COLOR RESEARCH AND APPLICATION
IN THIS ISSUE, February 2015

Eric Kirchner opens the first issue of this year by looking back about one thousand years to review "Color theory and color order in Medieval Islam." During the eleventh to fourteenth centuries Islamic scholars made significant contributions to color science, many of which are not commonly known. Kirchner focuses on developments of the understanding of the relationship between light, the medium, and color in color theory and also on the organizing and ordering of colors during that period. In summary, he provides a list of 31 scholars discussed, indicating their time and place of working, also the main works relevant for color theory.

For our next article we jump to something new in color space this century. Dong-Ho Kim proposes "The ULAB Color Space." While strides have been made in the development of color difference metrics since 1976 when the CIELAB color space and color difference metrics were adopted. In general the improvements in color difference metrics have been at the cost of losing the associated color space. The proposed ULAB space, while derived from CIELAB, incorporates corrections for lightness, chroma, and hue differences into its color coordinates thus making it possible to have a color space and an associated color difference metric that is much less complicated than CIEDE2000.

The CIECAM02 color-appearance model proposed by CIE Technical Committee (TC) 8-01 Colour appearance modeling for colour management systems has been used successfully in a widening array of applications. However, with the extended use some weaknesses have been uncovered, and another TC in Division 8 was formed to examine and propose remedies for the challenges discovered. Research relating to these issues has been the topic of several articles in this journal in recent years. In this issue Changjun Li, Changjie Ji, M. Ronnier Luo, Manuel Melgosa, and Michael H. Brill discuss "CAT02 and HPE Triangles." To remind the readers, the color-appearance transform CAT02 used to move from one set of viewing conditions to another, is embedded in the color appearance model for color management systems described in CIE Publication 159. The HPE triangle refers to the region of color space defined by the Hunt Pointer Estévez cone fundamentals. Two of the challenges recognized have been identified earlier as the Yellow-Blue Problem and the Purple Problem. In the present article the authors explain computation problems of CAT02 and provide methods for solving the Yellow-Blue and Purple problems simultaneously.

Up until now all the applications of CIECAM02 involve comparing how colors change in relation to other colors as the media or lighting conditions change, or for use as a color difference metric. In other words, as the color relates to the colors around it.Unrelated colors are seen as isolated colors such as red traffic light at night. In another article related to possible applications of CIECAM02, "Color appearance and color connotation models for unrelated colors," Bonseok Koo and Youngshin Kwak report on studies of unrelated colors. First they had observers evaluate color perception of unrelated colors by estimating the magnitude of hue, colorfulness, and brightness, then the observers also gave semantic ratings of each color using Ou's semantic scale, such as heavy-light or tense-relaxed, etc. Using the data they then tested three different color emotion models, and new models were proposed for color connotations of unrelated colors.

In our next article, "Influence of Lighting Conditions on the Appearance of Typical Interior Materials," Ruta Lasauskaite Schüpbach, Markus Reisinger, and Björn Schrader describe two experiments evaluating the effect of different types of lighting on materials in architectural interiors. One explorative study focused on the observers' preferences, the second study focused on the descriptive aspect of the lights as well as pleasantness. The four light sources used were two light-emitting diodes (LED), a high-intensity discharge (HID) lamp, and a compact fluorescent lamp. They concluded that the light source's influence on the evaluation of materials needs systematic investigation in future research.

In another article on color preferences, Iris Bakker, Theo van der Voordt, Peter Vink, Jan de Boon, and Conne Bazley examined preferences in color for various items. Understanding these preferences would be important to architects, interior designers, fashion designers and product designers. They examined not only what colors certain people liked, but also why or under what conditions specific colors would be selected, such as being able to focus, or feeling energetic. In "Color preferences for different topics in connection to personal characteristics" they focus on two questions: 1) What are the color preferences of adults and do they differ per topic? and 2) Is there any relationship between color preferences and personal characteristics, in a particular personality? They also note that many people had no color preference at all.

For years, people associate certain colors with specific companies or brands. These colors are often featured in the company's Logo and are very important to identifying the brand. With the internet and globalization the number of competing companies has grown exponentially. So the development of a logo and the choice of its colors has become a complex design problem. Christoph Bartneck and Adrian Clark have developed a tool that helps designers analyze large sets of graphics, thus leading to the capability of the designer to make informed choice about color for their graphics. In "Semi-Automatic Color Analysis for Brand Logos" they present two case studies which demonstrate the operation of their tools and illustrate the resulting descriptive statistics, and color analysis in relation with social-economic indicators.

Many forms of graphic and digital design have a commercial or an educational purpose. It is not sufficient to create the design to be aesthetically-appropriate and visually engaging, but usually it needs to meet a specific communication objective also. Two design elements, color and contrast, play key roles in visual perception, and the strategic use of these elements can contribute to the effectiveness of visual communication. In our next article Zena O'Connor discusses "Colour, contrast and Gestalt theories of perception: The impact on visual communications design."

Our previous article talked about how color and contrast could improve perception and understanding. Our next article goes in just the opposite direction. Mohammad Khajeh Mehrizi, Fateme Bokaee, and Nasrin Jamshidi want to use color and texture for concealment and making objects blend with natural or artificial backgrounds. This is not unusual in nature, fish and other animals use related techniques to camouflage themselves and survive. In "Visible- near infrared concealment of cotton/nylon fabrics using colored pigments and multi-walled carbon nanotube particles (MWNTs)" the authors report that the presence of MWCNTs in very low concentrations in printing formulations was found to cause considerable decline in near infrared (NIR) reflectance while a surprising increase in visible reflectance of samples was observed. Thus adding

MWCNTs to the pigment pastes used for printing could tune the overall reflectance in order to match the standard reflectance profile accepted for use in concealment color of desert areas of dark brown, light brown and olive green.

In our last issue T. W. Allan Whitfield talked about three men who through standards provided a color palette covering the entire built environment of Britain. Now Allan Whitfield and Jianne Whelton close this issue discussing "The arcane roots of colour psychology, chromotherapy, and colour forecasting." In the article Whitfield and Whelton discuss how the origins of the twentieth century fields of color psychology, chromotherapy, and color forecasting have their basis in the spiritualism, Theosophy and the science of the late eighteenth and nineteenth centuries. They conclude in their article that color is a special dimension and, given its rich and complex heritage, is likely to remain so."