Computational photography

Remarque
pas donné en 2018-19

Summary
The students will gain the theoretical knowledge in computational photography, which allows recording and processing a richer visual experience than traditional digital imaging. They will also execute practical group projects to develop their own computational photography application.

Content
Computational photography is the art, science, and engineering of creating a great (still or moving) image. Information is recorded in space, time, across visible and invisible radiation and from other sources, and then post-processed to produce the final - visually pleasing - result.
Basics: Human vision system, Light and illumination, Geometric optics, Color science, Sensors, Digital camera systems.
Generalized illumination: Structured light, High dynamic range (HDR) imaging, Time-of-flight.
Generalized optics: Coded Image Sensing, Coded aperture, Focal stacks.
Generalized sensing: Low light imaging, Depth imaging, Plenoptic imaging, Light field cameras.
Generalized processing: Super-resolution, In-painting, Compositing, Photomontages, Panoramas, HDR imaging, Multi-wavelength imaging, Dynamic imaging.
Generalized display: Stereoscopic displays, HDR displays, 3D displays, Mobile displays.

Keywords
Computational Photography, Coded Image Sensing, Non-classical image capture, Multi-Image & Sensor Fusion, Mobile Imaging.

Learning Prerequisites

Required courses
• A basic Signal Processing, Image Processing, and/or Computer Vision course.
• Linear Algebra.

Recommended courses
• Introduction to Computer Vision.
• Signal Processing for Communications.
Important concepts to start the course
• Basic signal processing.
• Basic computer vision.
• Basic programming (iOS, Android, Matlab).

Learning Outcomes
By the end of the course, the student must be able to:
• Identify the main components of a computational photography system.
• Contextualise the main trends in computational optics, sensing, processing, and displays.
• Create a computational photography application on a mobile platform.
• Design a computational photography solution to solve a particular imaging task.
• Assess / Evaluate hardware and software combinations for their imaging performance.
• Formulate computational photography challenges that still need to be resolved.

Transversal skills
• Evaluate one's own performance in the team, receive and respond appropriately to feedback.
• Continue to work through difficulties or initial failure to find optimal solutions.

Teaching methods
The course consists of 2 hours of lectures per week that will cover the theoretical basics. An additional 2 hours per week are dedicated to a group project designing, developing, and programming a computational photography application on a mobile platform (iOS, Android).

Expected student activities
The student is expected to attend the class and actively participate in the practical group project, which requires coding on either Android or iOS platform. The student is also required to read the assigned reading material (book chapters, scientific articles).

Assessment methods
The theoretical part will be evaluated with an oral exam at the end of the semester, and the practical part based on the students’ group projects.

Resources
Bibliography
• Selected book chapters
• Course notes (on moodle)
• Links to relevant scientific articles and on-line resources will be given on moodle.