UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Physical Sensors and Systems for Environmental Imaging

2425-2-F9102Q021

Aims

The course aims to provide fundamentals of Remote Sensing techniques and applications for Earth Observation in the optical domain. The objective of the course is to teach students the basics of remote sensing using instruments on satellite, airborne, drone and ground-based set-ups. State-of-the-art semi-empirical regression and physical-based model inversion are discussed together with novel AI based approaches.

Contents

The course includes lectures about the fundamental concepts of Remote Sensing techniques applied to Earth Observation and Environmental monitoring. The processing and interpretation of imaging data to quantitatively study the Environment. The course includes applied remote sensing topics aimed at characterizing major Earth surfaces characteristics and processes (e.g., vegetation, snow, water, atmosphere).

Detailed program

REMOTE SENSING FUNDAMENTALS
• Physical principles for Earth Remote Sensing
• Remote sensing systems and resolutions
• Space missions and the Copernicus program
• Multispectral/Hyperspectral image representation and interpretation
• Multi-scale remote sensing (satellite, airborne, drone spectral imaging)

IMAGE PRE-PROCESSING
• Radiometric/spectral/geometric processing

• Atmospheric correction methods

STATE-OF-THE-ART AND AI-BASED IMAGE PROCESSING METHODS
• Digital imaging enhancement and statistical analysis
• Image classification (land use classification)
• Spectral indices
• Bio-geophysical parameters retrieval
• Thematic maps of environmental parameters

MULTI-SCALE GEOSPATIAL MAPPING APPLICATIONS
• Agriculture
• Forestry
• Inland water
• Geology

Prerequisites

Basic knowledge on physics, computer programming, mathematical and statistical analysis, usually acquired from Bachelor-level courses.

Teaching form

Frontal Lectures in English with slides in power point (Instructional teaching, 4CFU)
Computing Laboratory (Interactive teaching, 2 CFU)
Although not strictly required, attendance to the lectures and practical sessions is strongly recommended. Lectures will be generally held in presence, unless further COVID-19 related restrictions are imposed.

Textbook and teaching resource

• Shunlin Liang, Xiaowen Li and Jindi Wang (2012) Advanced Remote Sensing: Terrestrial Information Extraction and Applications. [S.l.]: Academic Press.
• An Introduction to Statistical Learning. Robert Tibshirani
• Hands-On Machine Learning with Scikit-Learn, Keras, and Tensorflow: Concepts, Tools, and Techniques to Build Intelligent Systems. O'Reilly
• Slides, scientific manuscripts and handouts are available on the course website

Semester

First

Assessment method

ORAL EXAM AND PROJECT WORK
The student develops a practical project based on the course topics on an environmental application. The oral examination consists in a discussion of the project and an assessment of the theoretical foundations knowledge.

The final grade will be determined by:
-the evaluation of the discussion of the project work
-the evaluation of the knowledge of the different topics covered during the frontal lessons and the laboratory

Office hours

Via appointment by email.

Sustainable Development Goals

QUALITY EDUCATION | GENDER EQUALITY | DECENT WORK AND ECONOMIC GROWTH | INDUSTRY, INNOVATION AND INFRASTRUCTURE