UCLouvain

lelec2885

2017

Image processing and computer vision

5 credits	30.0 h + 30.0 h	Q1

Teacher(s)	De Vleeschouwer Christophe coordinator ;Jacques Laurent ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	This course is part of the ELEC/EPL program in "**information and signal processing**". The main objective of LELEC2885is to introduce all the concepts needed to understand the "image" signals, from their acquisition until their processing, through the important questions of signal representation and approximation occuring during data transmission or interpretation.
Aims	With respect to the AA referring system defined for the Master in Electrical Engineering, the course contributes to the develoopment, mastery and assessment of the following skills : • AA1.1, AA1.2 • AA3.1, AA3.3 • AA5.5, AA5.6 b. **At the end of this course, the student will be able to:** 1. Handle techniques of representation and approximation of images in order to extract their meaningful components with respect to a particular application, for example, in the fields of data transmission or interpretation; 2. Apply linear and non-linear filtering operations (e.g., morphological) to isolate certain frequency components or to cancel particular noises; 3. Detect structures of interest in an image, such as contours, key features, etc.. 4. Segment an image into regions of homogeneous characteristics, targeting a semantic interpretation of the image content; 5. Restore images corrupted a noise or a blurring; 6. Understand the basic principles of inverse problem solving in imaging and in compressed sensing; 7. Manage image databases using detection tools or classification; 8. Detect and track one or more object(s) of interest in video streams, in biomedical applications or for 3-D scene interpretation; 9. Compress image signals considering their visual perception and their accessability in the compressed signal representation; 10. Provide a solution to complex problems involving image processing, such as quality control, visiosurveillance, multimodal human-machine interfaces, and image compression. 1 - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	The evaluation includes three components : • An **oral examination**: Scheduled in January, this test evaluates individually the students on their understanding of the concepts and methods taught during the theoretical courses. • A **project (realized by a team of 2 or 3 students)**: The objective is to solve an actual problem in image processing and/or computer vision. Each group first prepares a brief midterm presentation (not rated); the objective is to evaluate the group progression in the project realization and to provide them advices on the selected approach and methodologies. The final project rating is based on a written report and on a final oral presentation made in December. • A **critical analysis of 3 scientific papers in the field**: This helps the student to develop his ability to analyze the advantages and the weaknesses of a scientific work, considering both its content and its general structure. Each student provides a report (1 page max per article) by December. These three components are weighted as 40%, 40% and 20% of the final grade, respectively.

Teaching methods	The course is organized around a series of lectures, each dealing with a specific problem commonly encountered in the field of image processing. Each lesson introduces a selection of the main solutions found in the literature and/or the industry to solve the problem of interest, and a list of references is provided for each covered topic. To complement the lectures, the student is also asked to read and criticize a number of scientific publications. The goal is to allow him/her to deal with a subject in depth, but also and especially to draw his/her attention to the way a scientific paper is built. Besides the lectures, a learning procedure "by problems" is implemented: a practical challenge is addressed by group of 2 or 3 students, based on a software platform for image processing. The envisioned solution and its implementation are carefully validated and evaluated, before a final oral and written presentation.
Content	• Image definition: pixels, resolutions and color systems • Image representation: from Fourier to wavelets. • Sparsity principles: from orthonormal bases to redundant systems • Tools for sparse decomposition: Matching Pursuit, greedy methods and Basis pursuit. • Sparsity and applications: denoising, deconvolution, compressed sensing, computational imaging. • Image perception, human visual system and application to watermarking. • Image and Video compression: JPEG, MPEG, and sparse approximation coding. • Basic tools of image analysis: filtering, thresholding, mathematical morphology. • Image Segmentation: clustering, watershed, graph cuts and Markov random fields. • Visual detection and recognition: point descriptors, image features, and classifiers. • Visual object tracking: Template matching, particle filters, graph-based formalisms
Inline resources	Moodle http://moodleucl.uclouvain.be/course/view.php?id=7579
Bibliography	Support de cours : Transparents, articles tutoriaux et parties de code Matlab. Les documents du cours sont disponibles sur Moodle Lectures conseillées : Durant l'année, l'étudiant doit lire 3 articles sélectionnés dans une liste de 40 articles distribués sur le site Moodle du cours.
Other infos	This course assumes that the basics of signal processing, such as taught in the course "signals and systems" (**LFSAB1106**) or "digital signal processing" (**LELEC2900**), are known.
Faculty or entity in charge	ELEC

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Aims
Master [120] in Data Science Engineering	DATE2M	5		
Master [120] in Electrical Engineering	ELEC2M	5		
Master [120] in Biomedical Engineering	GBIO2M	5		
Master [120] in Mathematical Engineering	MAP2M	5		
Master [120] in Computer Science and Engineering	INFO2M	5		
Master [120] in Computer Science	SINF2M	5		
Master [120] in data Science: Information technology	DATI2M	5		