MICRO-518

Quantitative imaging for engineers

Andò Edward

Cursus	Sem.	Type
Civil Engineering	MA1, MA3	Opt.
Microtechnics	MA1, MA3	Opt.
Minor in Imaging	H	Opt.
Robotics	MA1, MA3	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	During the semester
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly
Number of positions	

Summary

This course will arm students with knowledge of different imaging techniques for practical measurements in many different fields of engineering. Modalities will range from drone imaging all the way down to x-ray microscopy with practical sessions

Content

This course will be given by Edward Andò (and possibly others) from the Center for Imaging over 14 weeks.
This course is essentially the same as CIVIL-510 but is now in the MICRO section.
The material covered will be roughly as follows:

- Introductory lecture: Images and measurements
- Image acquisition basics: sensors and optics
- Image quality basics: noise, blur, contrast
- Practical session 1: Microscope characterisation
- Object detection and characterisation
- Depth measurement: structured light, time of flight
- Practical Session 2: Building a 21st centry sandbox, projecting height map onto sand
- Practical Session 3: Drone flight to scan building on EPFL campus
- (x-ray) Tomography: acquiring and analysing 3D volume images
- Practical session 3: 3D evaluation of a concrete specimen on PIXE
- Advanced image analysis: tracking movement with image correlation
- Crack detection and characterisation

This will finish with a written, short-answer, exam

Keywords

- quantitative imaging
- image analysis
- drone imaging
- photography
- microscopy
- x-ray tomography

Learning Prerequisites

Required courses

- Physique générale : mécanique (PHYS-101) -- or equivalent
- Analyse I (MATH-111) -- or equivalent
- Géométrie (MATH-123(b)) -- or equivalent
- Algèbre linéaire (MATH-111) -- or equivalent

Important concepts to start the course

Matrix manipulation
Gaussian/Normal distributions
3D geometry

Learning Outcomes

By the end of the course, the student must be able to:

- Analyze an image-based measurement system
- Interpret quantitative image-based measurements
- Propose suitable image-based measurement tool for different practical problems
- Quantify measurement errors and their source

Transversal skills

- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.
- Collect data.

Teaching methods

The course is built around a number of lectures that will indroduce concepts related to quantitative imaging, which is the idea of using images (photography, microscopy, x-ray imaging, hyperspectral imaging) in order to make a precise measurement (of dimensions, deformations, structure).

There will be practical exercise classes, using examples from civil, mechanical and possibly even biomedical engineering, to cement the knowledge gained during the course.

Expected student activities

Attendance **and active participation** at lectures/excercise sessions
Attendance **and active participation** in practical sessions

Assessment methods

The final mark will be given based on a single final exam in week 14, which will be written and closed-book.
This exam will have no numerical questions, and instead be composed of numerous questions with short answers, which someone understanding the main points of the course should have no problem in passing

Resources

Moodle Link

- https://go.epfl.ch/MICRO-518