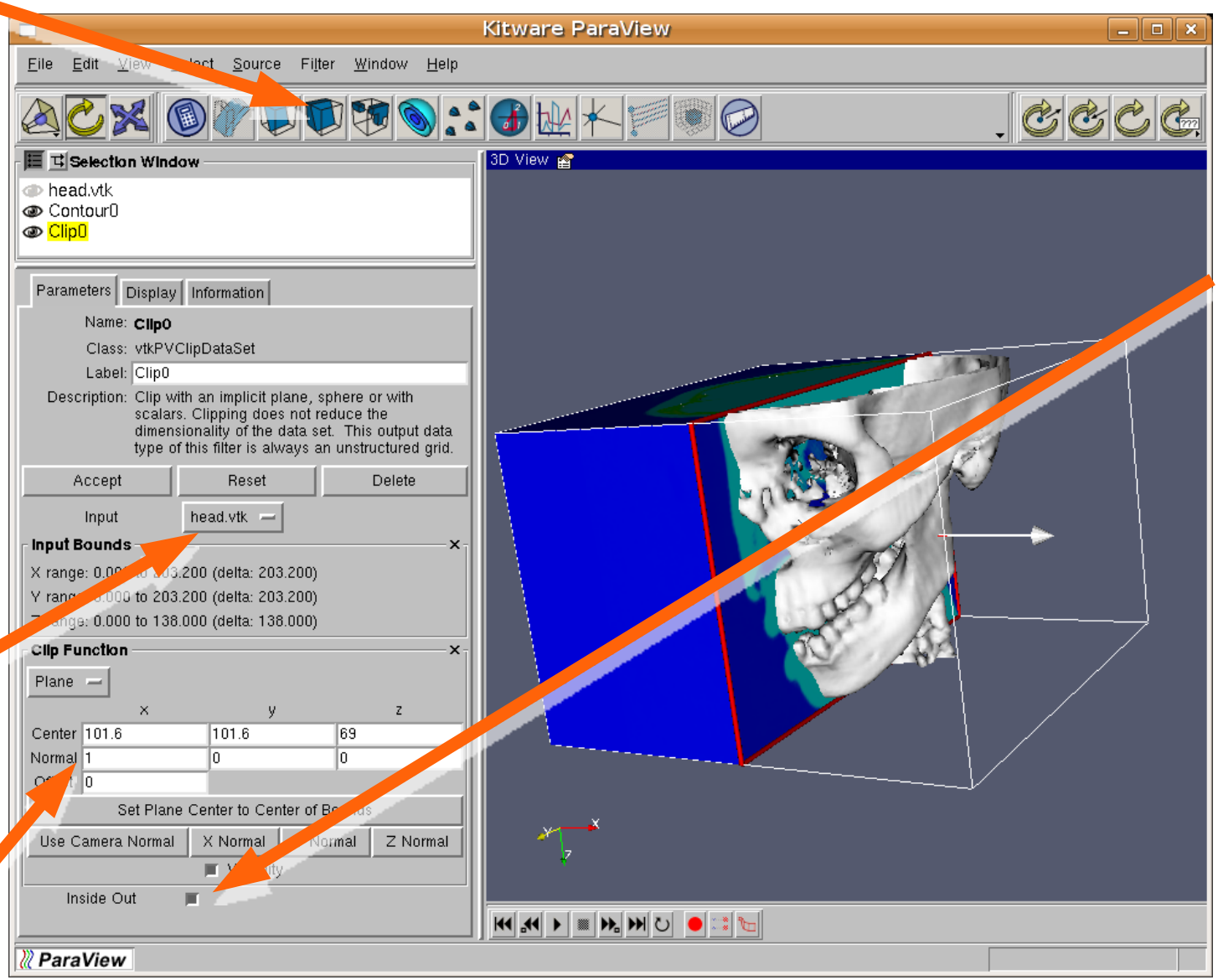
4. observe each module Bounding dimensions.

Data clipping

1. press Clip button to divide the data.

2. ensure that the source data module (head.vtk) is the input data.

3. choose the plane with normal (1,0,0)



4. tag Inside out to get the outer division part.

5. press Accept button to view the results.

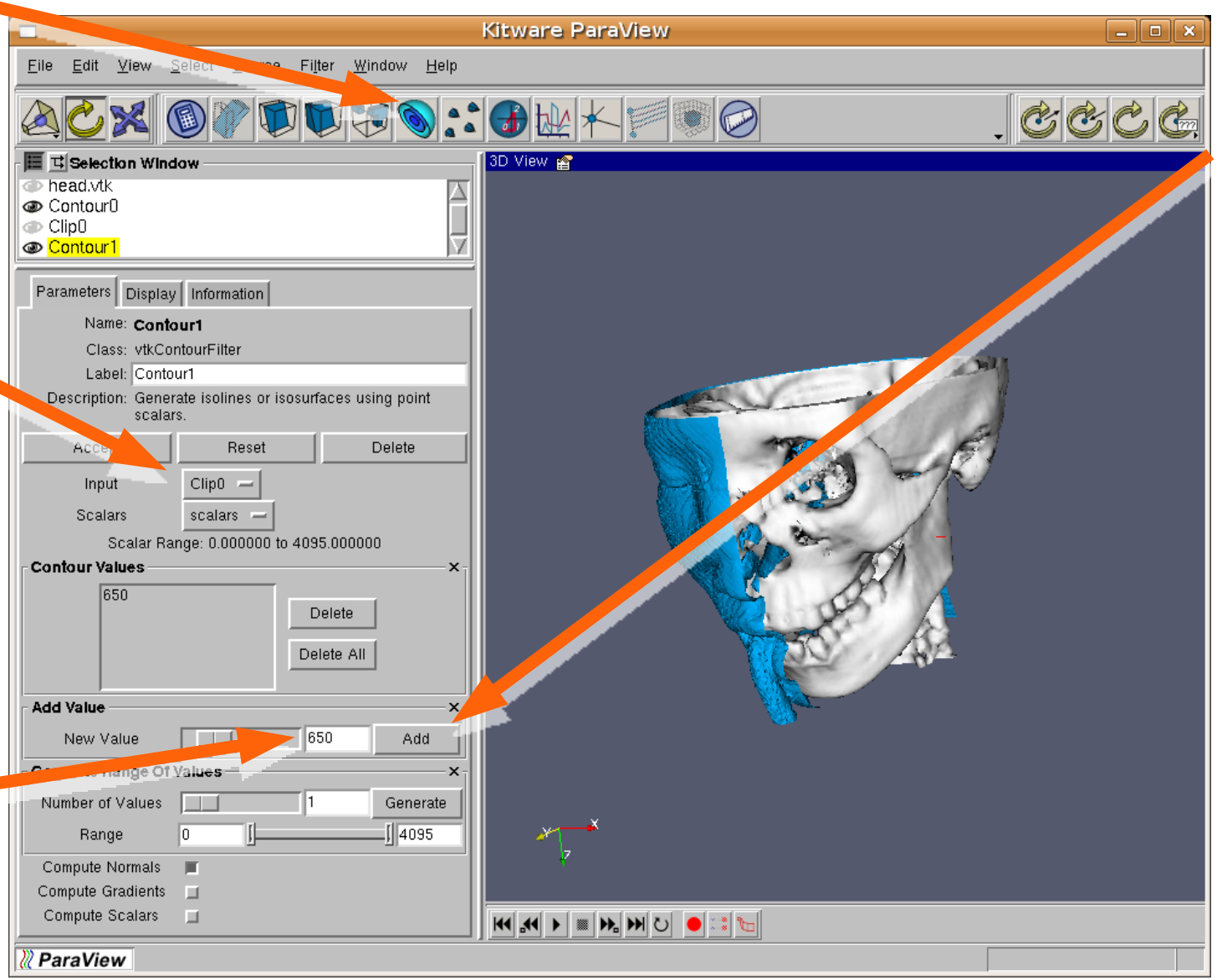
6. press eye icons to view only the bone.

Skin surface extraction

1. press the iso-surfaces extraction button.

2. choose previous module Clip0 as input data.

3. choose 650 as desired density.



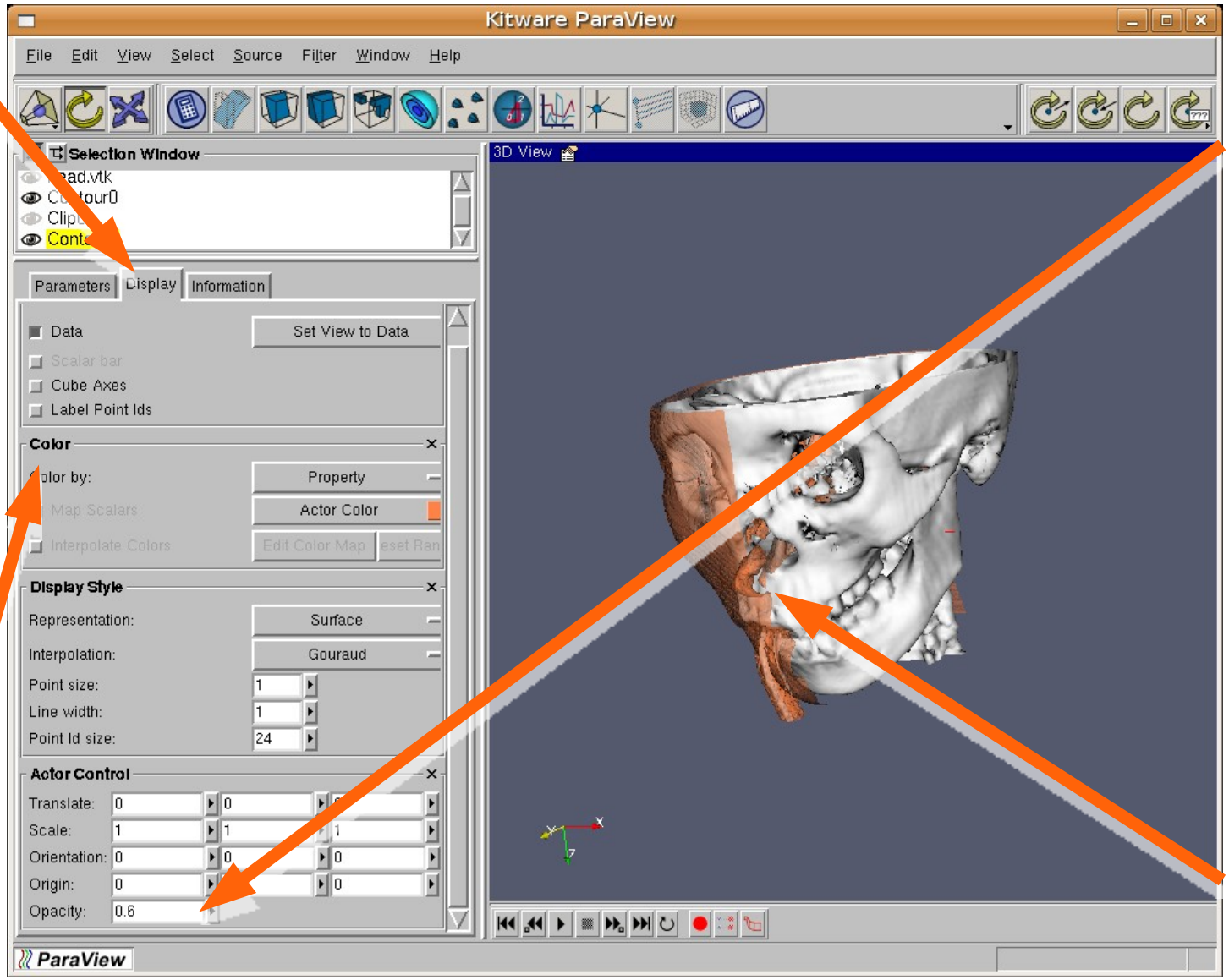
4. press Add button to add the density value.

5. press Accept button to obtain the results.

Opacity

1. select Display tab.

2. choose an orange color close to skin color.



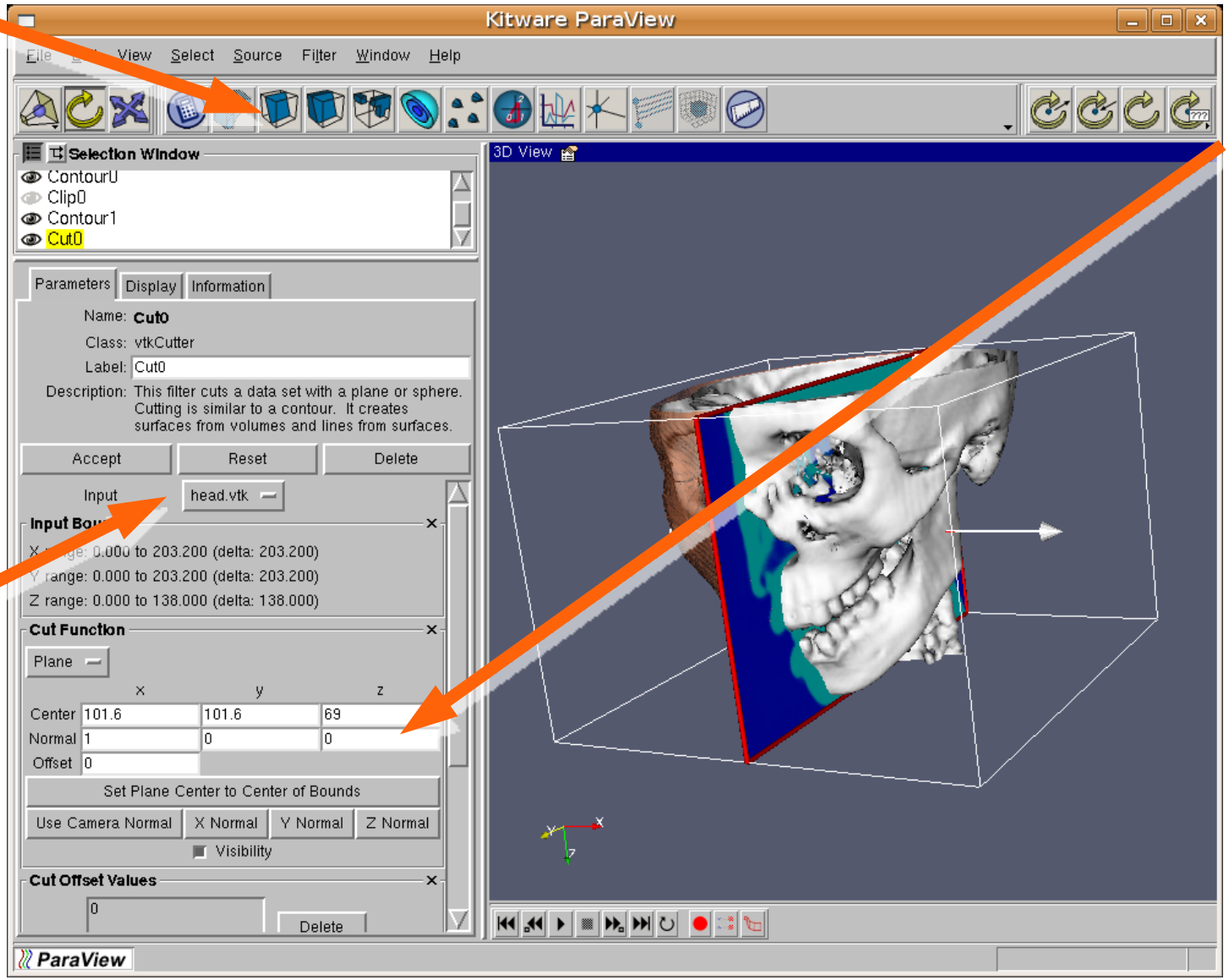
3. entry a 0.6 opacity.

4. observe that the skin surface is less opaque.

Data sections

1. press Cut button.

2. choose the source data module (head.vtk) as input.



3. set the plane normal to (1,0,0)

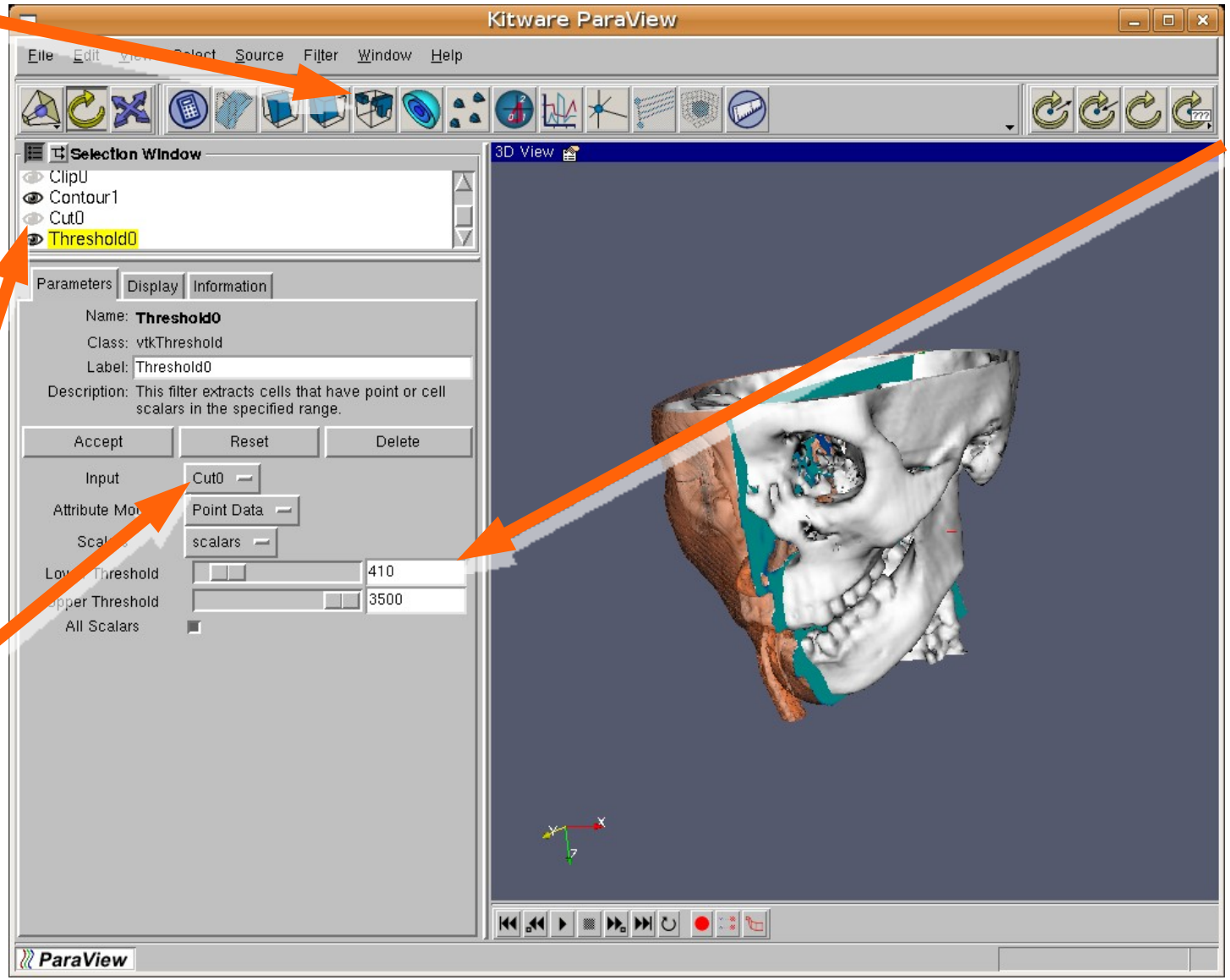
4. press Accept button to observe the resulting section.

Threshold filter

1. press the Threshold button.

2. hide the section module (Cut0).

3. choose the section module (Cut0) as input.



4. choose the range [410..3500] (to avoid the lower densities that represent the air).

5. press the Accept button.

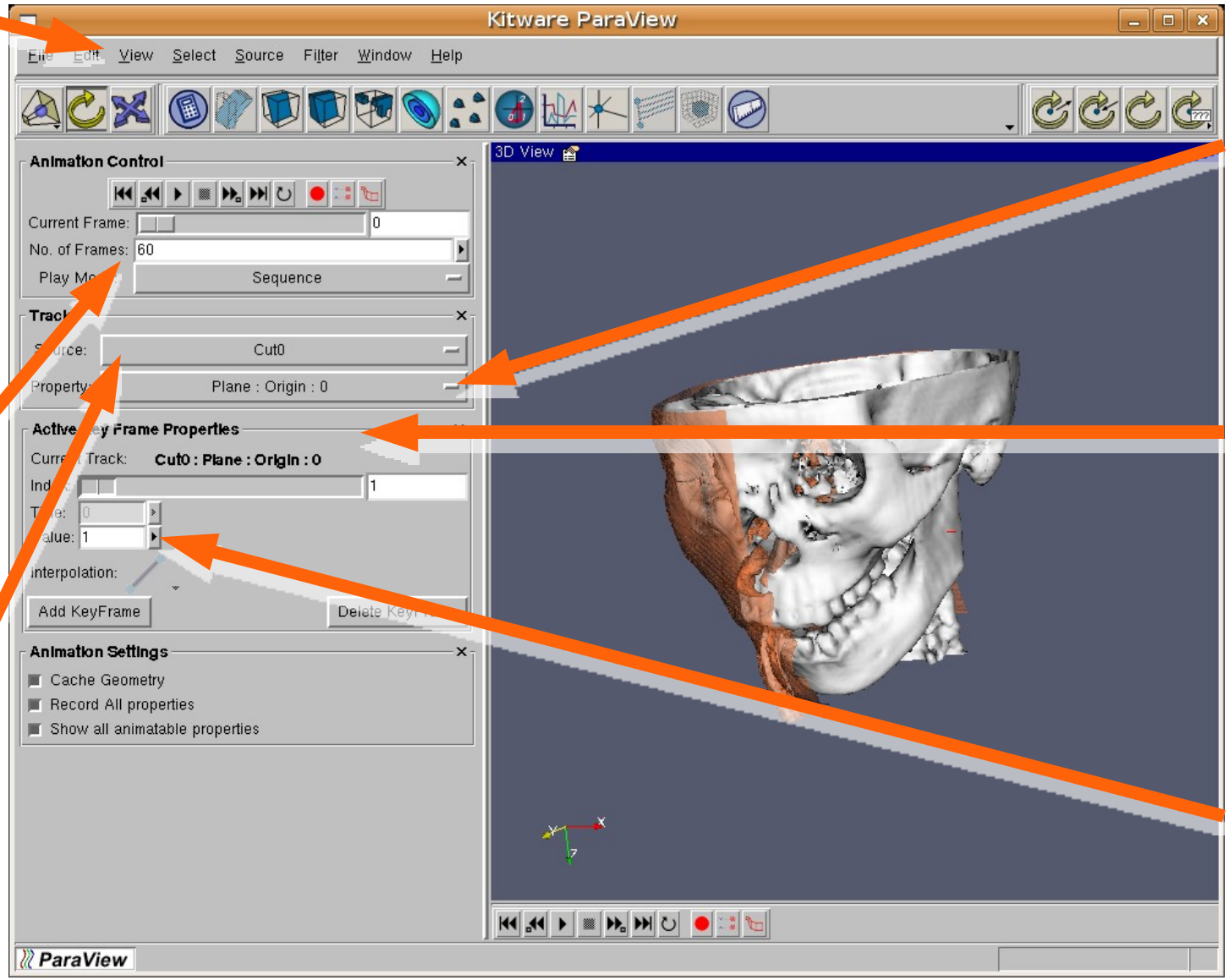
6. change to Display tab and set a 0.8 opacity.

Animation: initial state

1. press Menu View Keyframe animation.

2. set 60 frames.

2. choose the section module (Cut0).



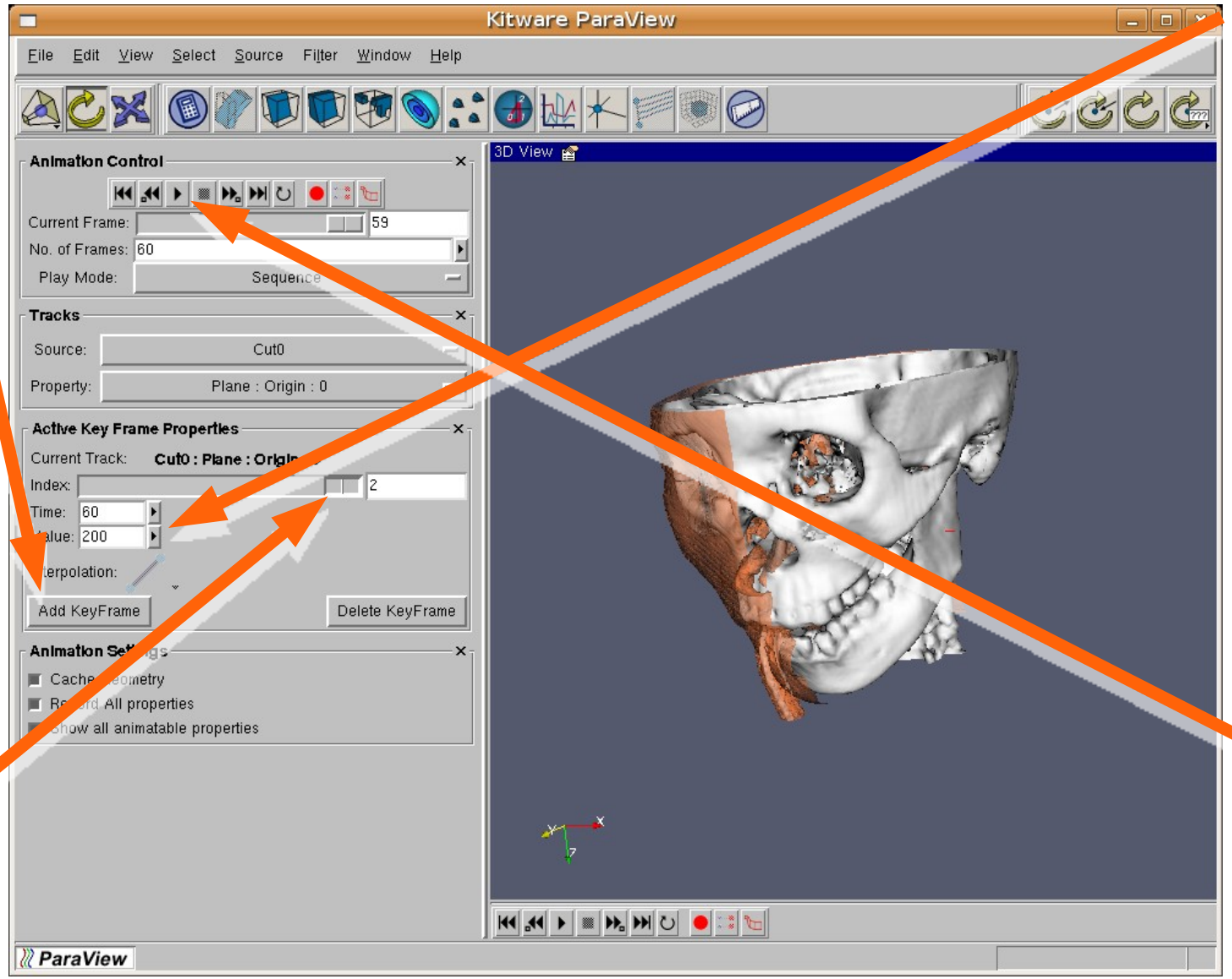
3. select the X compon. of the initial plane coordinates (Plane: Origin: 0).

4. press Add KeyFrame button.

5. put 1 as initial value.

Animation: final state

1. press Add KeyFrame button.



2. move to the second frame.

3. place 200 as the final value of the coordinate (press enter keyboard key to finish).

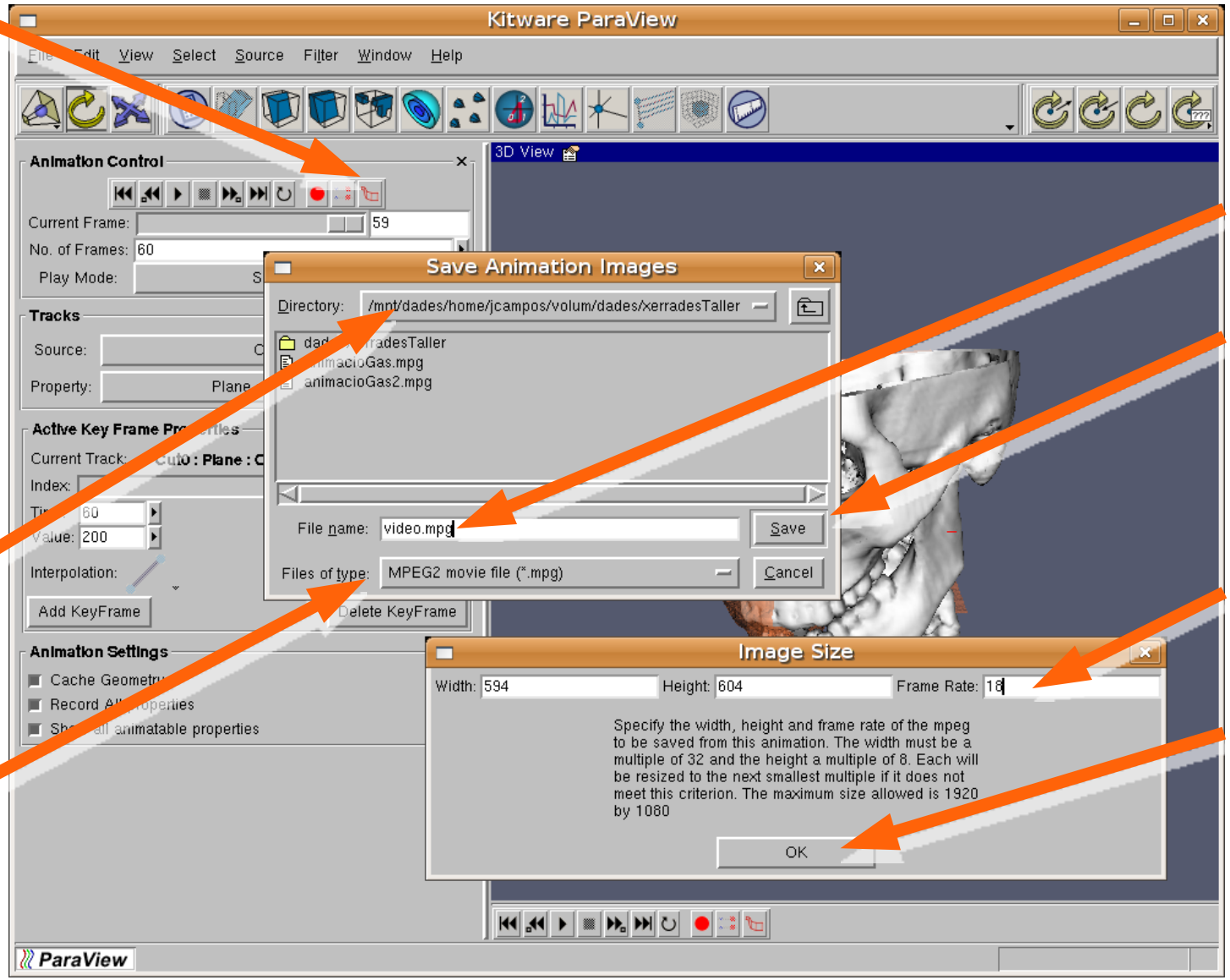
4. press Play button to preview animation.

Animation: saving

1. press Save button to store the animation.

2. change to your user's directory.

3. select MPEG2 movie file type.



4. choose the file name (*ani.mpg*)

5. press Save button.

6. entry 18 frames per second.

7. press OK button to create the animation movie.

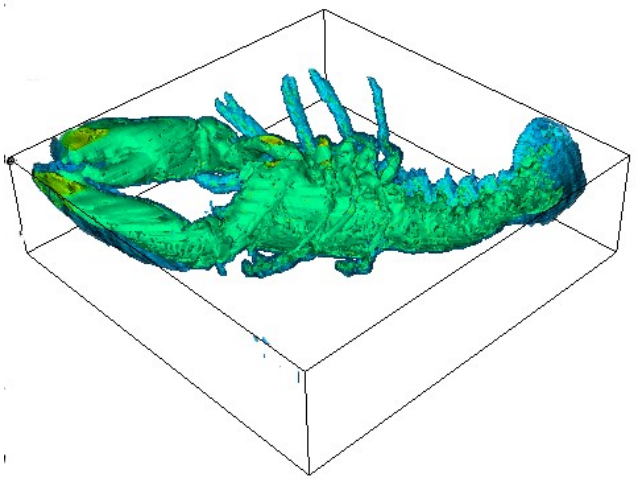
Questions

- Have you understood what is scientific visualization?
- How is the volume data?
- Cite three normal situation where volume data is used.
- Say three possible visualization types to obtain from volume data.
- Which other information could be extracted from volume data?

More information...

- About this workshop:
  - http://truja.lsi.upc.edu/movibio/soft/paraview/Workshop
- Interactive webs:
  - Human body: http://www.madsci.org/~lynn/VH/
  - Mouse: http://mouseatlas.caltech.edu/
  - Lemur: http://atlasserv.caltech.edu/Lemur/Start_lemur.html
- Wikipedia: http://en.wikipedia.org/wiki/Scientific_visualization
- Programs:
  - ParaView: http://www.paraview.org
  - Mayavi: http://mayavi.sourceforge.net

If you have more time...



- Create a new visualization from the dataset: lobster.dat.vtk
- Have a look to the complete visualization: head.pvs
  - you have to use Menu – File – Load session.