6—5:15

COMPUTER AIDED ANATOMY: RECONSTRUCTION AND CHARACTERIZATION OF THE OPERCULAR SURFACE OF MACAQUE STRIATE CORTEX. Björn Merker and Eric L. Schwartz, Brain Res. NYU Med. Ctr. 550 1st Ave NY NY 10016

Recent studies of the functional architecture of visual cortex have begun to raise quantitative issues regarding the metric structure (i.e. distances and angles) of cortical areas. In order to accurately analyze these kinds of questions, it is necessary to develop methods of characterizing the (generally) curved nature of neo-cortical surfaces, and of displaying cortical areas in both 3D and quantitatively flattened formats. We have developed an approach to this problem involving joint application of neuroanatomy, image processing, computer solids modeling, and differential geometry: 1) At each stage of histological processing, sources of distortion and shrinkage are documented through photography of the (intact) dissected dura, the perfusion fixed brain, and the face of the frozen block after each section is cut (movie camera mounted on the microtome). 2) These movie frames, stained and mounted sections, or autoradiographs are digitized via a CCD camera. 3) Computer contrast enhancement, edge extraction, and other image processing operations are performed on the digitized data. 4) Three dimensional surface tracking methods are used to reconstruct the cortical tissue, including patterns of staining or labeling. 5) Optimal algorithms for flattening and/or displaying these data in three dimensions are then applied to visualize the data on a video monitor. We will illustrate this methodology by showing a measurement of the Gaussian and mean curvature of the opercular surface of striate cortex, mapped in pseudo-color on the 3D computer model of the cortex. These curvature measurements provide essential bounds on the errors which are introduced by physical or computer flattening of the cortex.

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7—5:30

IMAGE PROCESSING SIMULATIONS OF THE FUNCTIONAL ARCHITECTURE OF PRIMATE STRIATE CORTEX. Eric L. Schwartz, Brain Res. NYU Med. Ctr. 550 1st Ave NY NY 10016

The functional architecture of striate cortex may be regarded as determining one of the data formats upon which later visual processing is performed. In this abstract, a series of computer images will be presented which illustrate several aspects of cortical mapping of images: 1)the conformal map log(z+a) provides a convenient one parameter fit to primate two dimensional topography, which is in reasonably good agreement with current experimental data(#).The constant "a" in this fit has received a variety of different estimates.In order to illustrate the significance of these variations, real scenes mapped according to different current estimates of this parameter will be shown. 2) The pattern of ocular dominance columns of striate cortex may be re-mapped to the visual field, using this methodology. Stereo pairs will be shown, both as they would appear on the opercular surface of striate cortex, and in the visual field. 3.)Multiple eye fixations of a visual scene are "blended" to produce a composite mulitiple-resolution view of the scene. This provides a graphic illustration of the maximum spatial information available over scan paths, and suggests some insight into the nature of visual world stability. 4.)A simulation of local orientation domains will be shown, and this will be combined with the ocular dominance column and topographic simulations to provide an image, as it would appear on the surface of striate cortex, contingent on these three major aspects of functional architecture.

#Van Essen,Newsome and Maunsell. Vis. Res. 24:429-448 (1984); Schwartz, E.L. Science, in press (1984). Supported by System Development Foundation and AFOSR #F49620-83-C-0108