COSI « Computational color »

Course code:
Course level: Master **ECTS Credits:** 5.00

Course instructor/s: Dr. Ville Heikkinen (University of Eastern Finland)

Education period (Dates): 3rd semester **Language of instruction:** English

Expected prior-knowledge: MATLAB, Basics of linear algebra.

Aim:

Course introduces computational methods for color calibration and estimation of reflectance spectrum from RGB- and multispectral measurements. The course also covers fundamental topics associated to calibration and estimation, such as spectral observation models, visual and non-visual spectral subspaces, device independent color spaces and spectrum based color management workflow. Mathematical methods like Principal Component Analysis (PCA), Non-negative Matrix Factorization (NMF), and Non-negative Tensor Factorization (NTF) are introduced for analysis and processing of spectral data.

Course outline

Computational methods introduced in the course are in the contexts of spectrum based (and standard CIE) color management and spectral data approximation. Main focus are in introducing properties of physical and empirical reflectance estimation and color calibration models. Topics covered in the course include :

- Models for spectral signals and color coordinates.
- Fundamental spectral subspaces.
- Spectrum based (and standard CIE) color management.
- Regression based color calibration and spectral reflectance estimation.
- Spectral reflectance estimation using Wiener estimation.
- Approximation of spectral data using PCA and subspace projections.
- NMF and NTF as methods for data analysis and feature extraction.

Lab experiments and/or sessions:

- Matlab programming topics in order to implement and master basic issues explained in the lectures. The use of other computer languages and/or software packages will be accepted.

Learning Outcomes:

After completing the course, students will be able to

- Understand basic concepts of spectral data and about their physical properties.
- Understand relation of spectral space to standard color spaces.
- Understand possibilities and problems in accurate color imaging and reproduction.
- Use standard computational methods for color calibration and spectral estimation and implement them with a programming language.
- Present their findings from practical assignments as scientific text.
- Search and review relevant literature for further investigation.

Assessment methods and tasks: final exam (75%), homework/lab reports (25%).

Assessment criterion: Grading 1—5.

External/internal examiner: Internal examiners evaluate the exam.

Examination support: -

Literature and study materials: Digital color imaging handbook, Edited by Gaurav Sharma, CRC Press (2003).

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