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(FY91 AASERT), RECEPTIVE FIELD NEURAL NETWORK ANALYSIS  
OF COLOR CONSTANCY AND COLOR CONTRAST

F49620-92-J-0316

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Dr Gershon Buchsbaum

University of Pennsylvania  
dept of Bioengineering  
Suite 120 Hayden Hall  
3320 Smith Walk  
Philadelphia PA 19104-6392  
AFOSR/NL  
110 Duncan Ave Suite B115  
Bolling AFB DC 20332-8080

AFOSR-TR-96

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Capt William P. Roach

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13. ABSTRACT (Maximum 200 words)

Color constancy, or the ability of the visual system to perceive color independently of the ambient illumination, was investigated in the context of a biologically-based neural network. In particular, the role of retinal adaptation and higher level visual operations in mediating color constancy was investigated. The study incorporated properties of individual cells and how they combine to make complex color and spatial operations. The neural network simulations indicate how early visual stages complement each other to compensate and maintain relatively constant color perception under conditions of varying illumination and spatial context in the image. The network takes advantage of several mechanisms in the human visual system, including retinal adaptation, spectral opponency, and spectrally-specific long-range inhibition. This last stage is a novel mechanism based on cells which have been described in cortical area V4. All stages include non-linear response functions. The model emulates human performance in several psychophysical paradigms designed to test color constancy and color induction. We measured the amount of constancy achieved with both natural and artificial simulated illuminants, using homogeneous gray backgrounds and more complex backgrounds, such as Mondrians. On average, the model performs as well or better than the average human color constancy performance under similar

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Author: Gershon Buchsbaum <gershon@eniach.seas.upenn.edu> at aun  
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BCC: John Tangney at AFOSR  
TO: saxonb@mail.rectech.upenn.edu at DDN  
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----- Message Contents -----

AFOSR F49620-92-J-0316 Technical Report 8/31/95

A. Publications:

Papers

Courtney, Susan, M., Finkel, Leif, H., Buchsbaum, Gershon, A Multi-Stage neural network for Color Constancy and Color Induction, IEEE Transactions on Neural Networks, in press, 1995

Courtney, Susan, M., Finkel, Leif, H., Buchsbaum, Gershon, Network Simulations of Retinal and Cortical Contributions to Color Constancy, Vision Research 35, 413-434, 1995

Conference Proceedings/Abstracts:

Courtney, Susan, M., Buchsbaum, Gershon, Finkel, Leif, H., Cone Adaptation and Cortical Silent Surrounds Cooperate to Produce Color Constancy and Color Induction, Annual Meeting of the Optical Society of America Technical Digest Series Vol. 23, pp. 63 (1992).

Buchsbaum, Gershon, The Basic Building Blocks of Color Vision: A Generalized View of the Opponent Colors Transformation, Advances in Color Vision, Optical Society of America, Vol. 4 pp. 84-86 (1992).

"Biologically-Based Neural Network Model of Color Constancy and Color Contrast," S. M. Courtney, G. Buchsbaum and L. H. Finkel, IEEE International Joint Conference on Neural Networks, Vol. 4, pp. 55-60 (1992).

Eckert, Michael, P., Buchsbaum, Gershon, The Relationship Between Retinal Receptor Packing and Tracking Eye Movement, Investigative Ophthalmology & Visual Science (ARVO) Vol. 33 pp. 1144, 1992.

Courtney, Susan, M., Buchsbaum, Gershon, Finkel, Leif, H., Color Constancy and Color Contrast in a Physiologically-Based Network Model, Investigative Ophthalmology & Visual Science (ARVO) Vol. 33 pp. 704, 1992.

Courtney, Susan, M., Buchsbaum, Gershon, Finkel, Leif, H., The Effects of Color-Opponent and Cone-Specific Processing Stages on Color and Brightness Perception, Investigative Ophthalmology & Visual Science (ARVO) Vol. 34, pp. 746 (1993)

Levitan, Bennett, S., Buchsbaum, Gershon, Multirate Filtering: A New Approach to Modeling Signal Sampling and Propagation in Multiple Retinal Cell Layers, Investigative Ophthalmology & Visual Science (ARVO), Vol. 34, pp. 783 (1993)

Courtney, Susan, M., Finkel, Leif, H., Buchsbaum, Gershon, The Effect of Opponent processing and Spatial Integration on 'Equivalent surrounds' Investigative Ophthalmology & Visual Science (ARVO), Vol. 35, pp. 1637, 1994.

Courtney, Susan, M., Finkel, Leif, H., Buchsbaum, Gershon, "A Multi-Stage Biological Network Model for Color Constancy and Color Induction", International Conference on Neural Networks 1996 (submitted)

B. Researchers:

Faculty:

Buchsbaum, Gershon  
Finkel, Leif, H.

Graduate students, Thesis title and present position:

Courtney, Susan, M., (Ph.D.) Retinal and Cortical Contributions to Color Constancy and Color Induction in a Multi-Stage Network (1993).  
Presently, Postdoctoral Fellow, NIH

Fan, Lawrence (M.Sc.) Research area: "Properties of Illuminant - Reflectance products and their relevance in Color Constancy"  
Accepted position with consulting company in computing and pharmaceuticals.

Hsu, Andrew (Ph.D. Candidate), "Signal processing in the primate retina: An ideal observer model." Graduation expected 9/96.

C. Honors:

Buchsbaum, Gershon, Elected Fellow of the Optical Society of America  
Buchsbaum, Gershon, Elected Fellow American Institute for Medical and Biological Engineering

AFOSR F49620-92-J-0316 New Invention Report 8/31/95

No patents or new inventions were created.

Gershon Buchsbaum