

THE TOPOGRAPHIC MAP OF MACAQUE V1 MEASURED VIA 3D COMPUTER RECONSTRUCTION OF 2DG SERIAL SECTIONS, NUMERICAL FLATTENING OF CORTEX, AND CONFORMAL IMAGE MODELING.

Eric L. Schwartz[†], Amar Munsiff[†], and Thomas Albright[‡] Computational Neurosci.[†] NYU Med. Ctr. 550 1st Ave. NY 10016 and Salk Institute[‡], La Jolla, CA 92037

To accurately measure a topographic mapping in cortex, it is necessary to deal with a number of sources of error, including reconstruction error associated with the physical curvature of the cortex and numerical error associated with modeling the two-dimensional map function. We describe a study which was designed to minimize these sources of error. A visual stimulus was presented to paralyzed and anesthetized (N_2O/O_2) Macaca fascicularis monkeys which consisted of log-spaced rings and rays, similar to those used in an earlier human PETT scan analogue of this experiment¹, together with square textured figures. The stimulus was flashed in counter-phase on a computer monitor, during i.v. administration of (C^{14})2DG. One brain hemisphere was cut in coronal section. The operculum of the other hemisphere was physically flattened between glass cover slips, and then cut tangentially. Both coronal and tangential sections were processed for 2DG autoradiography. The auto-radiographs of the coronal sections were digitized, and a computer model of the 2DG image of the posterior pole was constructed. From this brain reconstruction, a (3D)tangential model of the 2DG stimulus image in layer IV was constructed, using a surface tracking algorithm². This 3D shell was computer flattened, using algorithms previously described² to produce a planar model of the 2DG stimulus pattern. These procedures will be illustrated with comparisons of the 2DG stimulus pattern in the (physically) and (numerically) flattened hemispheres of the same animal. A topographic map function has been fit to this data by means of generating an isotropic (conformal) map function, using an implementation of the Symm algorithm³. We show a superposition of the numerically flattened data and the conformal model of it. There is good agreement between this locally isotropic model and the data. In addition, the numerically generated conformal map is similar to a simple complex log approximation to V1 topography. This work, together with a previous reconstruction of the macaque ocular dominance column pattern² provides accurate 3D and 2D computer models of several aspects of the functional architecture of macaque striate cortex.

1) Schwartz, Christman, and Wolf, Brain Research 104, 1981. 2) Schwartz, Merker, Wolfson and Shaw, IEEE Computer Graph. and App. July, 1988. 3) E.L. Schwartz, ARVO 24 1985

---- Supported by AFOSR 88-0275 and System Development Foundation----