TAIWAN TECH National Taiwan University of Science and Technology
色彩科技研究中心
Color, Imaging and Illumination Center

Symposium on Colour, Imaging and Illumination

Date: 10th November 2014

Venue: IB-202, International Building, National Taiwan University of Science and Technology (NTUST), Taipei, Taiwan

Morning Session

Time	Speaker	Topic
9:00	Prof. Bernard C. Jiang (Vice President of NTUST)	Opening
9:10	Prof. Shoji Tominaga	Multispectral imaging for achieving total appearance
10:10	Prof. Ronnier Luo	Technology for measuring skin colours
10:40	Coffee break	
11:00	Prof. Tzung-Han Lin	Developing a color 3D scanner from stereo camera
11:30	Meng-Che Tsai	LED backlight lens design with improved color and illuminance uniformity
12:00	Lunch	

Afternoon Session

Time	Speaker	Topic
13:00	Prof. Rafael Huertas Roa	Checking the performance of color difference formulae
13:40	Prof. Ferenc Szabó	LED4ART: LED Lighting for the frescoes of the Sistine Chapel
14:20	Dr. Yinqiu Yuan	Factors affecting visual comfort, clarity and preference in LED lighting applications
14:50	Coffee break	
15:10	Prof. Ronnier Luo	Status quo of lighting quality in recent research
15:40	Prof. Pei-Li Sun	Color subpixel rendering for flat panel displays
16:10	Yi-Chen Tsai	Digital quantification of colour discrimination and colour deficiency
16:40	Laboratory tour	

Morning Session

Time	Speaker	Affiliation
9:10	Prof. Shoji Tominaga	Professor at Graduate School of Advanced Integration Science, Chiba University, Japan
	Multispectral imaging for achieving total appearance Abstract: This presentation discusses multispectral imaging techniques for achieving total appearance of objects existing in a natural scene with various surface properties including color, gloss, and roughness. First, I will briefly review traditional multispectral imaging systems under passive illumination, and then introduce a recently developed spectral imaging method using active spectral illumination. Second, I will describe the basic reflection properties and the mathematical models for object surfaces consisting of different materials like dielectric, metal, and cloth. Third, I will discuss digital archiving of art paintings as an applied technology. The painting surface is regarded as a 2-D rough surface with gloss and shading. The surface is captured using a six-band imaging system, and the properties are estimated based on the captured images. An image rendering method is developed for achieving realistic appearance of the painting under arbitrary illumination and viewing conditions.	

<table>
<tr><td rowspan="2">10:10</td><td>Prof. Ronnier Luo</td><td>Professor at Graduate Institute of Color and Illumination Technology, National Taiwan University of Science and Technology, Taiwan</td></tr>
<tr><td colspan="2">Technology for measuring skin colours

Abstract: Skin colours have been closely associated with medical, cosmetic, photographic, imaging, lighting, applications. However, there are different technologies for measuring colours. Such as spectroradiometer, spectrophotometer with different geometry, visual aid, digital camera and multispectral imaging systems. Fifty subjects in 4 skin colour groups were measured using these technologies and their results were compared.</td></tr>
<tr><td>10:40</td><td colspan="2">Coffee break</td></tr>
<tr><td rowspan="2">11:00</td><td>Prof. Tzung-Han Lin</td><td>Professor at Graduate Institute of Color and Illumination Technology, National Taiwan University of Science and Technology, Taiwan</td></tr>
<tr><td colspan="2">Developing a color 3D scanner from stereo camera

Abstract: 3D scanner is a device that acquires real-world objects in 3D. It is capable of generating accuracy 3D digital data from real objects. In NTUST, we developed a color 3D scanner by simply using a stereo camera. However, it is a challenging task for creating realistic 3D appearance. In this talk, we will reveal how we develop a color 3D scanner. Our basic idea is using one moving laser for generating features, and the shape of real object, which is observed by the stereo camera, will be analysed. Likewise, this 3D scanner consists of a turntable, for rotating a 3D object to specific positions, and several LED light bulbs. During the scan process, 8 range data of the 3D object are obtained and integrated into one digital 3D model. The color images, which are pre-calibrated, are again cast on this 3D model by considering geometrical shapes.</td></tr>
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11:30	Meng-Che Tsai	PhD student at Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology, Taiwan
	LED backlight lens design with improved color and illuminance uniformity Abstract: Uniform color and illumination distribution both are important requirements in design of the LCD backlight. We propose a chromatic separation method to design LED direct-lit backlight lens, and the illuminance uniformity and color uniformity are much improved.	
12:00	Lunch	

Afternoon Session

Time	Speaker	Affiliation
13:00	Prof. Rafael Huertas Roa	Professor at Department of Optics, University of Granada, Spain

Checking the performance of color difference formulae

Abstract: The final goal of any color-difference formula is to replicate the visual judgment about the color difference between two patches. Although visual color differences are subjective measurements, is possible to achieve them, and they will considerer as the reference. Therefore the result of a color-difference formula, computed difference, must be compared with its correspondent visual judgment, perceived difference. Nowadays many color difference formulae are available, recent and historical. An index or method to check the performance of a color-difference formula is essential, not only to obtain the goodness of a formula but also in the development and fitting of new ones. Eventually, it is just a statistical problem, i.e. to compare two rows of data, computed and perceived differences. In Colorimetry two approaches are widely used, the PF/3 (Performance Factor by 3) and the STRESS (Standardized Residual Sum of Squares). The main difference between PF/3 and STRESS is that the latter is simpler, and allows statistical inferences on the statistical significance of two color-difference formulas with respect to a given set of visual data. The goal is to study the properties of PF/3 and their components, and of STRESS.

13:40	Prof. Ferenc Szabó	Professor at Department of Electrical Engineering and Information Systems, University of Pannonia, Hungary

LED4ART: LED Lighting for the frescoes of the Sistine Chapel

Abstract: The European Commission funded a pilot flagship project (LED4ART), which has the aim to demonstrate that high quality and energy efficient museum lighting based on LEDs is possible in 2014. The place of demonstration is one of the top ten museums in the world: the Sistine Chapel in the Vatican. A consortium consists of 6 partners from 5 countries is in charge of replacing the lighting system of the Sistine Chapel. Members of the consortium are OSRAM, the Vatican City State, OSRAM Italy, the Energy Research Institute of Catalonia (IREC), Fabertechnika and University of Pannonia. The role of the Virtual Environment and Imaging Technologies Research Laboratory in this project is to determine the LED spectral power distribution in order to present the world-famous frescoes to the visitors in the form as the artist imagined them. Beside this aspect, art preservation and energy efficiency are still important issues. In order to control the effect of LED light on frescoes, pigment ageing test are carried out in our laboratory. The project has been started in 2012 with the evaluation of the old lighting system and going to reach the final aims by the end of 2014. On-site measurements have been done in the Sistine Chapel before and after luminaire replacement, spectral optimization of LED spectra has been done according to modern colorimetric practice. During the presentation, the most important objectives and results of the project are presented.

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<tr><td rowspan="2">14:20</td><td>Dr. Yinqiu Yuan</td><td>Scientific Researcher at Green Energy and Environment Research Laboratories, Industrial Technology Research Institute, Taiwan</td></tr>
<tr><td colspan="2">Factors affecting visual comfort, clarity and preference in LED lighting applications

Abstract: The study aimed at investigating the influence of white LED lighting on visual comfort, clarity and preference in an indoor environment, as well as comparing the difference in lighting quality between white LED and conventional T5 fluorescent. To clarify the relationship between light source parameters and induced visual impressions, 3 psychophysical experiments were conducted in a darkened room which simulated a hospital patient room. Exp. 1 focused on the effect of incident angle of LED light. Exp. 2 examined the influence of CCT and illuminance intensity of LED light. Exp. 3 compared the visual difference between LED light and T5 fluorescent. The experimental results show the following findings:
1. Incident angle of light can cause significant influence on visual comfort with 22.5 degrees providing most comfortable lighting.
2. Lights with high visual comfort and preference located in the range of CCT at 5000K and illuminance at 900lx to 1200lx.
3. In terms of visual clarity, the higher the illuminance level was the clearer the object was seen.
4. T5 fluorescent performed better than white LED in providing more comfortable and desirable reading lights.</td></tr>
<tr><td>14:50</td><td colspan="2">Coffee break</td></tr>
<tr><td rowspan="2">15:10</td><td>Prof. Ronnier Luo</td><td>Professor at Graduate Institute of Color and Illumination Technology, National Taiwan University of Science and Technology, Taiwan</td></tr>
<tr><td colspan="2">Status quo of lighting quality in recent research

Abstract: The talk will cover the recent CIE topics on lighting quality including glare, colour rendering, visual comfort. Some recent research in these areas will be given including assessment of indoor lighting glare with nonuniform LED sources, evaluation of colour rendering indices, visual performance on different sources, etc.</td></tr>
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<tr><td rowspan="2">15:40</td><td>Prof. Pei-Li Sun</td><td>Professor at Graduate Institute of Color and Illumination Technology, National Taiwan University of Science and Technology, Taiwan</td></tr>
<tr><td colspan="2">Color subpixel rendering for flat panel displays

Abstract: Subpixel rendering is a way to increase the apparent resolution of a display by rendering pixels to take into account the screen type's physical properties. Adding white subpixel is often recommended for enhancing both resolution and brightness of the display. But it has to solve chromatic aliasing and color accuracy problems by applying spatial filtering and gamut mapping.</td></tr>
<tr><td rowspan="2">16:10</td><td>Yi-Chen Tsai</td><td>PhD student at Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology, Taiwan</td></tr>
<tr><td colspan="2">Digital quantification of colour discrimination and colour deficiency

Abstract: With the wide spread of novel display and illumination technologies, such as wide color gamut displays and color-varied LEDs, we predict that more problems of color discrimination would occur often than the past. If the color vision deficiency (CVD) observers could be efficiently diagnosed the degree of severity in CVD using by a digital tool, it would help us to build a friendly open environment of living and working for considering both normal color vision (NCV) and CVD observers. A novel method for digital quantification of colour discrimination and colour deficiency is presented. Results from a psychophysical method based on the theories of confusion line for establishing the Just-Noticeable Colour Differences (JND) was evaluated. The experimental results showed that there is clear difference between the Deutanopia-type colour deficient observers and the normal colour vision observers. In addition, there is a good correlation between the new method and D-15/Anomaloskop.</td></tr>
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