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FINAL REPORT - 11/1/84 to 10/31/86

NASA-Ames NCC 2-332

Computational Models of
Human Vision with Applications

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Final Report for NCC 2-332

Brief Background

The program of research supported by this grant was initiated in 1977 by the Joint Institute for Aeronautics and Acoustics of the Department of Aeronautics and Astronautics at Stanford University. The purpose of the research was to study human performance with the goal of improving the design of flight instrumentation. By mutual agreement between the scientists at NASA-Ames and Stanford, all research activities in this area were consolidated into a single funding mechanism, NCC 2-307 [Center of Excellence Grant, 7/1/84 - present].

In the past we have submitted annual progress reports describing the ongoing research activities supported by NCC 2-332. In this final close-out I will summarize the research that was supported when this grant was still funded.

Image Size and Resolution in Face Recognition - A.J. Bilson

Dissertation, University of Washington

Dr. Bilson successfully completed her research on efficient retrieval strategies for finding images in visual databases. Dr. Bilson ran a series of experiments in which she analyzed the space-computation tradeoffs required to accurately access images in a database of faces. In particular, Dr. Bilson investigated the effect of image size on the resolution threshold for face recognition. She studied the problem using a large and relatively heterogeneous set of faces. She demonstrated that for images subtending 1-4 degrees of visual angle, the resolution threshold for face recognition is approximately 4 cycles per face width. This value is independent of image size. Images subtending 0.5 deg

or less were not reliably recognized at any resolution.

Her results are summarized in her dissertation. A photocopy of her dissertation is attached.

Analysis of Spatial Vision Models - Nielsen and Wandell

Nielsen and Wandell completed their study and extension of the spatial vision work. Their project has been summarized in a manuscript which will be submitted for review. A draft of their manuscript is attached.

Surface reflectance estimation procedures - Wandell

Wandell published two papers that describe procedures for accurately rendering color image data. The procedures are practical applications of the theoretical work done by Maloney and Wandell on the recovery of surface reflectance information from image data. These applications apply to rendering of both synthetic color images and color camera data.

Wandell, B.A. Color rendering of color camera data. *COLOR reserch & applic.*, **11** S30-S33, 1986

Wandell, B.A. The synthesis and analysis of color images. *IEEE Trans. Pat. Anal. & Mach. Intell.*, **PAMI-9**, 2-13, 1987

ARVO abstracts/paper - Varner and Wandell

Varner and Wandell completed a series of measurements on the question of defining a metric space for color vision. Preliminary reports of their work have been described in the attached published abstracts. A full paper describing their results will be completed this summer.

Varner, D. & Wandell, B.A. How many MacAdam ellipses are there? *Optical Soc. Amer. Tech. Digest*, p. 37, 1986.

Varner, D. & Wandell, B.A. Using color thresholds to predict color discrimination. *ARVO abstracts, Suppl. Invest. Ophthal. & Visual Sci.*, 26, 206, 1985

Varner and Wandell have developed a new method for specifying color sensitivity in all directions in color space. Their method extends the classic method of using simply the spectral sensitivity function.

Asilomar meeting

At the request of the Federal Aviation Administration D. Varner, A.B. Watson, and J. Larimer organized and held a meeting to discuss the use of color in flight displays. The organization and preparation for this meeting was supported, in part, by funds from this grant.

At the meeting a series of recommendations were made concerning the standardization of the use of color in flight instrumentation. The results of this meeting have been summarized in a report written by D. Varner and J. Larimer that is available, in draft form, from A.B. Watson.