Development of the mouse skull

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We are developmental biologists

Our emphasis is to establish Phenotype / Genotype correlations through high-resolution volumetric imaging, statistical shape analysis and genomics.

• Changes in development due to Fetal Alcohol Exposure (FAE) and how this affects the development of the craniofacial complex specifically.
• Phenotypic characterization and comparison of new craniofacial mutations.
• Statistical associations between genomic regions and complex phenotypic traits (e.g. skull shape)
Imaging Modalities:

Optical Projection Tomography for embryos

MicroCT for mineralized specimens (aka adults).
Slicer and issues with our use cases

We use Slicer for visualization, recording coordinates of anatomical landmarks, segmentation and registration.

1. We have large datasets $1024^3$ or larger with small voxel sizes around 6-35 micron range. Rendering, units, fiducial sizes/text, ScalarOpacityUnitDistance variables major issues for us.

2. Specimens moving out of FOV in the VR module when the “center” icon is used

3. Etc. we have a list on wiki..
Also looking for collaborations for our challenges

We have large sample sizes (~500-600 OPT datasets):

1. We want to be able to quickly and accurately segments brain from these scans so that we can run coupled analysis of the face and brain phenotypes (Face is a major diagnostic feature of FAS).

2. Large scale shape changes throughout the development makes automated shape analyses challenging.
Project Week Goal: Procrustes Shape Analysis in Slicer

Basic Generalized Procrustes Approach

Original Configurations  Superimposition  Scaling  Rotation  Iterations to minimize the difference
Lollipop graphs of shape variation decomposition
Currently in Slicer (on volumetric data, not meshes)
Working on implementing templates

• Generated on meshes using Poisson Disk
• Need to generalize to surface
Working on implementing accurate template transfer
Sliding the template on the target.

- Goal is to minimize the bending energy between GPA aligned samples

- Difficulties include
  - Finding normals and tangent planes on volumetric data
  - Sliding along correct surface
Figure 7: Left: 40 unaligned annotations. Right: 40 aligned annotations with mean shape in red.
Principle Component Analysis