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 depressions 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.

Cortical Surface with Color Coded Curvature

To reconstruct the interface of gray/white matter in the MPFC, we use the isosurface generation algorithm by Guerzicz and Hamod 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 rightmost 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 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 the surfaces. Light colors show high positive mean curvature and dark colors show high negative mean curvature.

References:

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