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CREATING IMAGES OF THE FLATTENED CORTICAL SHEET.

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Purpose: Neuroimaging studies generally acquire data as a set of planar slices through the cortical manifold. Because it is difficult to visualize the spatial relationships between data collected in different planes, we have developed and are distributing software to create a single image of flattened cortex. These images are a means of displaying data from multiple planes.
Method: The process has four steps. 1) The user acquires a series of planar anatomical magnetic resonance (MR) images that span the part of cortex to be flattened. 2) Assisted by a graphical software tool, the user identifies a connected volume of gray-matter in the anatomical MR images. 3) A fully automated algorithm flattens a sampled set of the identified gray-matter voxels. The planar representation of the samples is computed using an iterative, stoachastic, algorithm based on metric multidimensional scaling. 4) The planar positions of the remaining gray-matter points are assigned by interpolation.
Results: We have made images of many brains and several cortical regions. In a typical session, we spent 5 hours identifying gray-matter in 26 planes spanning the medial occipital lobe; flattening the 30,000 identified gray-matter voxels required 2.5 hours of computation (HP 715/100). Over a 100 cm^2 region of gray-matter, distances between pairs of points in the image of flattened cortex differed from the true cortical manifold distances by 3 mm, on average.
Conclusions: These methods are useful for a variety of applications. They are particularly well-suited to fMRI studies in which repeated data acquisitions in individual subjects can be mapped onto the same image of the flattened cortical manifold. Software is available at `http://white.stanford.edu`.