UCLouvain

lelec2885

2021

Image processing and computer vision

5.00 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.
Learning outcomes	**At the end of this learning unit, the student is able to :** 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; 1 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.
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. • **An evaluation of the Python numerical exercises**: students are evaluated on a computer (in session or out of session) based on problems similar to those presented during the year. These 2 components are weighted as 70% and 30% 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. In addition to the theoretical classes, numerical exercise sessions under Python are organized in a computer room. Students are asked to program different algorithms associated with a consistent sub-selection of the techniques taught. They use existing Python libraries for this purpose. Learning is provided by problem solving, based on real or synthetic images/signals, sometimes associated with external databases. The course is given in the classroom exclusively.
Content	• Image representation: Pixels, Fourier and Multiscale Transforms. • The wavelet transform. • The sparsity principle and applications: from orthonormal bases to redundant systems. • Human visual system and salient image features.

	• Image classification and deep learning introduction. • Basic tools of image analysis: mathematical morphology and relatives. • Image segmentation, (spectral) clustering, watershed and level sets • An introduction to computational imaging • Detection-based (multi-) object tracking: detect-before-track • Recursive visual object tracking: track-before-detect • Principles of stereo vision • From entropy coding to image compression • Video compression, and sparse approximation coding
Inline resources	Moodle https://moodle.uclouvain.be/course/view.php?id=982
Bibliography	Support de cours : Transparents, articles tutoriaux et parties de code Python. Les documents du cours sont disponibles sur Moodle ---------- Course materials: Slides, tutorials and parts of Python code. Course documents are available on Moodle
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	Learning outcomes
Master [120] in Data Science Engineering	DATE2M	5		
Master [120] in Electrical Engineering	ELEC2M	5		
Master [120] in Computer Science and Engineering	INFO2M	5		
Master [120] in Data Science: Information Technology	DATI2M	5		
Master [120] in Biomedical Engineering	GBIO2M	5		
Master [120] in Computer Science	SINF2M	5		
Master [120] in Mathematical Engineering	MAP2M	5		