CIMET Color Science

Course name: Color Science
Course code: CIMET CS
Course level: Master
ECTS Credits: 5.00

Course instructors: Eva M. Valero and Rafael Huertas (University of Granada)

Education period (Dates): 1st semester
Language of instruction: English

Expected prior-knowledge: Matlab and MSExcel basic knowledge

Aim and learning outcomes: -
To supply fundamentals and basic knowledge of basic Colorimetry and practical information on color measurements and computation of color specifications.
Learning outcomes:

- Training on color attributes, color measurements and color specification systems.
- Knowing the relationships between colorimetric values and color attributes and color vision mechanisms.
- Practical measurement and calculation of different colorimetric values: color coordinates, whitness index, color rendering index and degree of metamerism.

Topics to be taught (may be modified):
1) Light, Vision, Photometry: Light, mechanism of the human eye, radiometric quantities, interaction of light with materials, brightness and spectral responsivity of the human visual system, definition of photometric quantities, types of vision according to luminance level, relations between photometric quantities.
2) Color Vision and Color Specification Systems: Mechanism of color vision, chemistry of color vision, color specification and terminology, Munsell Color System, additive and substractive mixing, color systems using additive color mixing.
3) CIE Standard Colorimetric System: RGB color specification system, conversion into XYZ color specification system, CIE1964 color space, tristimulus values and chromaticity coordinates, metamerism, dominant wavelength and purity, color temperature, illuminants and light sources, standard and supplementary illuminants.
4) Uniform Color Spaces: Uniform chromaticity diagrams, uniform lightness scales, CIE uniform color spaces, correlates of perceived attributes, comparison of CIELAB and CIELUV color spaces, color difference equations based on CIELAB.
5) Measurement and Calculation of Colorimetric Values: Direct measurement of tristimulus values, spectral colorimetry, geometrical conditions for measurement, colorimetric values in CIELAB and CIELUV uniform color spaces.
6) Evolution of CIE Standard Colorimetric System: Maximum value of luminous efficacy and optimal colors, chromatic adaptation process, Von Kries, predictive equation for chromatic adaptation, CIE predictive equations for chromatic adaptation, color vision models, color appearance models, analysis of metamerism.
7) Application of CIE Standard Colorimetric System: Evaluation of the color rendering properties of light sources, evaluation of the spectral distribution of daylight simulators, evaluation of whiteness,

evaluation of degree of metamerism for change of illuminant, evaluation of degree of metamerism for change of observer, designing spectral distributions of illuminants, computer color matching.

Practical Laboratory Sessions

1. Instruments to measure color.
2.1. Group 1: Obtaining spectroradiometric data from radiant sources. Computing its tristimulus values.
2.2. Group 2: Obtaining illuminance and luminance data
3.1. Group 1: Obtaining spectral reflectance and color coordinates of solid samples with a spectroradiometer.
3.2. Group 2: Obtaining spectral reflectance and color coordinates of solid samples with a spectrophotometer.
3.3. Group 3: Obtaining spectral transmittance and color coordinates of liquid samples with a spectrophotometer.
4. CIELAB coordinates and color differences.
5. Color measurements of goniochromatic colors.

Literature and study materials:

Lessons outlines (presentations), description and guides for exercises' sessions.
Handouts of the material covered in the lectures will be distributed.

Reference book:

"Colorimetry. Fundamentals and Applications" by Ohta and Robertson. Wiley, 2005

Additional books:

"Color Science:concepts and methods, quantitative data and formulae". Wyszecki and Stiles, Wiley, 1982
"Principles of Color Technology". Billmeyer, Saltzman and Berns. Wiley, 2000.
"Colorimetry. Understanding the CIE System". Janos Schanda (Ed). CIE. Wiley, 2007.
"Computational Color Science using Matlab". Westland and Ripamonti. Wiley, 2004

Form(s) of Assessment: Written exam (75%), exercises (25%)

Additional information:

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