UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Vision for Industry and Environment

2324-1-F9102Q029-F9102Q030M

Aims

The course presents the theoretical foundations, application scenarios, and practical use cases for the design of vision systems for industrial and environmental monitoring by using AI approaches. After the course, the students will have the ability to analyze, design, measure, compare, and test such systems as well as determine the extent to which the system can function in a non-ideal setting.

Contents

The course includes a theoretical part and a practical part. The theoretical part presents the overall framework of vision systems for industrial and environmental monitoring, the algorithmic and AI methods and techniques used in each step of the system, and the relevant application scenarios. The practical part provides the students the skills to analyze, design, and implement the algorithms used in the considered systems.

Detailed program

- Image acquisition: image formation (sensor, pinhole, lens), lighting and sensor characterization (color, exposure, speed), vision in industry and environment (contactless monitoring, industrial cameras, non-ideal settings).
- Pattern recognition for vision systems: AI for image preprocessing (quality analysis, enhancement), segmentation (object detection, semantic segmentation, pixel-level annotations), 3D reconstruction (multiple-views, structured light), 2D/3D feature extraction (handcrafted, representation learning), classification and regression (nearest neighbor, neural networks, convolutional neural networks).
- Industrial monitoring: AI for vision-based monitoring of manufacturing process (detection of machinery fault, detection of tool defects, guidance of assembly lines), analysis of raw materials (volume estimation,

granulometry measurement), product quality control (surface defects detection, assembly errors, predictive maintenance), virtual sensors (vision-based depth estimation, synthetic environments), human safety monitoring (person tracking, incident detection).
- Environmental monitoring: AI for processing images captured using centralized vision (detection of fire and smoke, flood and drought, landslides, structural health monitoring), monitoring using images acquired with distributed vision (crop condition analysis, wildlife monitoring, traffic monitoring, vehicle accident detection, waste and illegal drop-off detection).

Prerequisites

Fundamental concepts of computer science, computer programming, image processing, and machine learning.

Teaching form

Lectures and assisted exercises. Lessons will be held in presence, unless further COVID-19 related restrictions are imposed. Attendance to both lectures and exercises is warmly recommended.

Textbook and teaching resource

- Mohamed Elgendy, Deep Learning for Vision Systems, Manning, 2020. ISBN: 9781617296192.
  https://github.com/moelgendy/deep_learning_for_vision_systems
  http://www.computervisionbook.com/
- Slides and handouts are available on the course website.

Semester

Second semester.

Assessment method

The exam includes a practical part and an oral part. The practical part consists in a practical project, agreed in advance with the lecturer, on the use of the course topics in a practical application. The oral part consists in a discussion of the project and an assessment of the knowledge of the theoretical foundations of the application area considered in the project. The grade will reflect both parts and is expressed in thirtieths.

Office hours

Via appointment by email.

Sustainable Development Goals

QUALITY EDUCATION