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SCHOOL OF MEDICINE
AND PUBLIC HEALTH

2-simplex data

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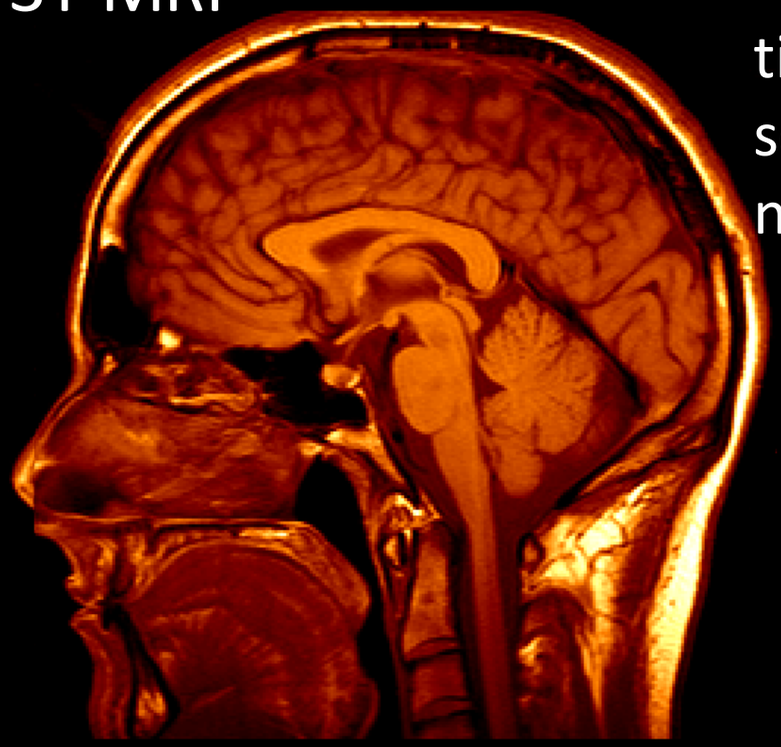
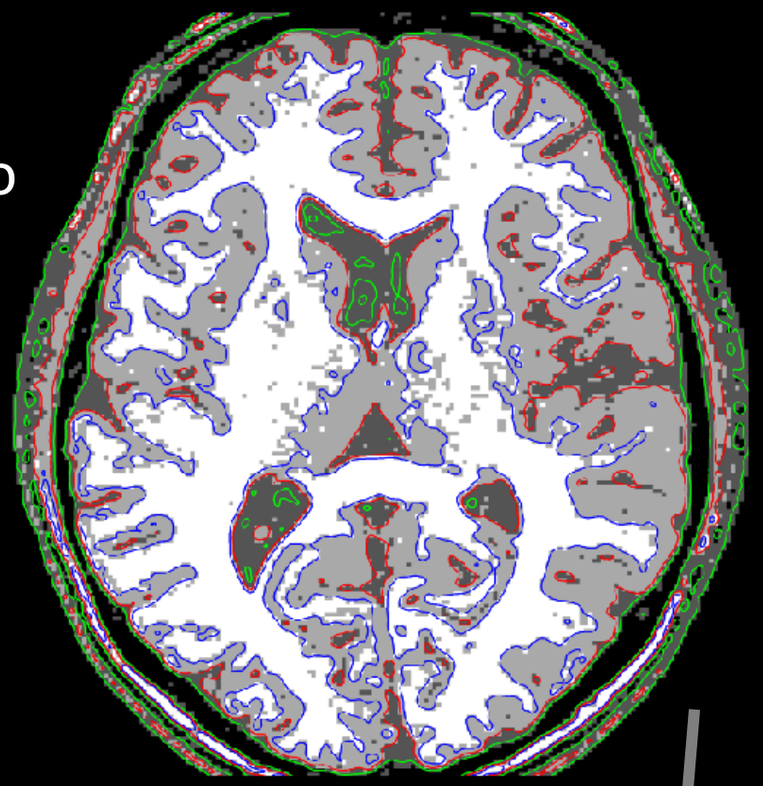
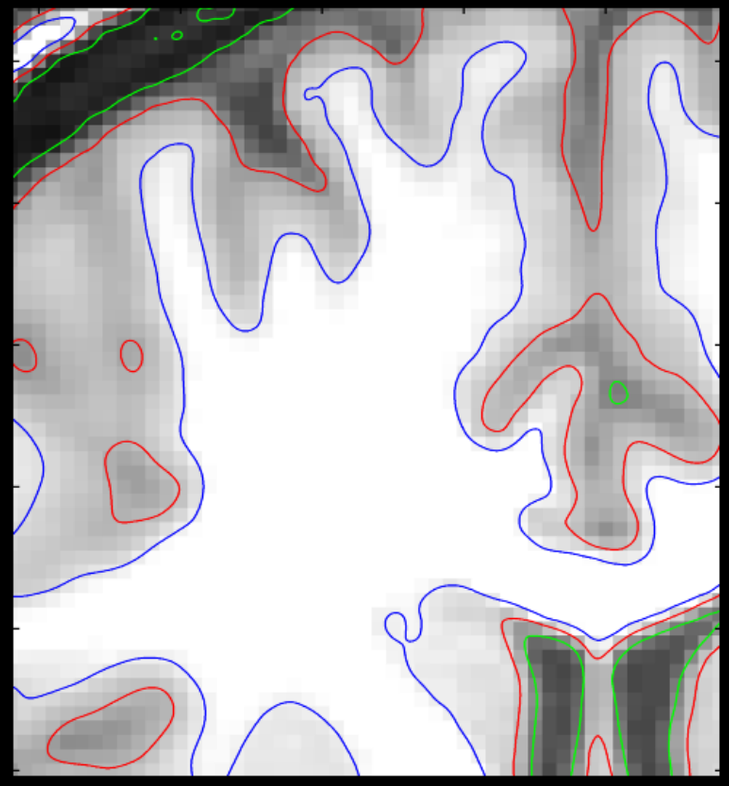
3T MRI scanner

3T MRI

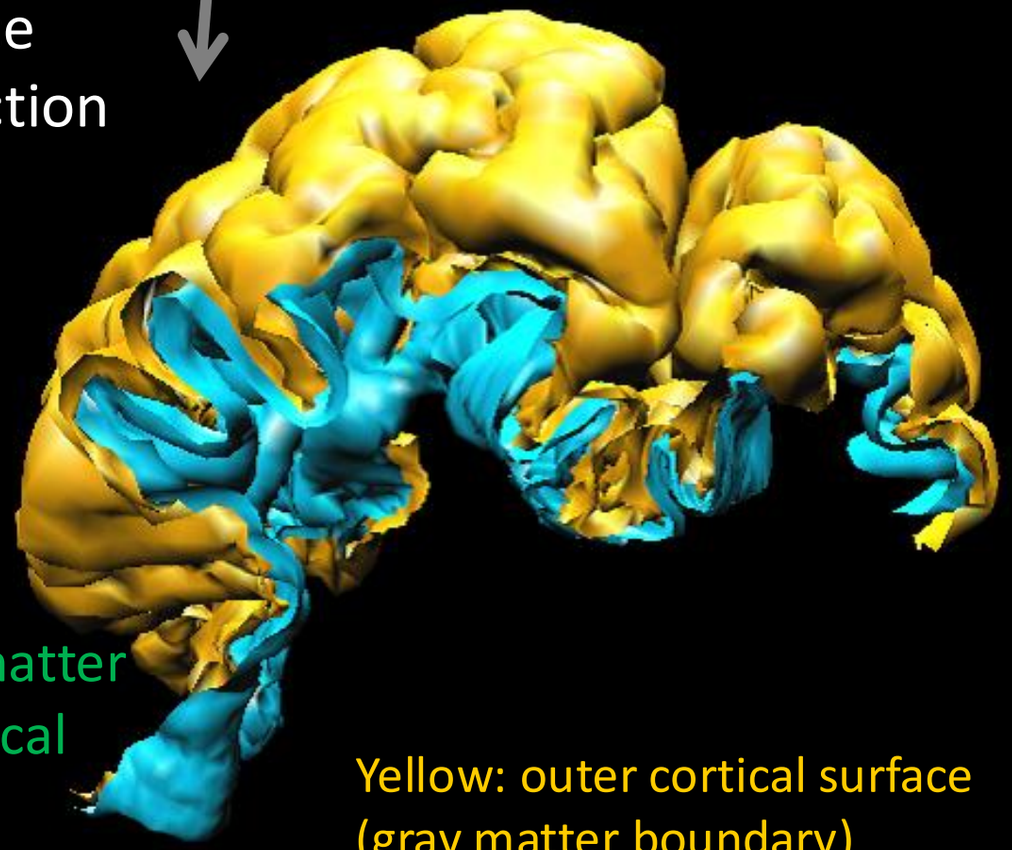


tissue segmentation





surface extraction



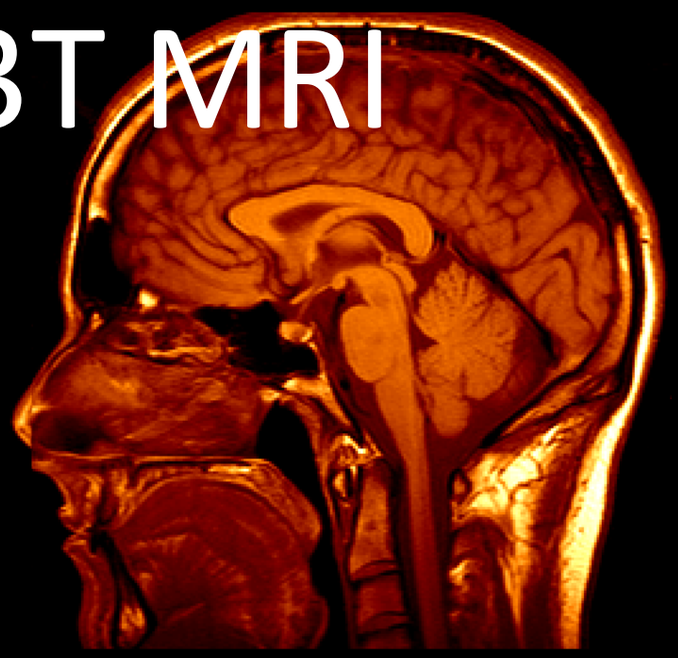
Yellow: outer cortical surface (gray matter boundary)
Blue: inner cortical surface (white/gray matter interface)

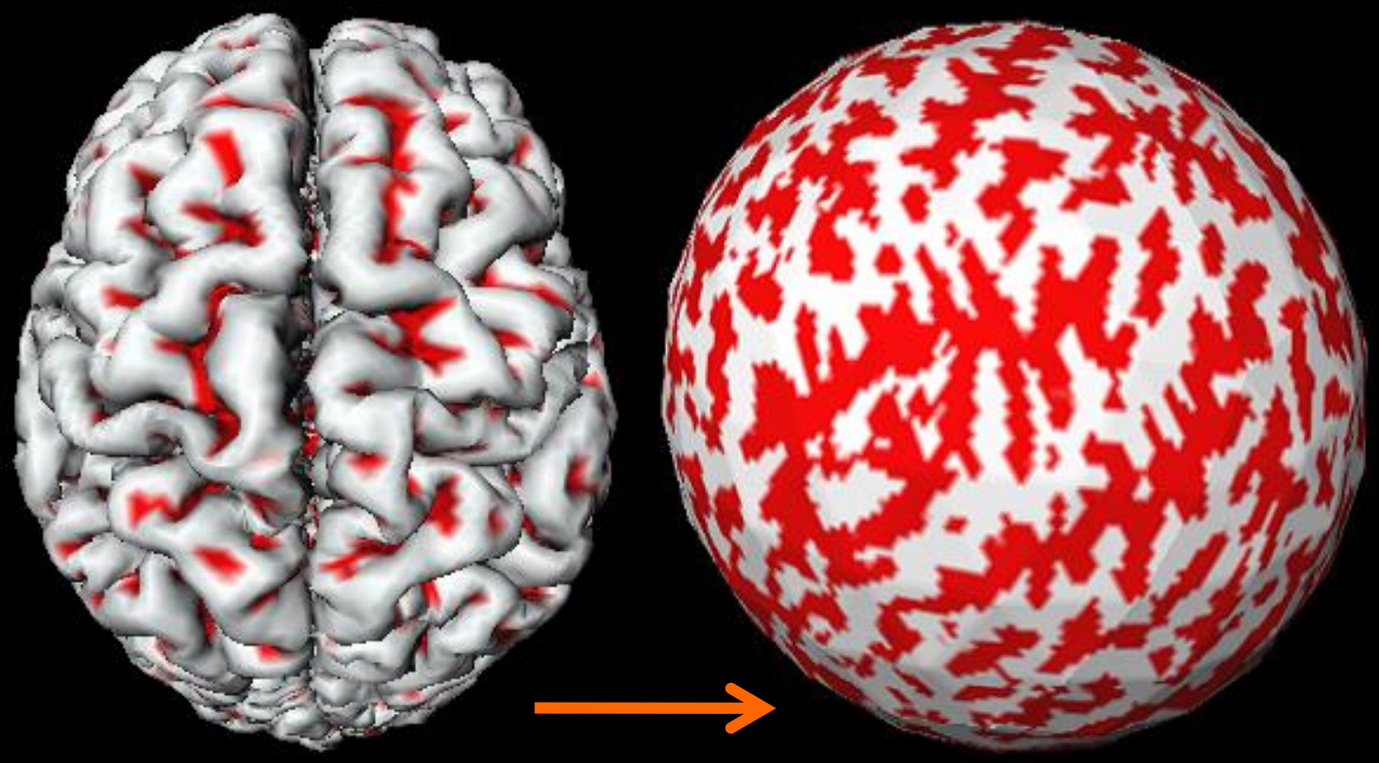
Smaller sulci
→ More gray matter
→ Thicker cortical thickness

Triangle mesh with about 0.6 million triangles per whole brain

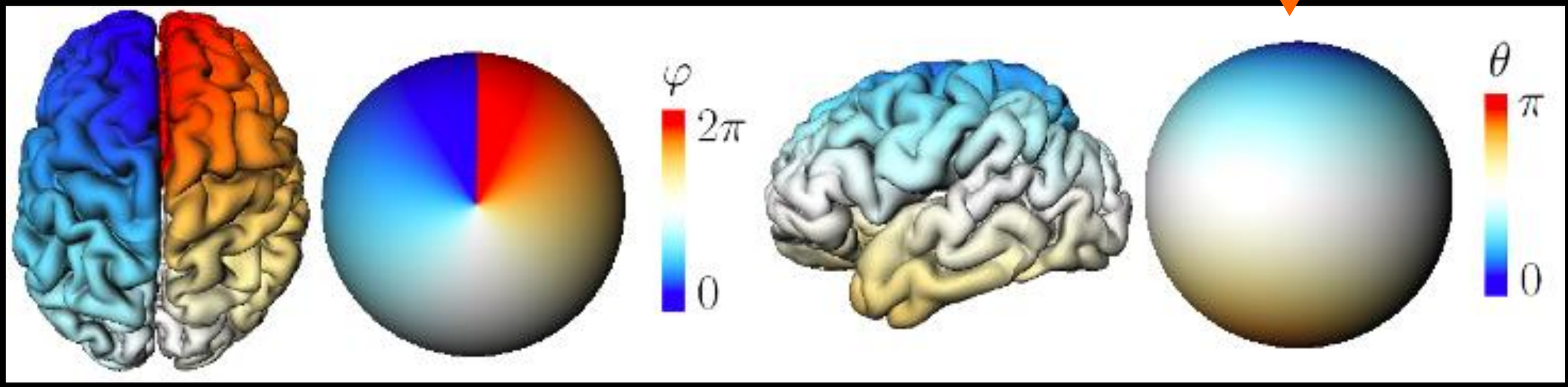
Cortical surface flattening

3T MRI





FreeSurfer deformable surface algorithm



Spherical angles

Data structure for triangle mesh

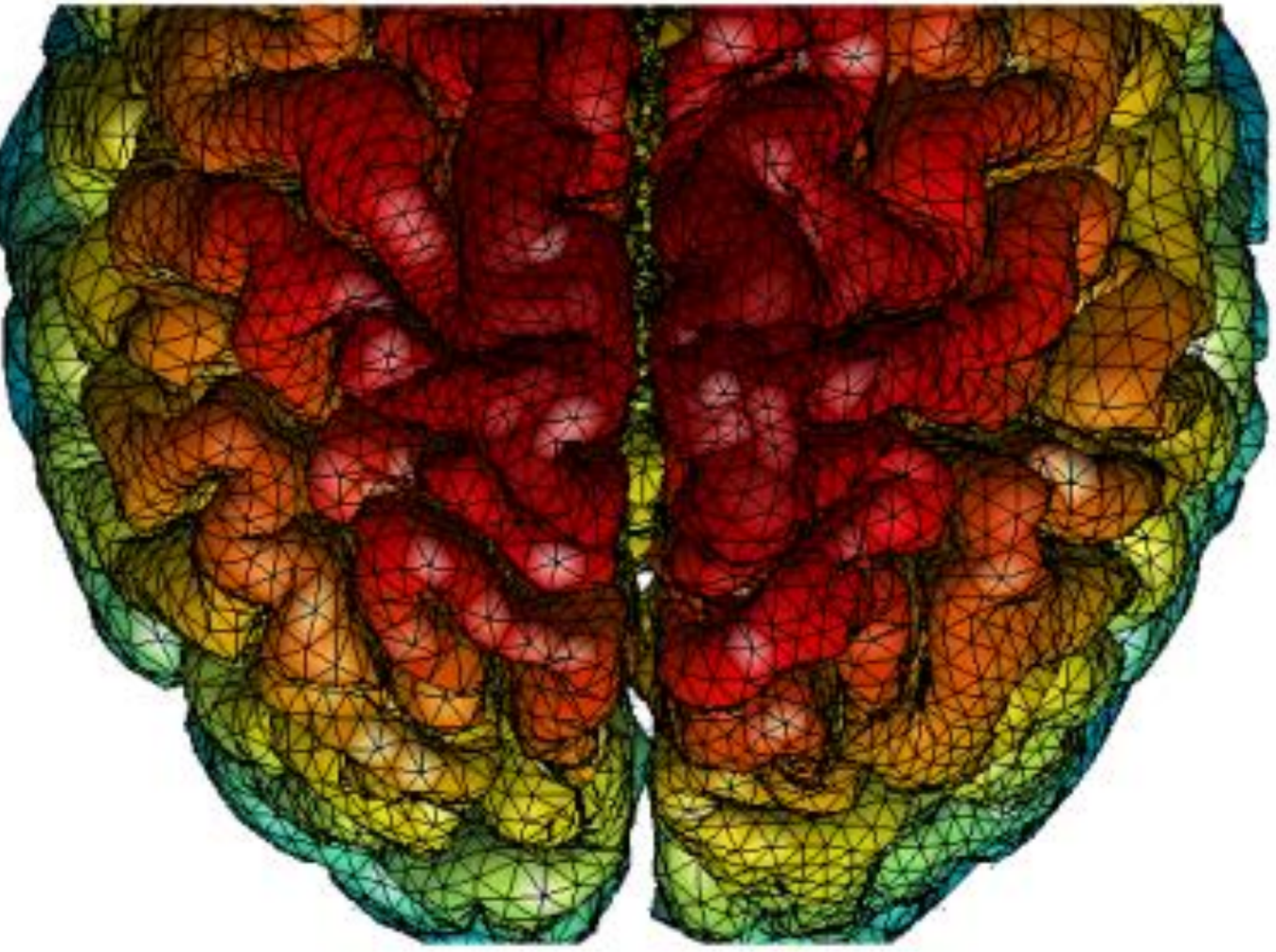
```
>>surf =
     vertices: [1282x3 double]
        faces: [2560x3 double]
```

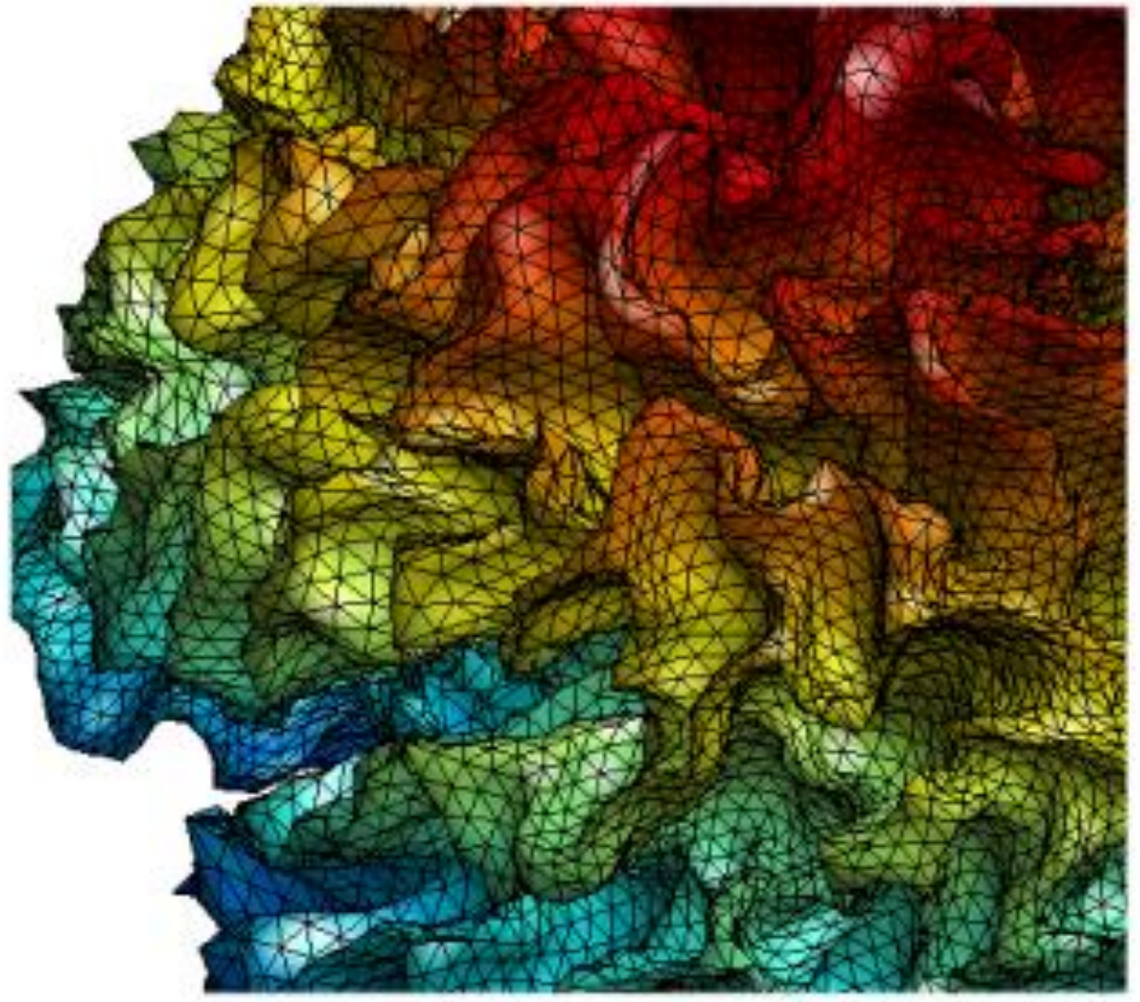
structured array

```
>>surf.faces
ans =
           1           2           3
           1           4           2
           1           3           5
         ...
```

```
>> surf.vertices
ans =
    75.0000   93.0000   51.5050
    74.5050   93.0000   52.0000
    75.0000   92.5050   52.0000
      ...
```

vertex coordinates





How many edges in surface mesh?

Since two adjacent triangles share the same edge, the total number of edges is 2E = 3F.

How many edges in surface mesh?

Example.

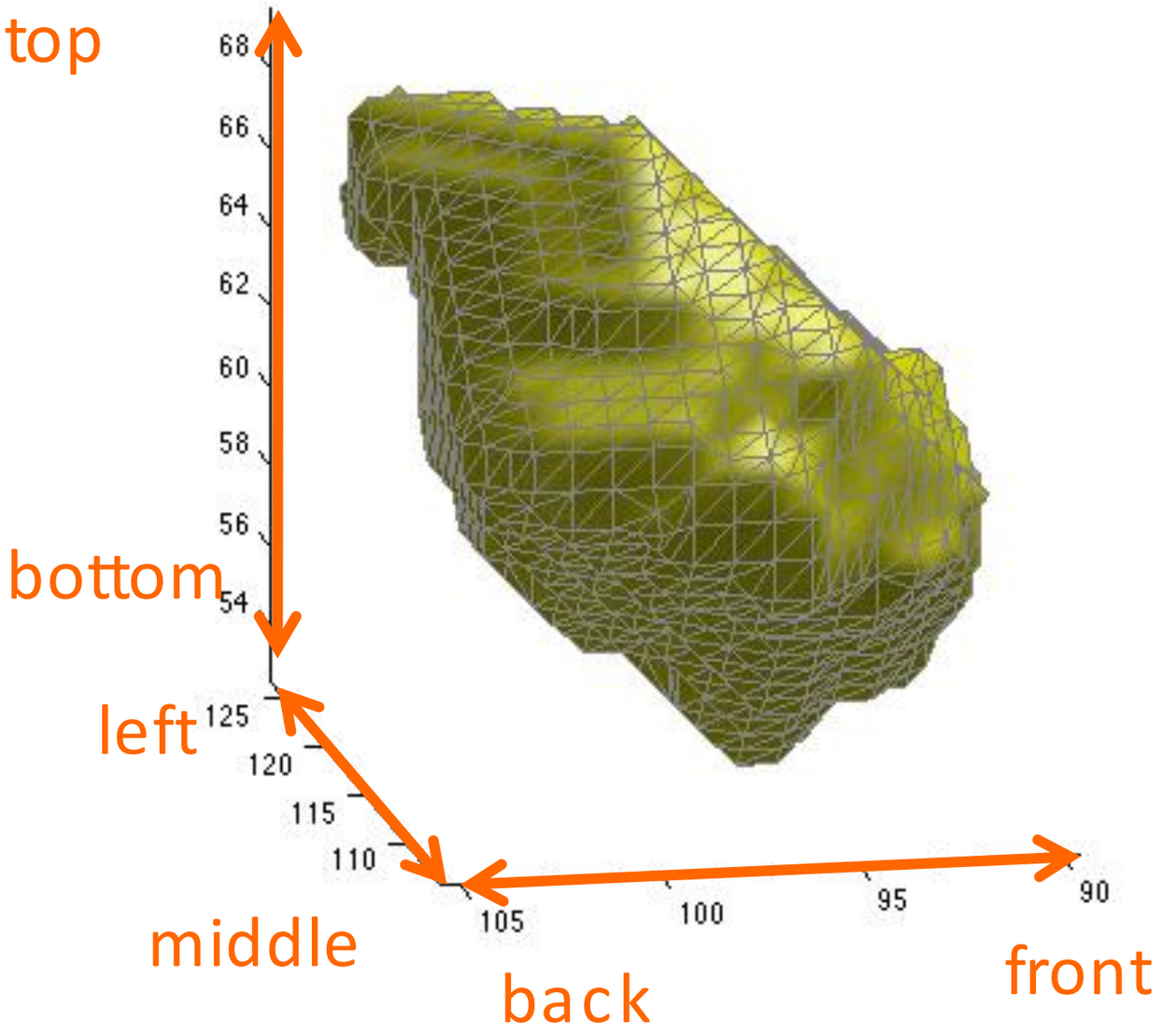
surface =

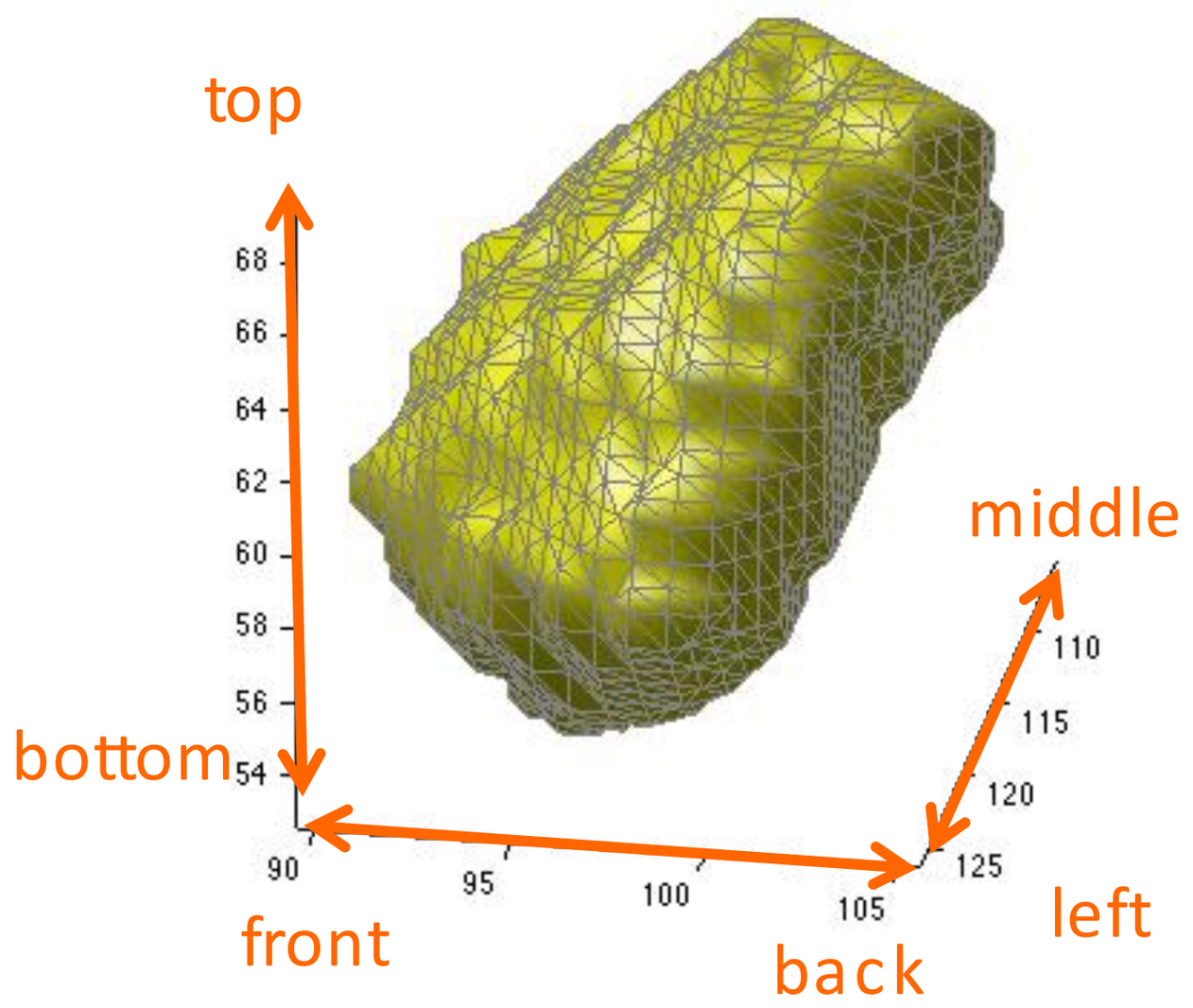
struct with fields:

vertices: [5916×3 double]
faces: [11824×3 double]
edges: [17736×2 double]

Check 2E = 3F

2D surface mesh of the left amygdala





Functional regression: Filter out geometrical noises.

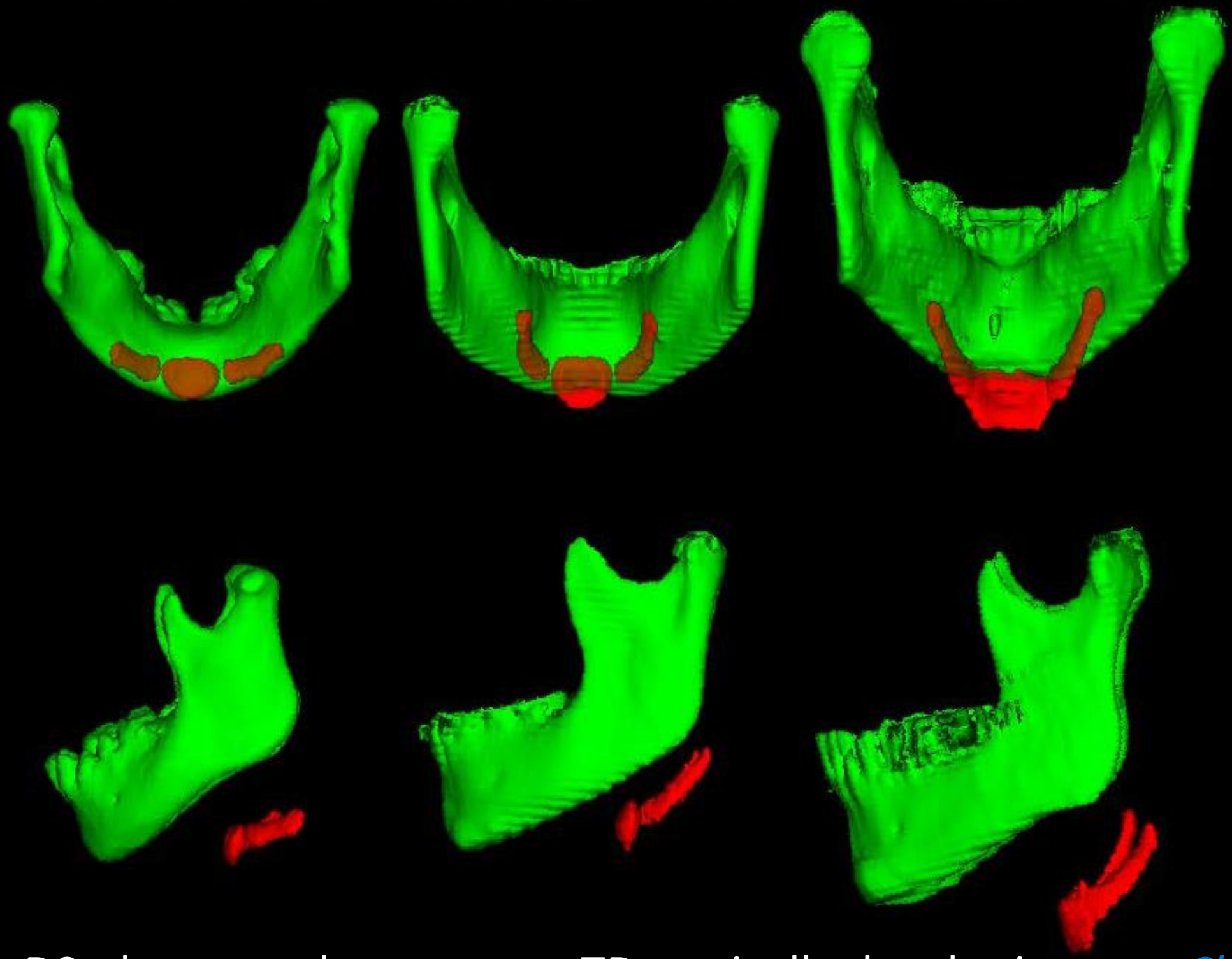
Functional registration: Align functional data in a common space

Topology changing bone fusion

DS; 10 yrs, 6 mo.

TD; 10 yrs, 11 mo.

TD; 44 yrs, 1 mo.



DS: down syndrome

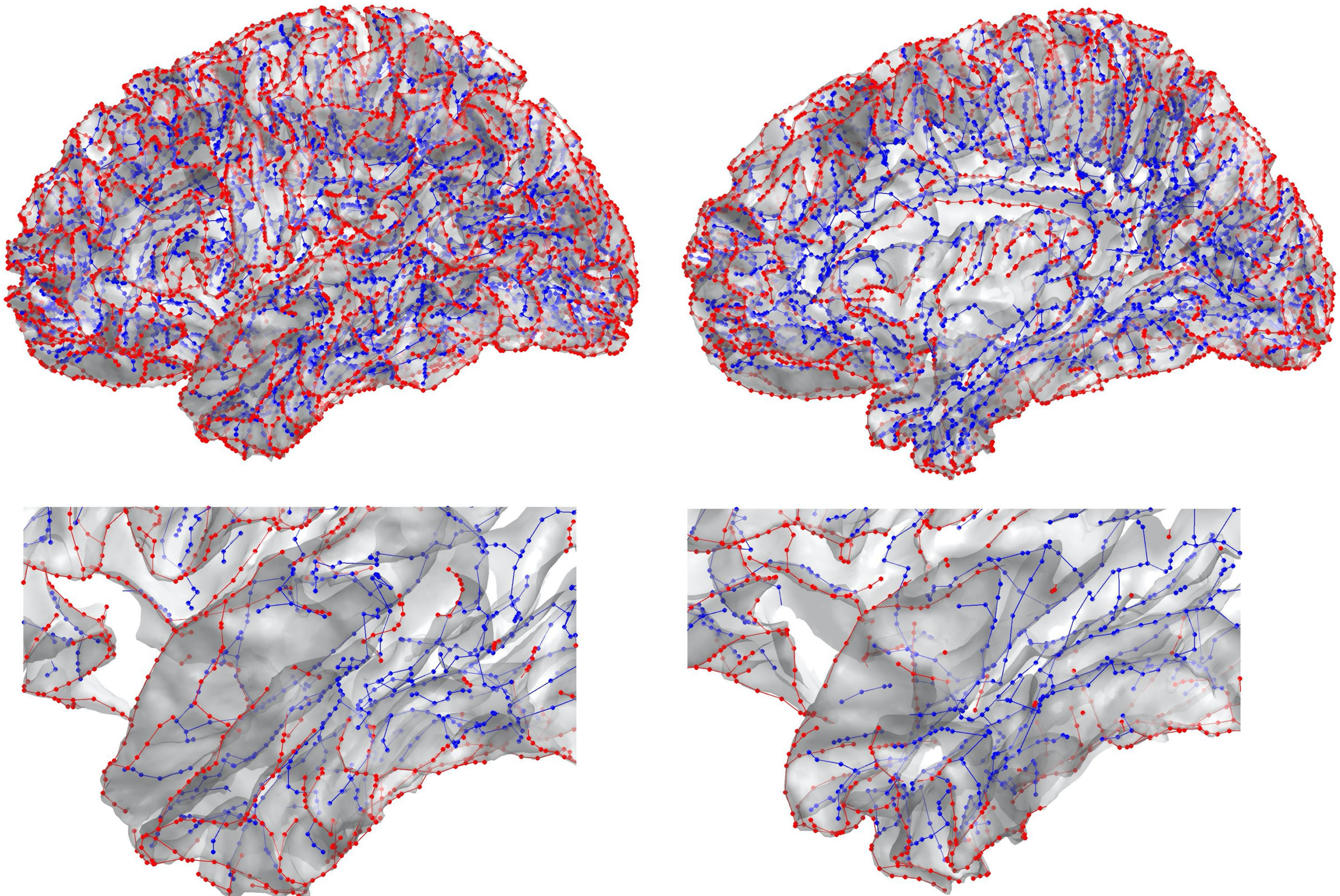
TD: typically developing

Chung et al. 2020

Sulcal/gyral curves superimposed on top of other surface indices

Huang et al. 2019 IEEE Tractions on Medical Imaging

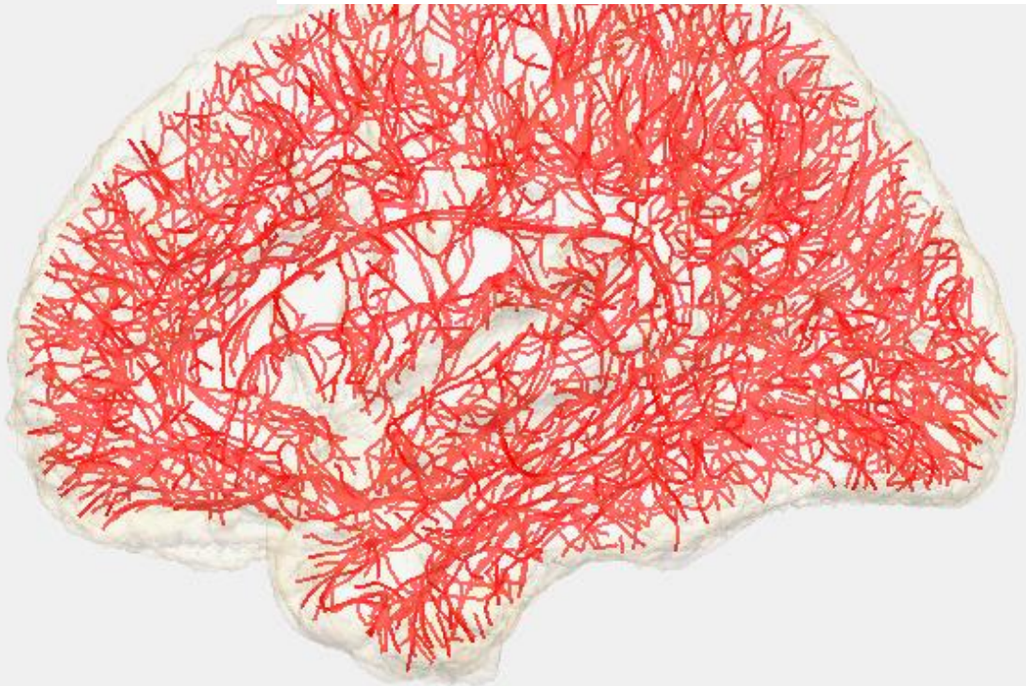
Sulcal/gyral trees in two different subjects



Sulci = valley regions

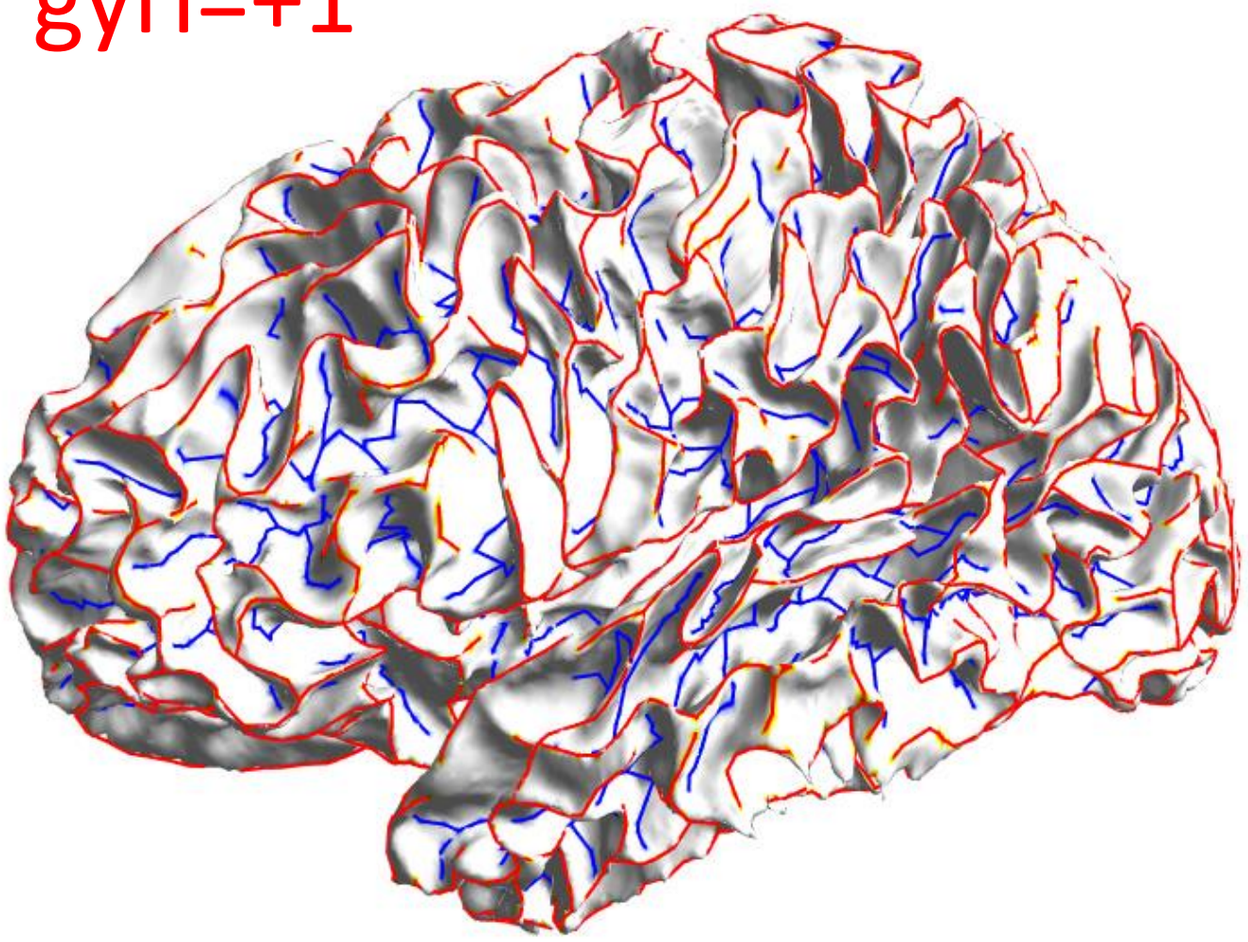
Gyri = mountain regions

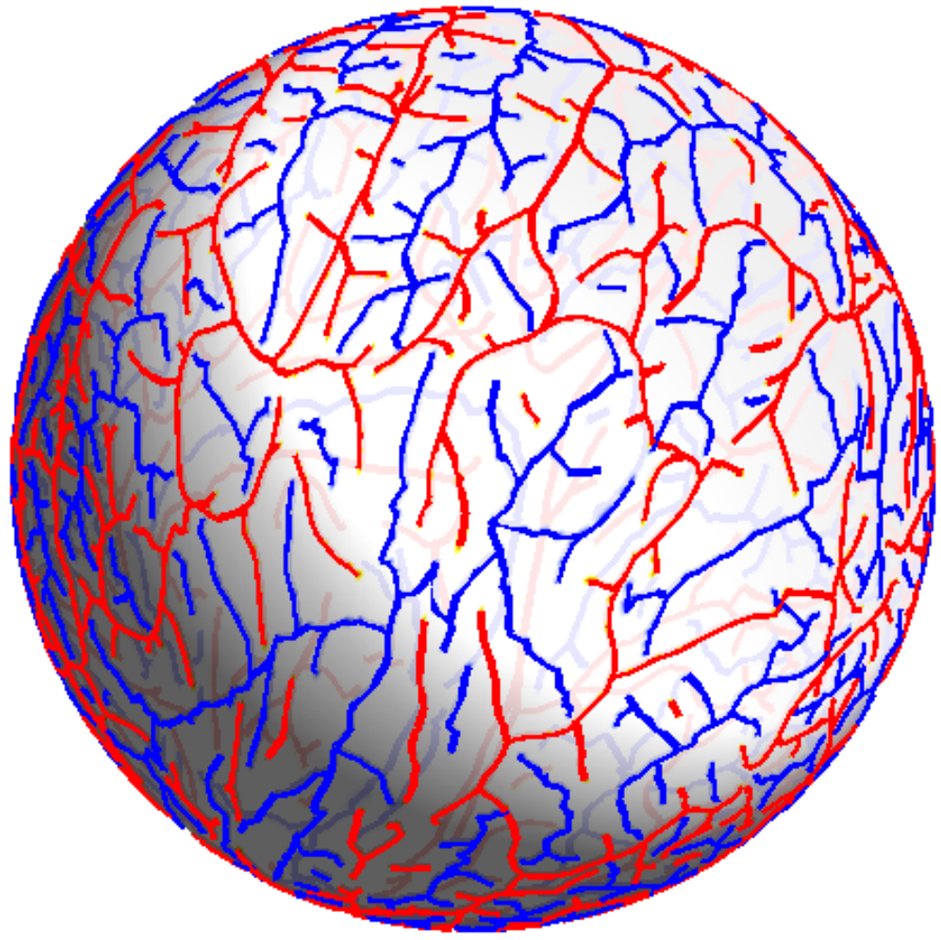
3D volume projection



sulci = -1

gyri=+1





White matter surface

Trees on 2-sphere