



**CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY**

Name(s) George Liaw; Bryan Lin	Project Number S1310
Project Title Modeling and Analysis of Human Binocular Perception of Position and Velocity in the Visual Cortex	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals This research focuses on developing a mathematical representation for human binocular visual perception from the visual field to the primary visual cortex based on spatial and physiological characteristics of the visual pathway.</p> <p>Methods/Materials First, a spatial relationship between single visible spot in the visual field and its retinal projection on the spherical surface for a monocular vision system was established. A novel approach, called peel-off mapping, was then formulated in dealing with flattening the spherical retina to a 2-dimensional (2-D) plane before being mapped to the visual cortex. Velocity level mapping that described how a visible moving spot was projected from visual field to the spherical retinal surface was developed and then mapped onto the visual cortex. More importantly, all the kinematical relationships established for monocular system were extended to binocular vision. Finally, a complete model was developed that allows for quantitative computation of binocular disparity as well as disparity due to stereo-motion in the primary visual cortex.</p> <p>Results Computer simulations were carried out and simulation results not only show the validity of the proposed model but also provide a platform for better understanding about some of the visual perception processes and interpreting some of the experimental results conducted on human.</p> <p>Conclusions/Discussion A quantitative modeling for human visual perception has been established based on spatial and physiological characteristics the first time. Considering highly nonlinear mappings involved in the visual image propagation in the human visual pathway, the model can help visualize the representations of images or visual information at different stages in the visual pathway by providing rich 2-D and 3-D simulation results. The proposed model also provides a platform to compute binocular disparity and disparity due to stereo-motion at the primary visual cortex level. The formations of these input signals help further explore subsequent brain activities in the higher level cortexes.</p>	
Summary Statement This project provides a mathematical representation of a fairly complex biological/physiological system, human binocular visual perception from the visual field to the primary visual cortex mapping.	
Help Received Professor Ou Ma at University of New Mexico answered email questions.	