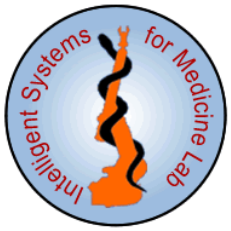


Tutorial for using Slicer 3D

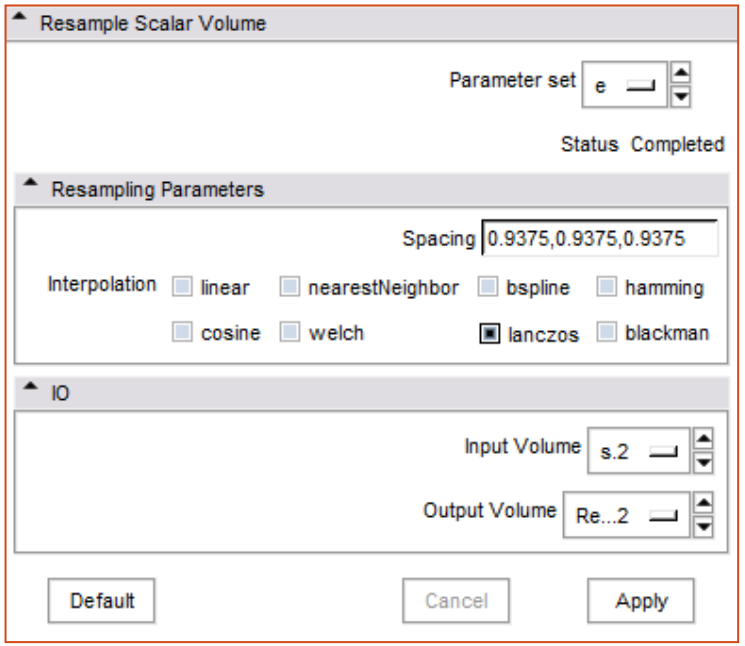
This presentation sums up the different steps with all the parameters used in the modules

Jeremie Voltz

Step 1: Resampling

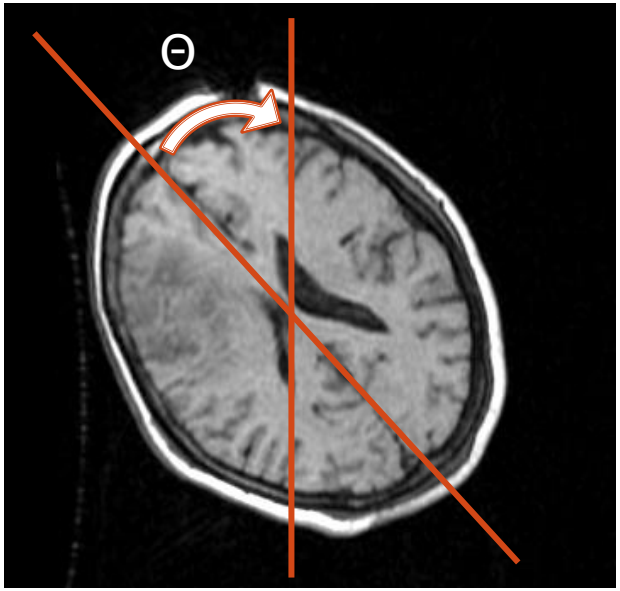
- Use the module “Resample Scalar Volume”
- Create a new CommandLineModule
- Set the spacing parameters as showed on the screenshot
- Tick the “lanczos” box in interpolation
- Choose your input volume
- Create a new Output Volume

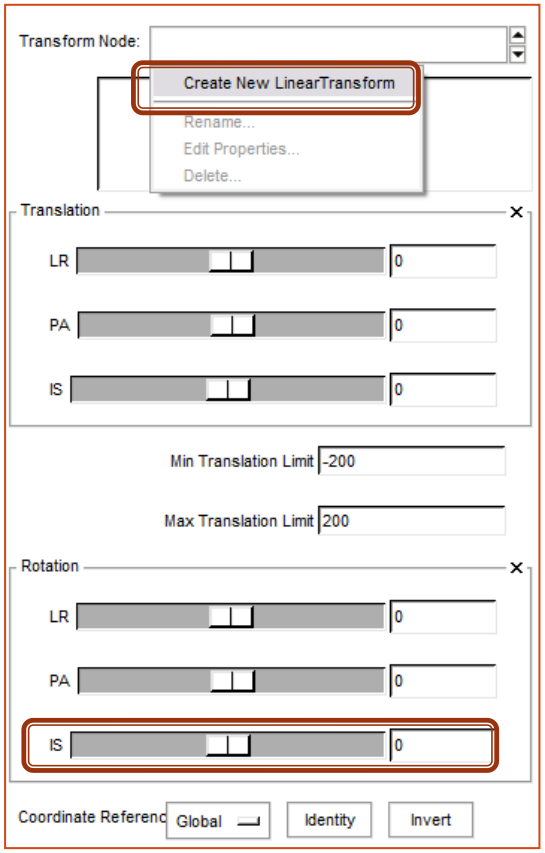
- **Rename all the new volume or transforms in the “Data” module with meaningfully names for more convenience**



Step 2: Rotate the image

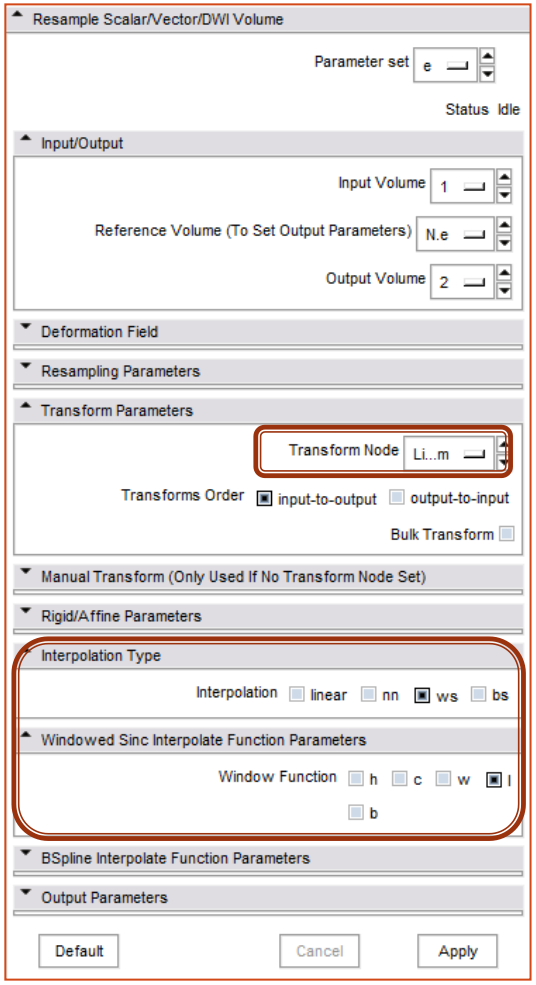
- Use the module “Transforms”
- Create a new LinearTransform
- Set the angle Θ in the box IS





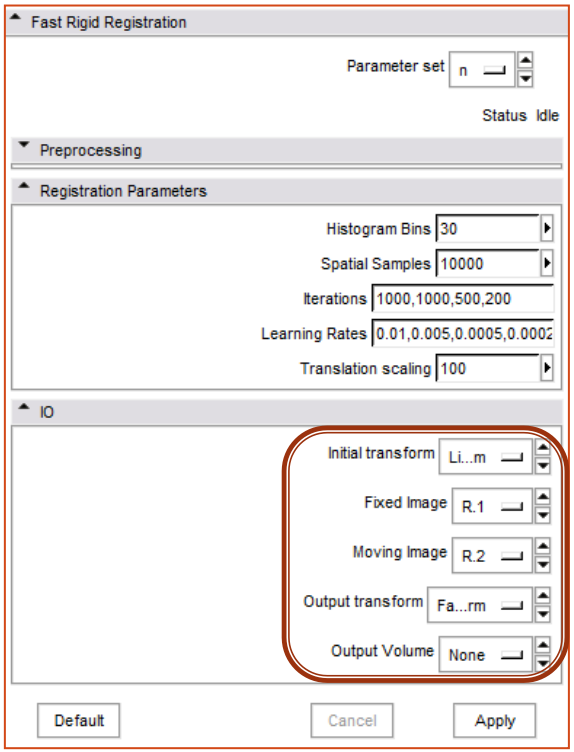
Step 2: Rotate the image

- Use the module “Resample Scalar/Vector/DW Volume”
- Choose the preoperative image as input volume and create a new output volume
- Select the previously created LinearTransform in “Transform Node”
- Select the interpolation parameters
  - Tick the box “ws” in Interpolation
  - Tick the box “l” in window Function



Step 3: Rigid Registration

- Use the module “Fast Rigid Registration”
- Let the parameters in default values
- Select the previously created LinearTransform in “Initial Transform”
- Select the rotated preoperative image as fixed
- Select the resampled intra-operative image as moving
- Create a new Output transform
- You don’t need to create a new volume, we just need the transform now



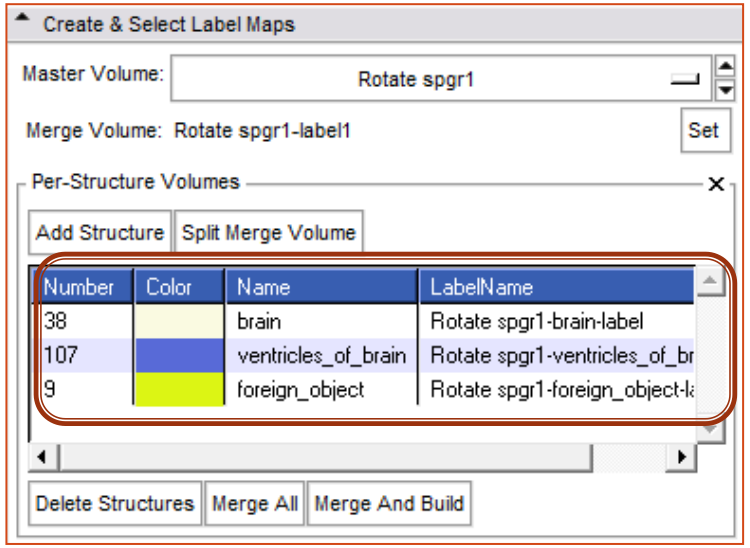
Step 3: Rigid Registration

- Return to the module “Resample Scalar/Vector/DW Volume”
- Choose the intra-operative image as input volume and create a new output volume
- Select the previously created “Fast Rigid registration transform” in “Transform Node”
- Use the same parameters as before

- As result after these 3 steps, you might have the preoperative and intra-operative image rotated and registered
- Save your work: scene, volumes, transforms…
- You’re ready for the segmentation

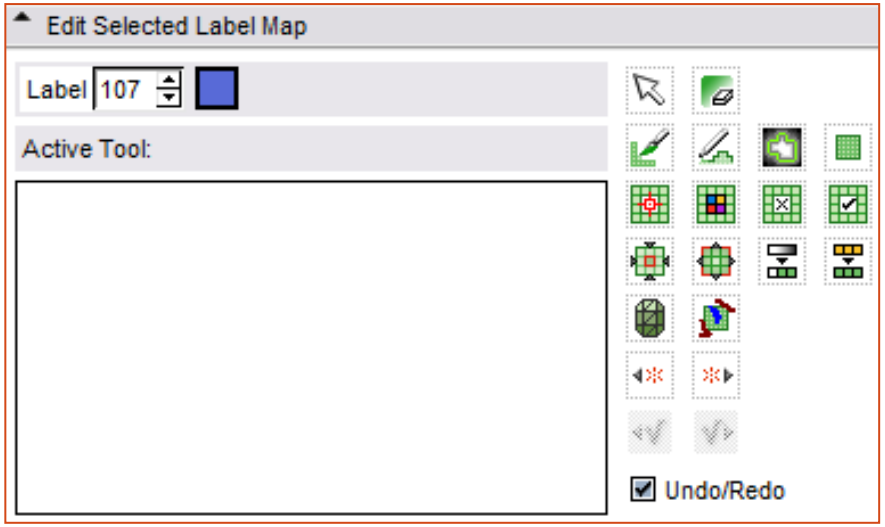
Step 4: Segmentation

- Use the module “Editor”
- The segmentation will be done on the pre-operative image
  - Put it in Master Volume
- Set the merge volume
  - Create new
  - Colour table: GenericAnatomyColors
- Add the different structures: brain, tumour, ventricles…
- To edit the label maps, just click on it in the table



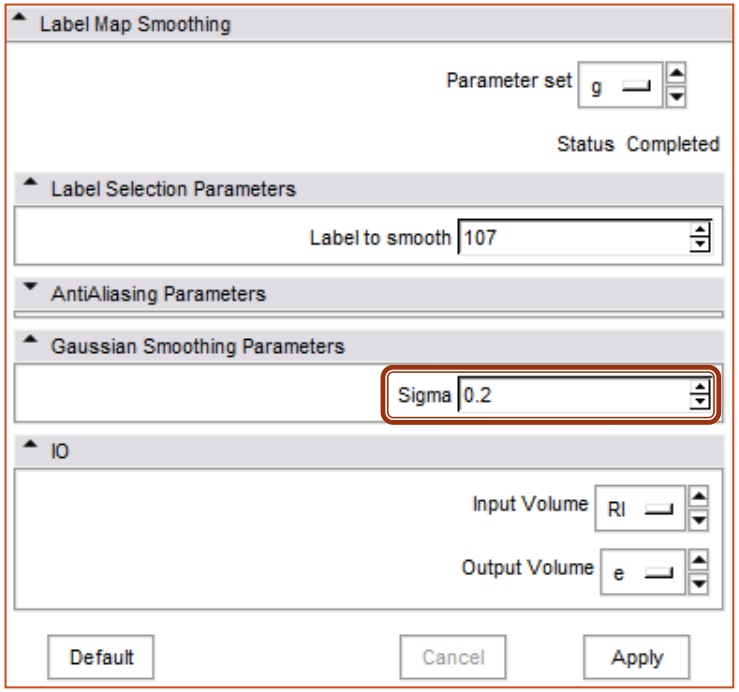
Step 4: Segmentation

- The tools useful in our cases are
  - : LevelTracing (more particularly for the ventricles)
  - : Threshold (can be use but the image has to be clean up after that)
  - : Draw (draws the edges and fills in with the chosen colour)
  - : Paint (useful for filling up the holes)
  - : EraseLabel (set the colour in zero to erase the label)



Step 5: Smoothing

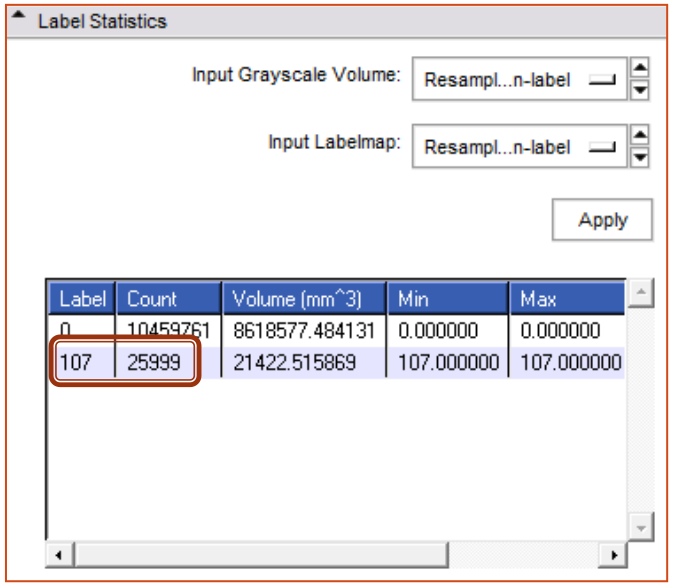
- Use the module “LabelMapSmoothing”
- Select the label (colour) to smooth
- Choose a value for sigma between:
  - 1 -> gives good result and is the maximum value
  - 0.2 -> is the default value
- Choose your input label map and a new Output volume



Step 5: Smoothing

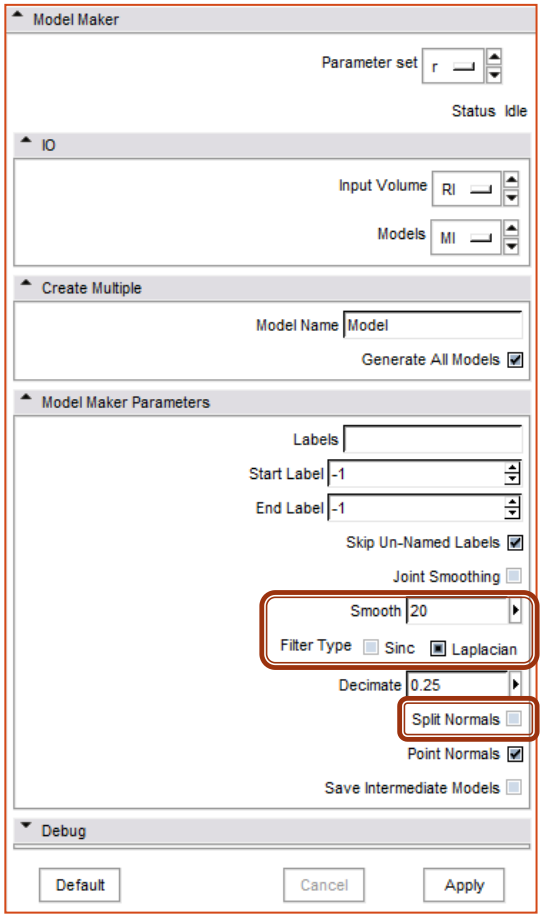
- Use the module “LabelStatistics” to check your smoothed label map
- Put the original label map in the two input boxes
- Check the count of voxels and repeat the operation with the smoothed label map
- The count shouldn’t decrease more than **3%**

  If it’s the case, repeat the smoothing with a decreased sigma



Step 5: Model making

- Use the module “ModelMaker”
- Choose your input label map and create a new ModelHierarchy
- Name your model
- Define the parameters as showed in the screenshot (max for smooth is 20)
- Check the difference between the model and the label map by ticking the box “Slice intersections visible” in the module “Models”
  - If there is a big difference, recreate the model by decreasing the Laplacian parameter
- Save your models for the meshing

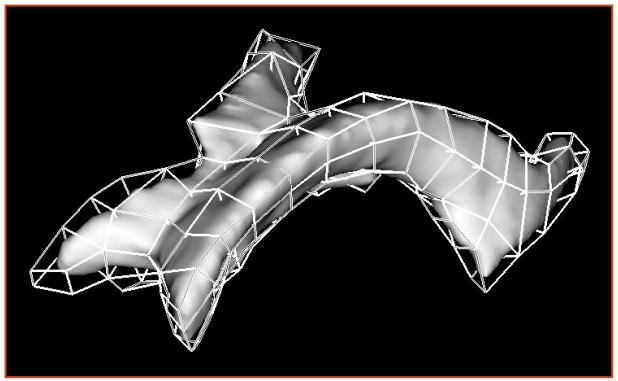


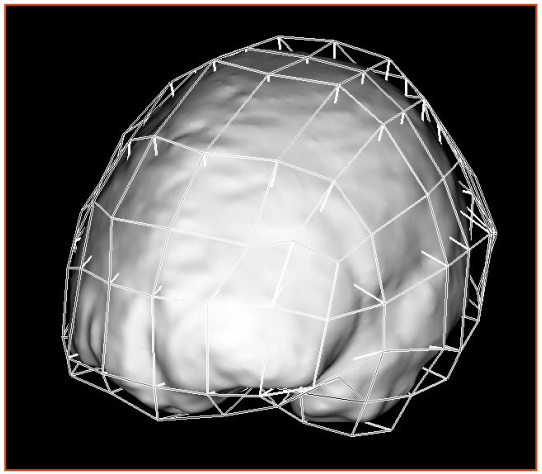
Step 6: Meshing (Block(s))

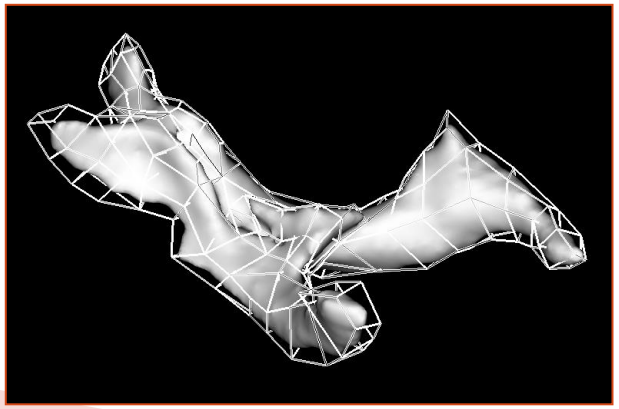
- Use the module “IA-FEMesh” or the independent software
- Load a surface which is your .vtk file
- Create a block from the chosen surface bond
- You can now built and edit this block
  -  : Manipulate the corners or faces from the block
  -  : Split the block to create new ones
  -  : Add a block to a face from an other
  -  : Delete a block from the structure of blocks
  -  : Mirror a block or a structure (useful for symmetric parts like ventricles)
  -  : Merge two corners (useful after using the mirror)
- The block should be as close as possible from the original surface to mesh

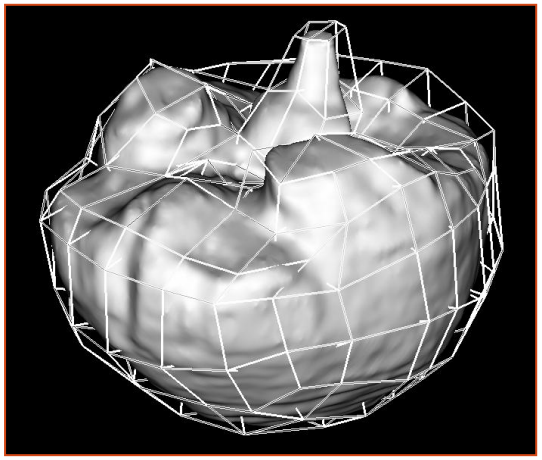
Step 6: Meshing (Block(s))

- Here you can see the blocks around the parenhyma and the ventricles



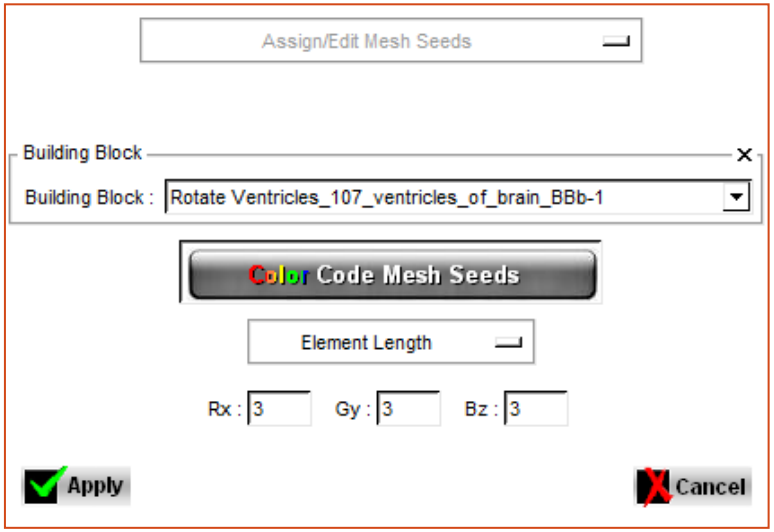




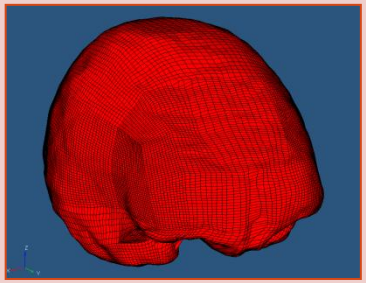
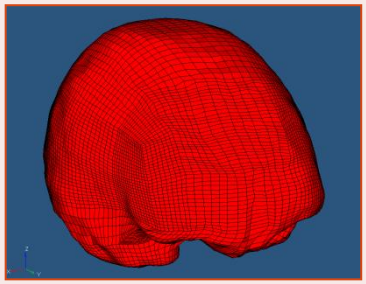
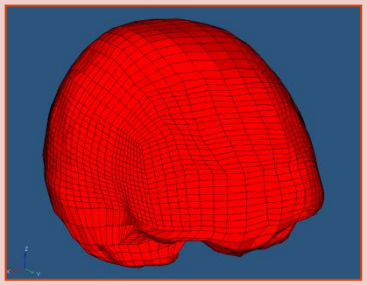


Step 6: Meshing (Mesh)

- Choose the size of the elements in the tab “Mesh” and the choice “Assign/Edit Mesh Seeds”
- Define the element length for the three direction
  - The values can be different for each direction
  - Try a first mesh with a default value of 3 in each direction
- You can improve the size after have had a look at the quality of the meshing

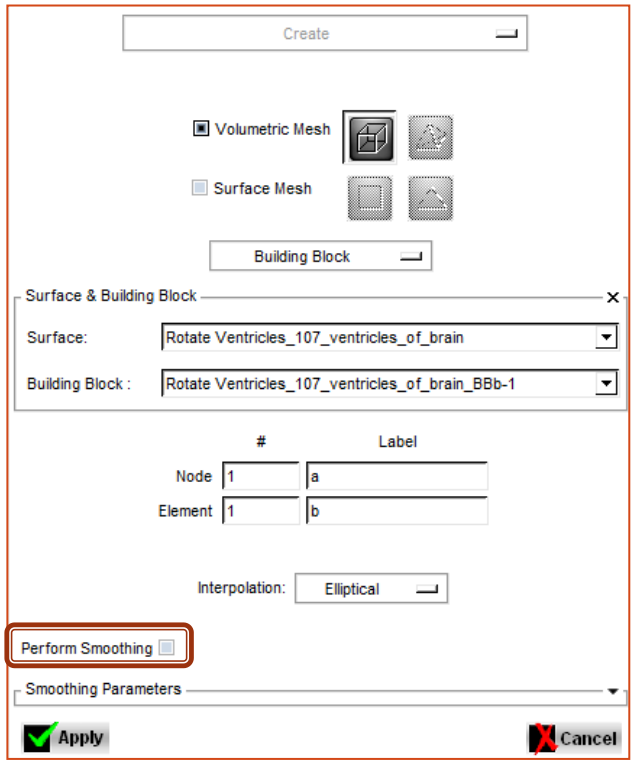


Step 6: Meshing (Mesh)

Element Length	Graphic result	Number of elements
Color Code Mesh Seeds Element Length Rx : 2 Gy : 2 Bz : 2		# Elements 178956 # Distorted 1124 Minimum -35.652 Maximum 28.412 Average 6.284 Variance 19.661
Color Code Mesh Seeds Element Length Rx : 3 Gy : 3 Bz : 3		# Elements 50584 # Distorted 476 Minimum -39.749 Maximum 94.494 Average 21.577 Variance 230.821
Color Code Mesh Seeds Element Length Rx : 5 Gy : 5 Bz : 5		# Elements 9369 # Distorted 173 Minimum -131.413 Maximum 484.198 Average 108.395 Variance 6608.267

Step 6: Meshing (Mesh)

- You will now create the volumetric mesh on Building Blocks
- Choose the surface and the block you want to use. This is useful when you import the whole model of the brain (parenhyma, tumour, ventricles) in the same session
- Give a label to node and element (you can put what you want as here)
- Tick the case “Perform smoothing” off



Step 6: Meshing (Quality)

- Choose “Evaluate/Display/Mesh Quality”
- Select the mesh and the type of metric you want to evaluate
  - Jacobian is the most important, no element should have a negative number
- The Summary Report gives you the count of element as well as the number of distorted elements and other stats.