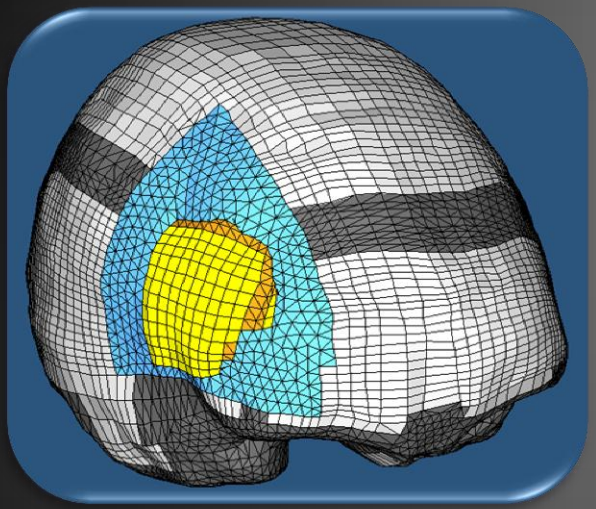
MECHANICAL ENGINEERING

THE UNIVERSITY OF WESTERN AUSTRALIA

Intelligent Systems for Medicine Lab



Brain meshing

This presentation is about the work I did during my 5-month internship

Tuesday 5th July 2011

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Contents

Introduction

- Internship abroad
- Lab work on a challenging project
  - Continuing Mathieu's work from 2009
  - Modelling the brain

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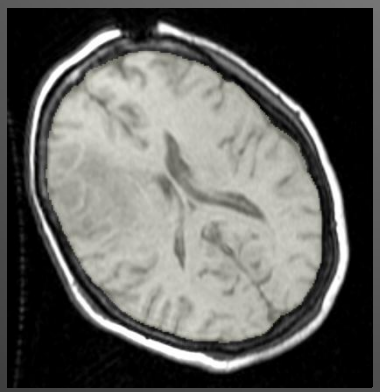
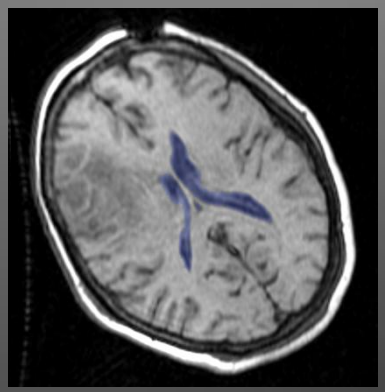
Slicer3D

- Resampling
  - Bigger resolution: 0.9375mm
  - Lanczos interpolation type
- Registration
  - Align the two images: useful for the measure of the displacements

Slicer3D

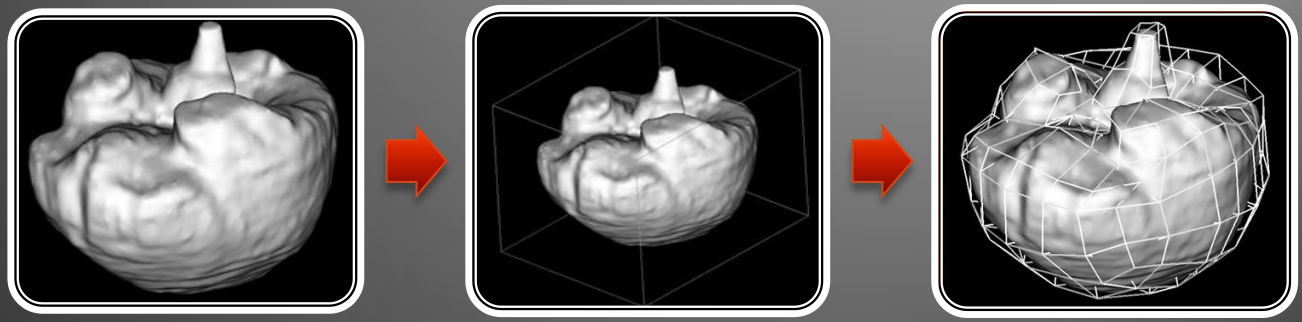
- Segmentation
  - Tried several automatic registration modules:
    - EMSegmenter
    - Simple Region Growing
    - Fast Marching Segmentation
  - All segmentation done manually





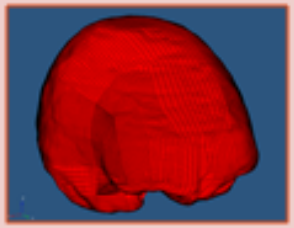
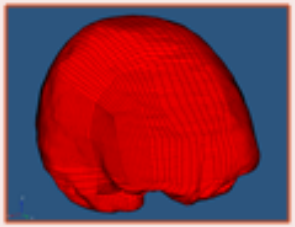
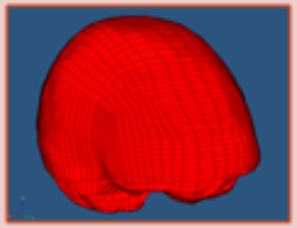
IA-FEMesh

- Blocks
  - As close as possible to the surface
  - Not too much deformed
  - Use of symmetry for brain



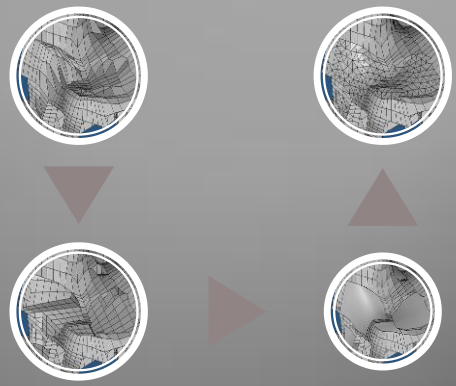
IA-FEMesh

- Mesh

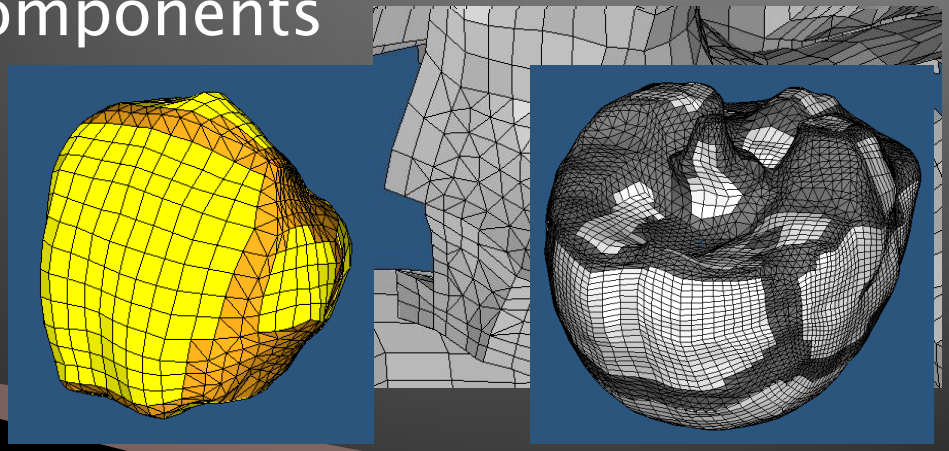
Element Length	Graphic result	Number of elements
Color Code Mesh Seeds Element Length Rx : 2 Gy : 2 Bz : 2		# Elements 178956 # Distorted 1124 Minimum -35.652 Maximum 28.412 Average 6.284 Variance 19.661
Color Code Mesh Seeds Element Length Rx : 3 Gy : 3 Bz : 3		# Elements 50584 # Distorted 476 Minimum -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

Cleaning the mesh

- Negative Jacobian elements
- Many steps
  - Find faces
  - Creation of surfaces
  - Surface Automesh
  - Tetramesh

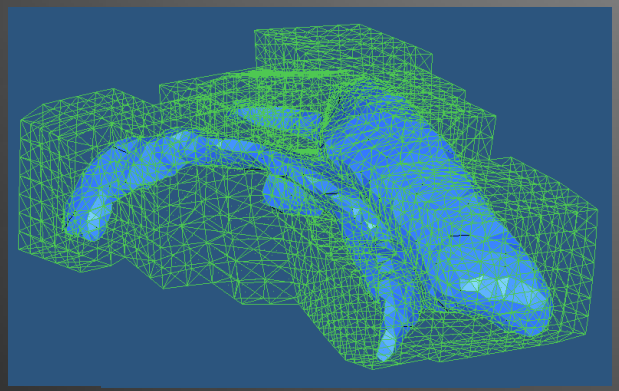


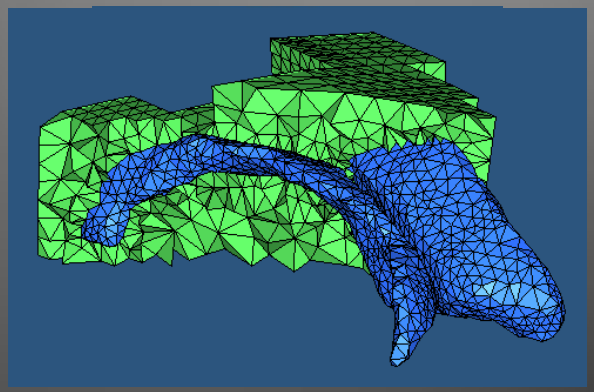
- Brain and tumour separated in two components



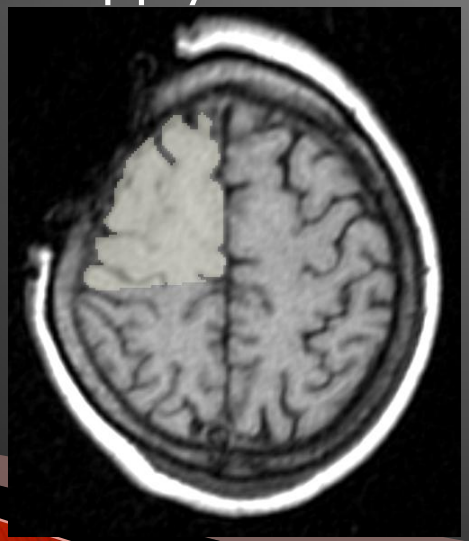
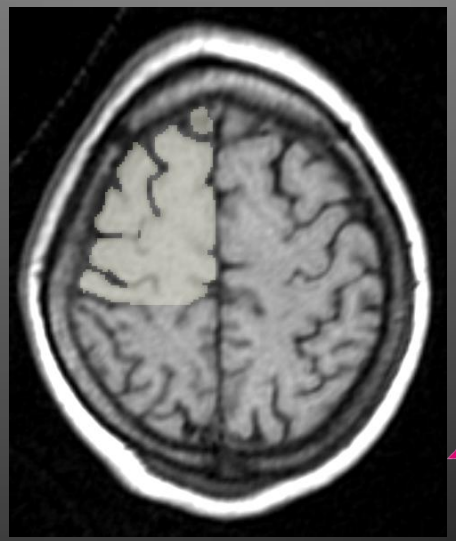
Assembly of the components

- Creation of the hole inside the parenchyma in order to insert the tumour and ventricles
- Complete the gap with tetrahedrons from faces





Computing the deformation

- Accurate segmentation of the brain in the area of interest for both intra and preoperative images
- Use of Grand's algorithm
  - Registration
  - Calculation of the displacements
  - Apply the deformation to the model
- 


Conclusion

- Plenty of time needed to learn how to use the software
- No results after deformation
  - Too many elements
  - Meshing problems
  - Wrong materials properties
- Tutorials made for Slicer3D and IA-FEMesh
- Demonstration made for HyperMesh with a tutorial

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Thank you for your attention

- If you have any questions, I'd be pleased to answer you