UCL Université catholique de Louvain

LELEC2885

2013-2014

Image processing and computer vision

5.0 credits	30.0 h + 30.0 h	1q

Teacher(s) :	Jacques Laurent (compensates Macq Benoît) ; De Vleeschouwer Christophe (coordinator) ; Macq Benoît ;
Language :	Anglais
Place of the course	Louvain-la-Neuve
Inline resources:	> http://icampus.uclouvain.be/claroline/course/index.php?cid=ELEC2885
Prerequisites :	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.
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 :	a. Contribution of the course to the AA program Axe 1 (1.1, 1.2), Axe 3 (3.1, 3.3), Axe 5 (5.5, 5.6) At the end of this course, the student will be able to: -- 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; -- Apply linear and non-linear filtering operations (e.g., morphological) to isolate certain frequency components or to cancel particular noises; -- Detect structures of interest in an image, such as contours, key features, etc.. -- Segment an image into regions of homogeneous characteristics, targeting a semantic interpretation of the image content; -- Restore images corrupted a noise or a blurring; -- Understand the basic principles of inverse problem solving in imaging and in compressed sensing; -- Manage image databases using detection tools or classification; -- Detect and track one or more object(s) of interest in video streams, in biomedical applications or for 3-D scene interpretation; -- Compress image signals considering their visual perception and their accessability in the compressed signal representation; -- Provide a solution to complex problems involving image processing, such as quality control, visiosurveillance, multimodal human-machine interfaces, and image compression *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 of each year, 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 of intelligent vision or of computer vision. Each group realizes first a brief midterm presentation (not evaluated); 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 score 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 (3 pages, 1 page per article) in 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, color systems, image (multi-resolution) representation, filtering -- Image perception, human visual system, watermarking, and image restoration -- Mathematical morphology -- Image Segmentation: clustering, watershed, model matching, and active contours -- Detection and Content-based Retrieval: classifiers, relevance feedback, active learning -- Visual object tracking: Lucas-Kanade tracker, kernel-based tracking, particle filters -- Image compression: JPEG and JPEG2000 -- Video compression: MPEG, AVC, and SVC -- Matching Pursuit image representation and compression -- Sparsity and applications: compression, denoising, deconvolution, and compressed sensing -- Image Acquisition for Machine Vision: Before Image Processing
Bibliography :	Course support: Slides, tutorials and part of matlab codes. These documents are available on icampus. Advised reading: During the semester, the student must read 3 or 4 articles selected in a list of 40 available on iCampus (after authentication) at http://icampus.uclouvain.be/claroline/course/index.php?cid=ELEC2885
Other infos :	Teaching language is English. Students can present their oral exam in French or English
Cycle and year of study :	> Master [120] in Computer Science and Engineering > Master [120] in Computer Science > Master [120] in Biomedical Engineering > Master [120] in Mathematical Engineering > Master [120] in Electro-mechanical Engineering > Master [120] in Electrical Engineering
Faculty or entity in charge:	ELEC