Last update: 08-07-2016

230561 - IMPROCES - Image Processing in Biophotonics

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 731 - OO - Department of Optics and Optometry

Academic year: 2016

Degree: ERASMUS MUNDUS MASTER'S DEGREE IN PHOTONICS ENGINEERING, NANOPHOTONICS AND BIOPHOTONICS (Syllabus 2010). (Teaching unit Optional)
MASTER'S DEGREE IN PHOTONICS (Syllabus 2013). (Teaching unit Optional)

ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: Artur Carnicer, UB.

Degree competences to which the subject contributes

Basic:

CB7. (ENG) Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio.

CB8. (ENG) Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicio.

CB6. (ENG) Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB10. (ENG) Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

Specific:

CE3. (ENG) Màster en Fotònica:
Conocer los fundamentos de la física del láser, los tipos de láser y sus principales aplicaciones

CE4. (ENG) Màster en Fotònica:
Demostrar que conoce los fundamentos de la formación de imagen, de la propagación de la luz a través de los diferentes medios y de la Óptica de Fourier.

CE6. (ENG) Màster en Fotònica:
Haber realizado un conjunto de prácticas de laboratorio de nivel avanzado, similar al de futuros trabajos experimentales de investigación

CE9. (ENG) Màster en Fotònica:
Capacidad para sintetizar y exponer los resultados de investigación en fótonica según los procedimientos y convenciones de las presentaciones científicas en inglés.

Generical:

CG1. (ENG) Màster en Fotònica:
Capacidad para proyectar, diseñar e implantar productos, procesos, servicios e instalaciones en algunos ámbitos de la fotónica como los relacionados con la ingeniería fotónica, la nanofotónica, la óptica cuántica, las telecomunicaciones y la biofotónica

CG2. (ENG) Màster en Fotònica:
Capacidad para la modelización, cálculo, simulación, desarrollo e implantación en centros de investigación, centros tecnológicos y empresas, particularmente en tareas de investigación, desarrollo e innovación en todos los ámbitos relacionados con la Fotónica.

CG4. (ENG) Màster en Fotònica:
Capacidad para entender el carácter generalista y multidisciplinario de la fótonica viendo su aplicación por ejemplo a la medicina, biología, energía, comunicaciones o la industria

Last update: 08-07-2016

230561 - IMPROCES - Image Processing in Biophotonics

Transversal:

1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
2. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding how companies are organised and the principles that govern their activity, and being able to understand employment regulations and the relationships between planning, industrial and commercial strategies, quality and profit.
3. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.
4. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
5. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Teaching methodology

- Lectures

Learning objectives of the subject

This subject overviews several topics on digital image processing focusing on biophotonics applications. This is a hands-on course that provides an in-depth treatment of image processing techniques, emphasizing software principles and practical implementation. Despite no previous knowledge on digital image processing is required, those students willing to attend this course should be familiar with Python or Matlab computing environments. No background on basic programing techniques will be provided.

Study load

Total learning time: 75h	Hours large group:	22h 30m	30.00%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	2h 15m	3.00%
	Self study:	50h 15m	67.00%

Last update: 08-07-2016

230561 - IMPROCES - Image Processing in Biophotonics

Content

Issue 1	Learning time: 2h Theory classes: 2h

Description:
Python libraries for image processing: Scipy based, scikit-image, opencv.

Issue 2	Learning time: 4h Theory classes: 4h

Description:
Intensity transformations. Spatial filtering in image and Fourier domains

Issue 3	Learning time: 2h Theory classes: 2h

Description:
Cameras: image and video acquisition.

Issue 4	Learning time: 5h Theory classes: 5h

Description:
Point spread function analysis and image restoration in optical microscopy

Issue 5	Learning time: 4h Theory classes: 4h

Description:
Cell segmentation using Watershed transform.

Last update: 08-07-2016

230561 - IMPROCES - Image Processing in Biophotonics

Issue 6	Learning time: 5h 30m Theory classes: 5h 30m
Description: Single particle tracking.	

Planning of activities

Visita to an image processing research unit	Hours: 2h 18m Theory classes: 2h 18m

Qualification system

- Exam. Students have to solve a practical problem based on the topics developed of the syllabus. Students can use documentation, notes and code discussed during the course. The use of their own computer is encouraged and access to the internet will be granted during the exam.
- A remedial exam will be scheduled for those students that fail the test.

Last update: 08-07-2016

230561 - IMPROCES - Image Processing in Biophotonics

Bibliography

Basic:

González, R.F.; Woods, R.E. Digital image processing. 3rd ed., international ed. Upper Saddle River: Pearson Education Internacional, 2010. ISBN 0132345633.

Others resources:

Hyperlink

Python documentation

http://docs.scipy.org/doc/scipy/reference/ndimage

Python documentation

http://docs.opencv.org/3.0-beta/doc/py_tutorials/py_tutorials

Python Image deconvolution

http://scikit-image.org/docs/dev/auto_examples/plot_restoration

Image Segmentation with Watershed Algorithm

http://opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_imgproc/py_watershed/py_watershed

Audiovisual material

Python documentation

http://scikit-image.org/

Trackpy: Fast, Flexible Particle-Tracking Toolkit

http://soft-matter.github.io/trackpy/stable/