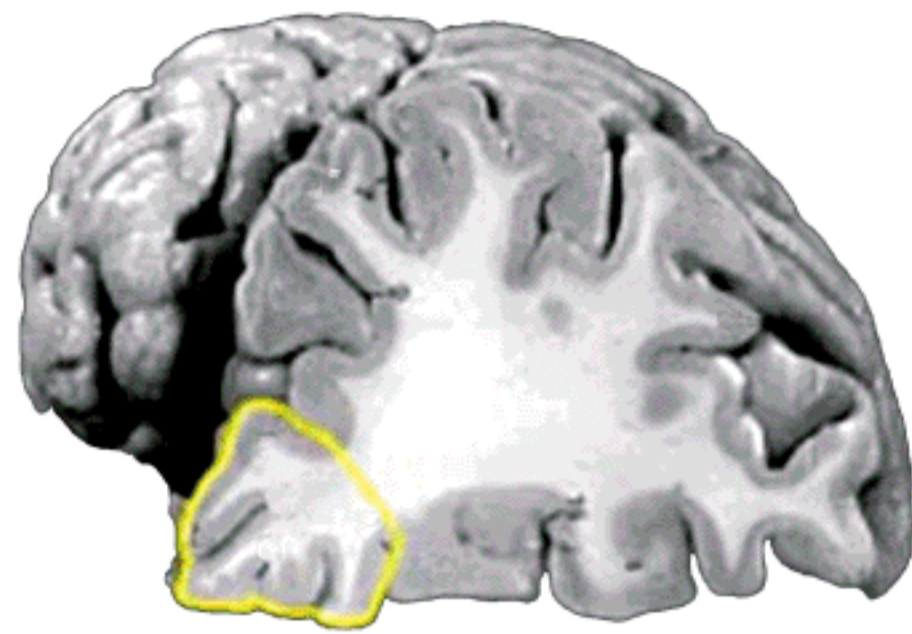
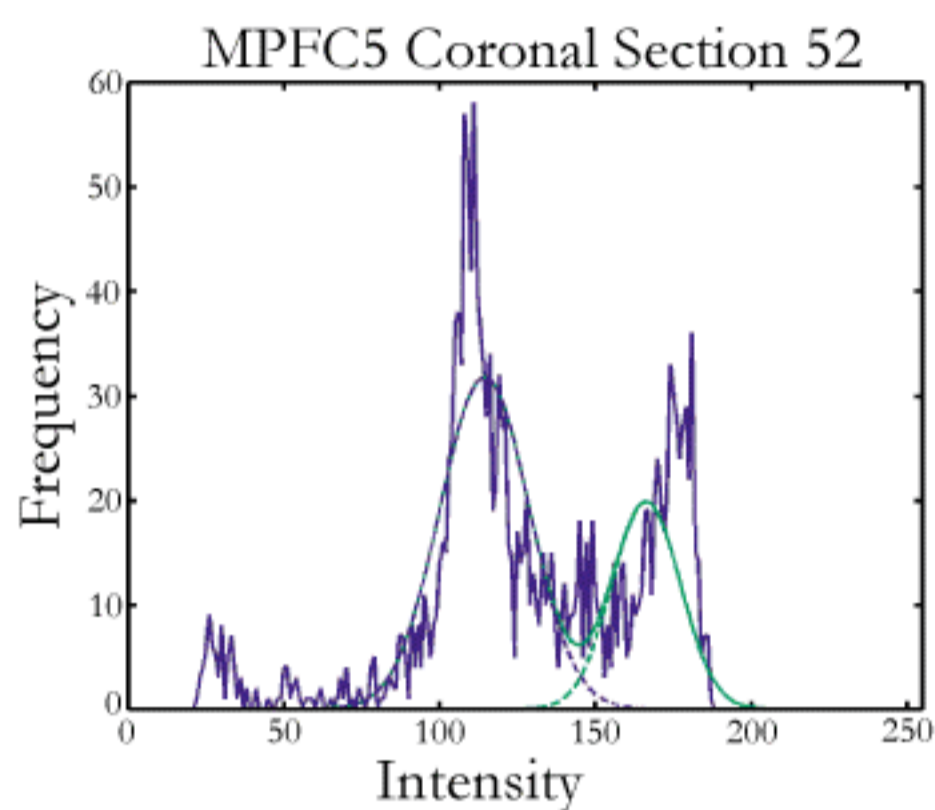


## Bayesian Segmentation of Neocortex



Our group in the Center for Imaging Science has been reconstructing the Neocortical gray/white matter interface from different cortical regions because it plays a very important role in understanding brain function. The coronal section in the left panel displays in yellow the boundary of the medial prefrontal cortex being examined in depression studies (MPFC). To separate the gray/white matter and gray/cerebrospinal (CSF) interfaces of the MPFC, we use a Bayesian segmentation algorithm. The results of the Bayesian segmentation are shown just below. Gray and white matter in a coronal section are segmented with the corresponding segmentation colored respectively in green and white.

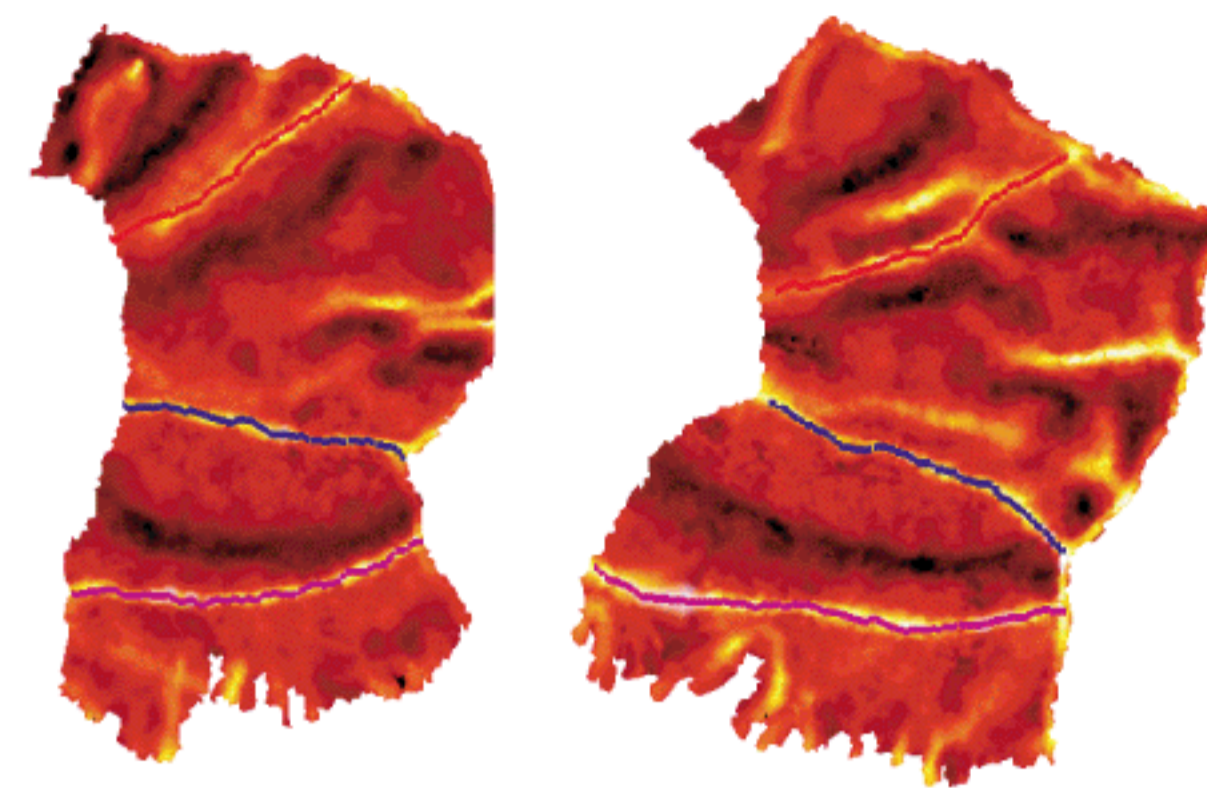
Coronal



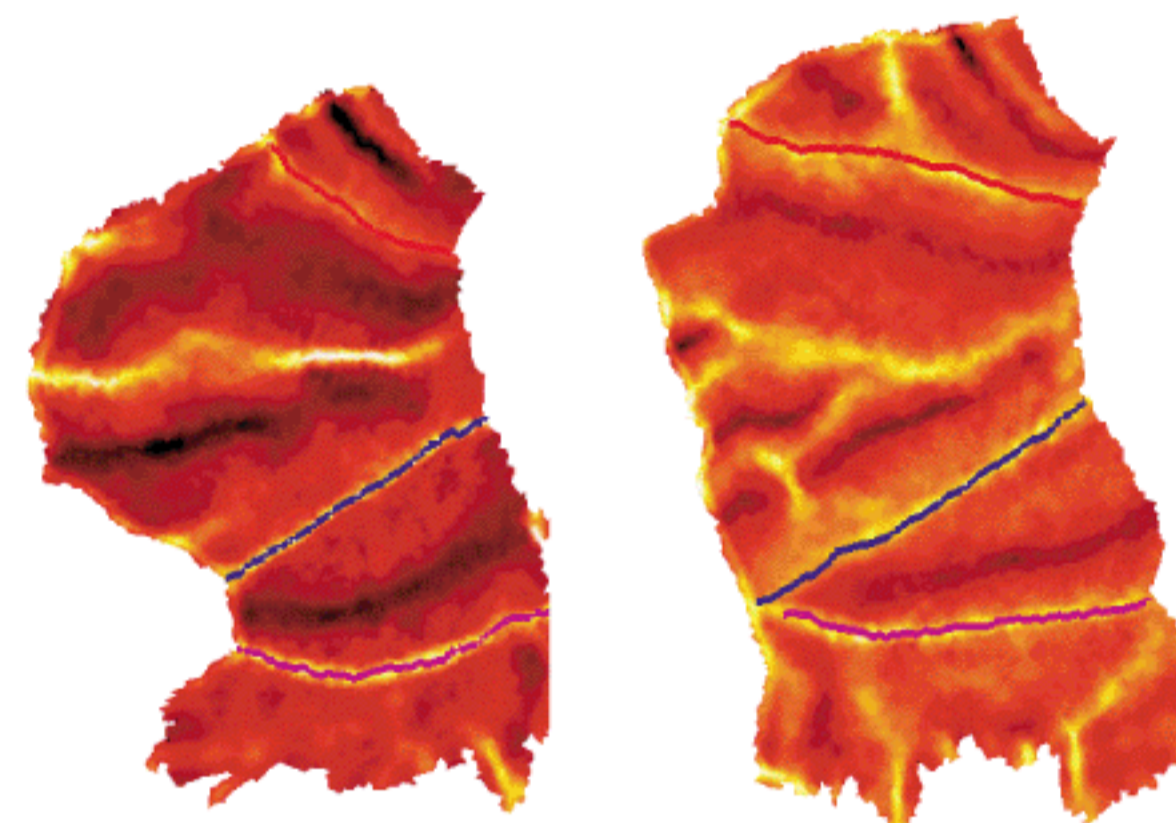
Bayes Segmentation



## Euclidean Conformal Flat Maps of Gray/White Matter Surface



Left Hemisphere



Right Hemisphere

Conformal Flat maps are used to study the geometry of the MPFC. Their existence is guaranteed by the Riemann Mapping Theorem. The shape of the cortical surface is preserved in the flat map by maintaining the proportion that each angle of the original surface contributes to the triangulated graph. Moreover the mapping transfers the color coded curvature information from the cortical surface to the flat map.

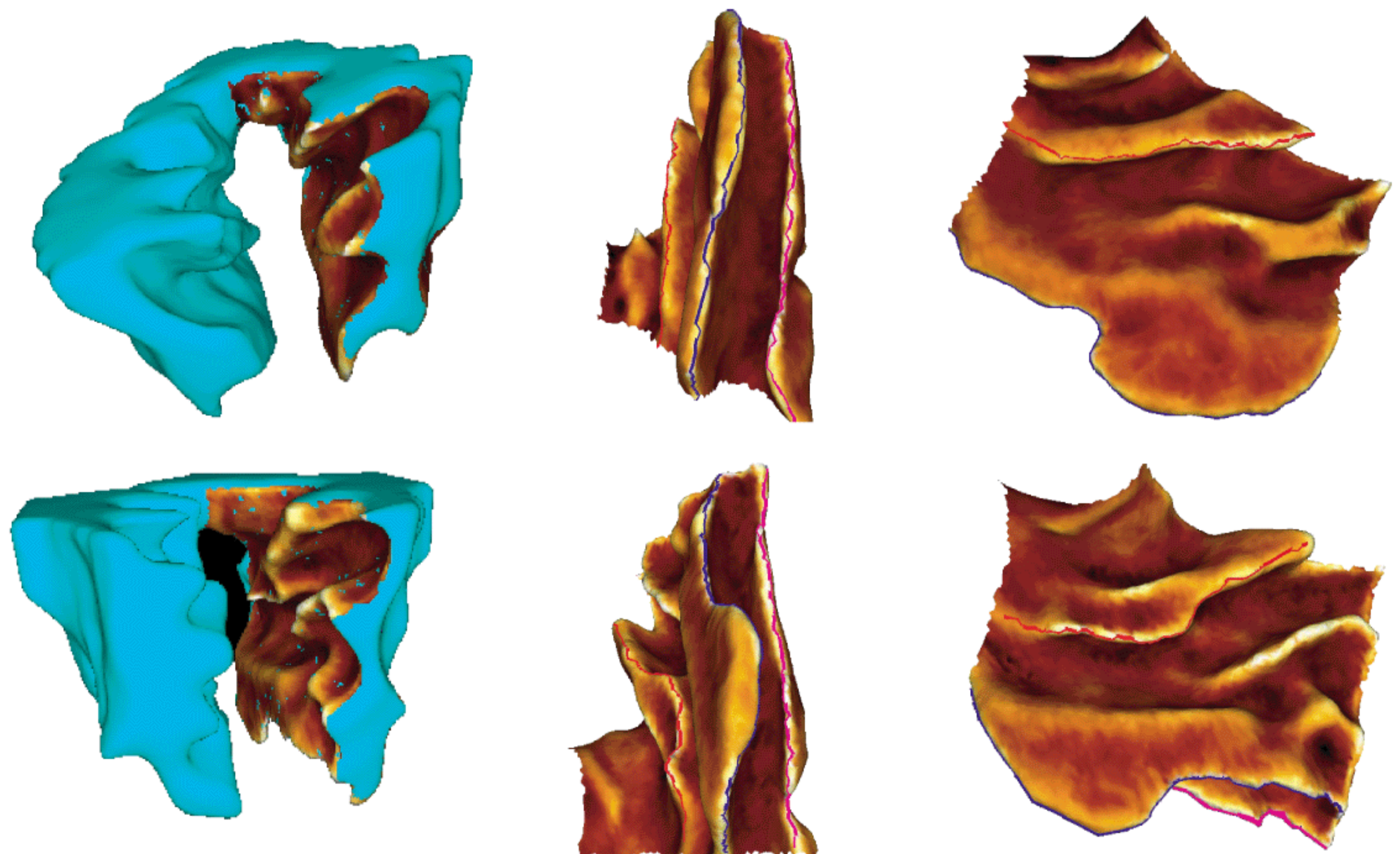
The first and second rows in the left figure display the (medial prefrontal) conformal flat maps. The colored lines on the cortical surfaces and conformal flat maps depicts the Cingulate Gyrus (red), Gyrus Rectus (blue) and the Medial Orbital Gyrus (pink) on the cortical surfaces which can be traced on the conformal flat maps. These are generated using dynamic programming algorithms for tracing extremal curves.

## Cortical Surface with Color Coded Curvature

To reconstruct the interface of gray/white matter in the MPFC, we use the isosurface generation algorithm by Gueziec and Hummel which builds triangulated surfaces. The left column on the right figure shows medial prefrontal cortical surfaces reconstructed from Brain MRI scans of two individuals. The two right most columns show the inferior and medial views of the reconstructed cortical surfaces.

We represent the cortical surface up to the quadratic terms in a Taylor series. A tangent plane is defined at the each vertex with normal and an associated orthogonal basis at each vertex.

The intrinsic curvature of the cortical surface is computed by the means of the eigenvalues of the curvature matrix at every point of the surface and is used to color code the surfaces. Bright colors show high positive mean curvature and dark colors show high negative mean curvature.



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