

### A LAMINAR CORTICAL MODEL FOR 3D BOUNDARY AND SURFACE REPRESENTATION OF COMPLEX NATURAL SCENES

How do we see the world in depth? How does the visual cortex process complex natural scenes? The 3D LAMINART model has been developed to explain many data from psychophysical experiments in terms of how laminar cortical mechanisms interact to create 3D boundary and surface representations. Yongqiang Cao and Stephen Grossberg have worked in CELEST Thrust 1 (Learning in Visual Perception and Recognition) to extend the model to show how the same mechanisms, properly refined, can explain how the brain generates 3D surface representations in response to complex natural scenes. The model describes how monocular and binocular cortical cells interact with later stages of 3D boundary formation and surface filling-in in the LGN and cortical areas V1, V2, and V4. It proposes how interactions between layers 4, 3B, and 2/3 in V1 and V2 contribute to stereopsis, and how binocular and monocular information combine to form 3D boundary and surface representations. The major challenge for processing natural scenes is that the 3D boundaries are often unconnected and incomplete, and that cluttered surface regions incorporate many possibilities of false binocular matches. The main new developments are: (1) feedback interactions between V1 binocular cells and V1 surface cells help with initial depth assignments, notably how V1 surface filling-in helps to enhance V1 monocular and binocular boundaries, and (2) feedback between V2 boundaries and surfaces complete broken boundaries and eliminate false binocular matches. The model hereby provides a unified approach to providing both a quantitative explanation of data about 3D stereopsis and surface perception of psychophysical displays, as well as a system for 3D processing of natural scenes in computer vision applications.

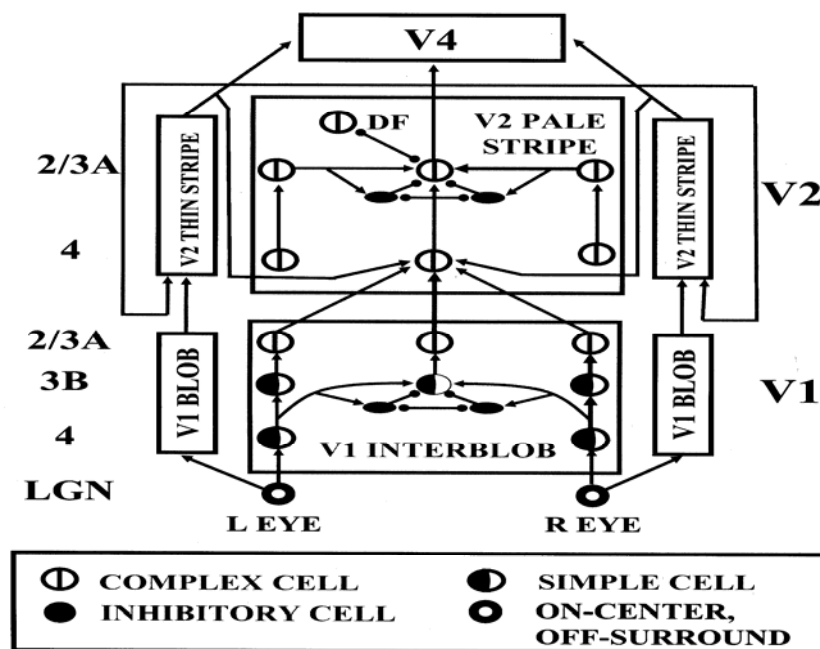


Figure. A 3D LAMINART model circuit diagram.