uc3m | Universidad **Carlos III** de Madrid

Surgical Navigation and Imaging

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

    Biosignals and Bioimages
    Biomedical image processing (or equivalent course)

OBJECTIVES

    CB6 Having and understanding the knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
    CB7 Students know how to apply their acquired knowledge and problem-solving skills in new or unfamiliar settings within broader (or multidisciplinary) contexts related to their field of study.
    CB8 Students are able to integrate knowledge and to face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.
    CB9 Students know how to communicate their conclusions and the knowledge and ultimate reasons behind them to specialised and non-specialised audiences in a clear and unambiguous way.
    CB10 Students have the learning skills that will enable them to continue studying in a way that will be largely self-directed or autonomous.

    General competences

    CG2 Ability to apply the knowledge of skills and research methods related to engineering.
    CG3 Ability to apply the knowledge of research skills and methods related to Life Sciences.
    CG4 Ability to contribute to the widening of the frontiers of knowledge through an original research, part of which merits publication referenced at an international level.
    CG5 Ability to perform a critical analysis and an evaluation and synthesis of new and complex ideas.
    CG6 Ability to communicate with the academic and scientific community and with society in general about their fields of knowledge in the modes and languages commonly used in their international scientific community.

    Specific competences

    CE6 Ability to understand the basis of the main technologies involved in biomedical imaging systems.
    CE7 Ability to solve a biomedical problem from an engineering perspective based on the acquisition and processing of biomedical images

DESCRIPTION OF CONTENTS: PROGRAMME

    1. Introduction. Course description. Historical background on surgical navigation. History of navigation and image guided surgery.

    2. Tracking systems.
    Mechanical, optical and magnetic tracking systems: operating principles, advantages and limitations.

    3. Image registration.
    Need and definition of the image registration.Landmark-based registration; methods based on surfaces and volumes: Procrustes, ICP, Mutual Information. Accuracy measurements and error estimation.

4. Clinical applications of navigation.
Examples of applications in neurosurgery, orthopedic surgery and traumatology, training of clinical staff, acquisition and fusion of ultrasound, radiotherapy ...

5. Detection and improvement of workflow in surgery.
Algorithms for estimation of workflow in surgery. Automatic analysis of video sequences.

6. Augmented reality in surgery.
Technical bases of augmented reality and virtual systems. Required hardware. Application development tools.

7. Laparoscopy and robotics in surgery. Device requirements in endoscopy. Surgical microscope. Use of infrared image in surgery.

8. 3D printing in the clinical setting.
Background on 3D printing. Printing technologies. From the image to the printed model. Utility of customized phantoms. Clinical applications.

9. Development tools in image-guided surgery.
Libraries and protocols: PLUS, OpenIGTLink .. 3DSlicer environment with Python. Development of specific modules.

LEARNING ACTIVITIES AND METHODOLOGY

AF3	Theoretical practical classes
AF4	Laboratory practices
AF5	Tutorials
AF6	Team work
AF7	Student individual work
AF8	Partial and final exams

Activity code	total hours number	presencial hours number	% Student Presence
AF3	134	134	100%
AF4	42	42	100%
AF5	24	0	0%
AF6	120	0	0%
AF7	248	0	0%
AF8	16	16	100%
SUBJECT TOTAL	600	184	30,66%

ASSESSMENT SYSTEM

% end-of-term-examination/test: 30

% of continuous assessment (assigments, laboratory, practicals…):   70

SE1	Participation in class
SE2	Individual or team works made during the course
SE3	Final exam

SE1 and SE2: 70%
SE3: 30%

Continuous Evaluation system (%)	Minimum weighting (%)	Maximum Weighting
SE1	0	20
SE2	0	100

BASIC BIBLIOGRAPHY

- Terry Peters; Kevin Cleary Editors Image-Guided Interventions: Technology and Applications, Springer, 2008

BASIC ELECTRONIC RESOURCES

- 3DSlicer . Slicer IGT: http://www.slicerigt.org/wp/

- Perklab . 3DSlicer BootCamp: https://github.com/PerkLab/PerkLabBootcamp/

- Rafael Moreta-Martinez, David García-Mato, Mónica García-Sevilla, Rubén Pérez-Mañanes, José A. Calvo-Haro, Javier Pascau . Combining Augmented Reality and 3D Printing to Display Patient Models on a Smartpho: https://www.jove.com/v/60618/combining-augmented-reality-3d-printing-to-display-patient-models-on