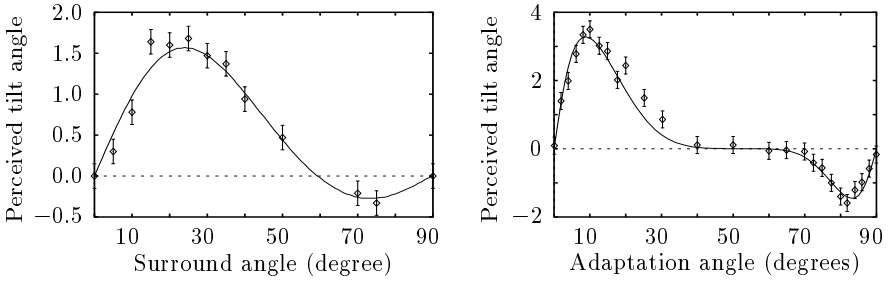
TILT ILLUSIONS AND DYNAMIC DECORRELATION: A THEORY OF LATERAL INTERACTIONS OF THE ORIENTATION SELECTIVE CELLS IN STRIATE CORTEX (V1). Dawei W. Dong*. California Institute of Technology, 139-74, Pasadena, CA 91125.

Natural images possess significant correlations. We explore the hypothesis that visual information in V1 is adaptively transformed into a decorrelated representation through lateral interactions of the orientation selective cells. Although retina and LGN do spatial and temporal decorrelation to incoming images (Dong and Atick 1994), only the lowest order correlations are eliminated. Therefore, the signal sent to V1 is still correlated and the activities of the orientation selective cells are correlated because of the high order correlations in the signal. Using some recently measured high order statistical properties of natural images, we predict the form of the lateral interactions in V1 which reduces the high order correlations. The predicted lateral interactions are anisotropic. The theory not only agrees with the physiological experiment by Gilbert and Wiesel (1990), but also gives a unified and quantitative explanation of the psychophysical experiments on tilt or orientation illusions as shown below. The solid curves are the theoretical predictions; the data points are from Westheimer (1990) on orientation contrast (left) and Campbell and Maffei (1971) on orientation adaptation (right).



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