Munsell Color Science Laboratory

Owing to our close proximity to the Eastman Kodak Company and Xerox Corporation, we have a number of part-time graduate students matriculated into the Color Science M.S. and Imaging Science M.S. and Ph.D. programs. Each program has an appropriate research component in the form of a thesis or graduate project. Because the students are not supported by grants and contracts, we have greater flexibility in subject matter and experimental design. Because the students have extensive industrial experience, many of the topics have immediate industrial applicability. Below is a summary of the research performed by our talented part-time learners.

Greg Howell, Eastman Kodak Company

**Colorant Formulation Using a Digital Camera**

I am working with Dr. Roy S. Berns. Traditional Kubelka-Munk based computer colorant formulation relies on spectrophotometric measurements. For a single set of three colorants, filter colorimeters can be utilized in place of the spectrophotometer with an apriori analysis of each colorant’s spectral absorption and scattering. This can be extended to the use of a color digital camera in extracting spectral information from a painting composed of a limited and known set of pigments. My graduate project will compare a Kodak DCS-100 with both red, green, and blue separation filters and a set of Melles Griot 50 nm interference filters to a spectrophotometer in predicting the concentrations of various combinations of three pigments. An acrylic artist’s paint system will be used. The three chromatic pigments are cadmium red light, phthalocyanine blue, and cadmium yellow light mixed with a base of titanium white.

Dave Wyble, Xerox Corporation

**Modeling Dot Gain with Principal Component Analysis**

I am working with Dr. Roy S. Berns. Modeling binary halftone printers has long been a difficult task. Straight area-coverage calculations such as Murray-Davies and Neugebauer are only applicable in ideal situations, where colorant is applied uniformly to a non-scattering substrate. In more realistic applications, both optical and physical dot gain exist. Physical dot gain is the departure of the print from the ideal bitmap, and is a property of the printing process; optical dot gain is caused by light spreading in the substrate. Dot gain corrections have been used successfully, such as the Yule-Nielsen n-value, but these tend to be very empirical and do not allow for adjusting dot gain for different halftone area coverages. First principals approaches have been proposed which more accurately predict the behavior of light in the substrate, but these tend to be computationally complex. We propose a new method of dot gain characterization using...
principal component analysis. It is hoped that by performing PCA on the individual separation data, dot gain information can be extracted that can be applied to overlay colors. While still an empirical analysis, this approach can allow the amount of dot gain to be varied according to separation, and, more importantly, to be varied as a function of area coverage.

Alex Vaysman, Xerox Corporation

Trade-Off Between Spatial and Color Resolution in Digital Printing

I am working with Dr. Mark Fairchild on my masters thesis. My thesis topic is “Degree of Quantization and Spatial Addressability Trade-offs in Perceived Quality of Color Images. I will be conducting a psychophysical experiment to evaluate the quality of continuous tone color images of different bit depths printed at different addressibility.

Bob Poetker, Eastman Kodak Company

Building Printer Device Profiles Using MATLAB

I am working with Dr. Roy S. Berns. MATLAB is a mathematical software package which can be run on either a NT/95, 3.1, Mac, or Sun computer platform. Its biggest asset is the ability to allow for straightforward and simple programming of complicated equations, formulas, and models using scalar, vector, and/or matrix variables. Extensions to the base software package are predefined calling functions which incorporate known algorithms. A subset of these functions are optimization routines that find the optimal solution for nonlinear continuous equations. The MS Project is to evaluate two of these routines, FSOLVE and LEASTSQ, on their usefulness as convergence functions for inverting printer models. Using a 3-color Kubelka-Munk printer model with 2nd order polynomial dot gain functions and an interaction matrix, a Matlab program was written to evaluate the number, accuracy, and speed of convergence while varying the starting RGB digital counts and converge arch method. Reference targets (input data set) are in CIELAB coordinates which were produced by running a 6x6x6 data set through the forward model and converting resulting densities into desired metrics. The final output will be a technical report describing in detail the procedure and analysis of the evaluation and a software function that can be called by a Matlab program to convert L*, a*, b* into RGB digital counts by inverting the user defined printer model.

Fritz Ebner, Xerox Corporation

Gamut Mapping Derived from Observer Matches in Simple Graphics and the Influence of Context on Gamut Mappings

I am working with Dr. Mark Fairchild. I work at Xerox in the office Color Printing Group on small color laser printers. I work on color correction, halftoning, and how it all fits into the system. My thesis topic is called “gamut mapping from below” and is involved in looking at the gamut mapping problem from a bottoms up perspective, i.e. to minimize some constraint (e.g. smallest perceptual distance, preservation of the “meaning” of the color, preferred rendering in a constrained gamut, etc.) I am also interested in the influence of image context (or content) on gamut mapping decisions and on the meaning of colors in computer generated graphics.

EDITOR’S NOTE:
There was no Fall Issue this year. Unfortunately, I did not have sufficient information to share and therefore, I did not want to take up your time with “filler.” Thanks for your patience.

Munsell Color Science Laboratory
Chester F. Carlson Center for Imaging Science
54 Lomb Memorial Drive
Rochester, New York 14623-5604
EDITOR: Colleen M. Desimone