UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Signal and Imaging Acquisition and Modelling in Environment

2425-1-F9102Q017

Aims

Provide core knowledge and skills for signal and imaging acquisition and analysis methods in the environment. Teach how to analyze high resolution images acquired via remote sensing with a complex apparatus (telescope, satellite, hyperspectral cameras, etc.) and how to identify their features using ML/AI methods.

Contents

Basic theory of signal and imaging detectors, statistics and signal to noise ratio optimization, identification of sources and signals in noisy data. Analysis of time series and imaging data with ML methods (e.g. random forest classifier/regressors, self organizing maps, deep learning methods) using Python. Forecasts and tests of ML predictions.

Detailed program

- Operation and characterization of imaging detectors (focusing on optical CCDs), description of the calibrations needed.
- Characterization and description of other detectors for remote sensing of the environment.
- Statistics of photon counting experiments, noise and background sources, techniques for the detection of signals above the noise.
- Data handling packages in Python language, brief description of data visualization methods and ML implementations.
- Hands-on projects will be proposed where the students will learn how to extract relevant data and images from multi-petabyte catalogs and how to analyze them.
- Acquire imaging data from Bicocca Telescope and use ML with the aim to identify and characterize sources

in the sky and the effects of light pollution.

Prerequisites

Classes of the first semester

Teaching form

Lectures followed by hands-on sessions. The students will use their laptop in the classroom. Coding and analysis platforms will be accessible through the GMail account of the Bicocca campus (Google Colab).
All activities will be in English.

Textbook and teaching resource

Relevant material will be provided via handouts.

Semester

Second semester.

Assessment method

Written individual scientific report on the activities performed in the lab and oral exam on the topics presented in the lab and discussed during the lessons.

Office hours

By appointment (via email).

Sustainable Development Goals