Univerza v Ljubljani
Fakulteta za elektrotehniko

Computer Vision
01a - Introduction

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University of Ljubljana

Today's schedule

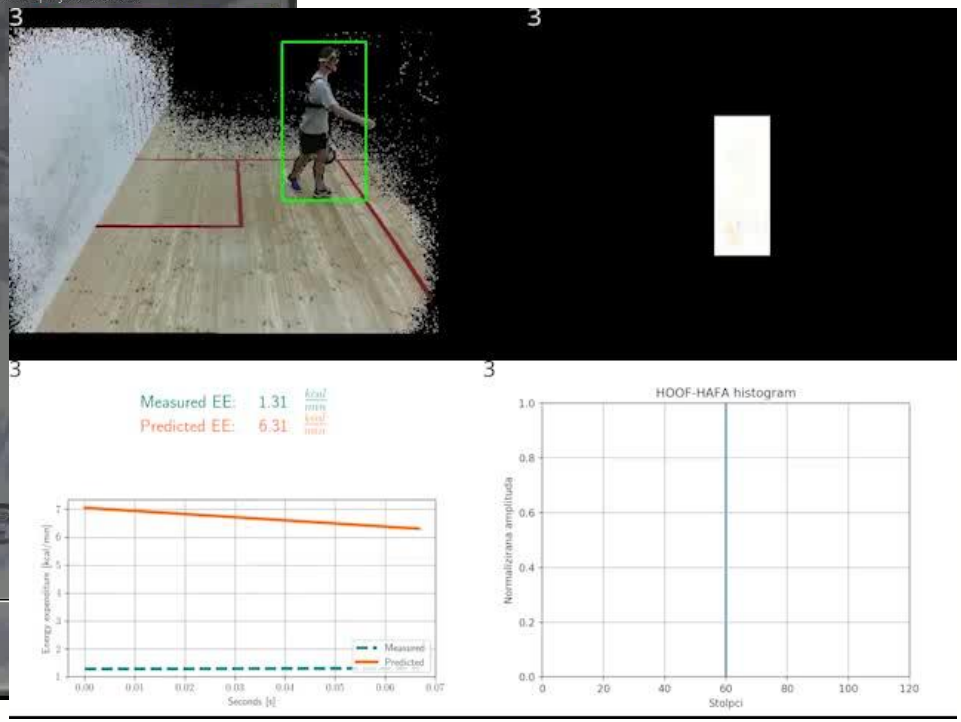
- My introduction
- Your introduction
- Computer vision course
  - Short overview of the course
  - Prerequisites for students (knowledge, skills)
  - Course structure
    - Lectures, lab work, exams, grading
- Origins & use of computer vision today
  - As a motivation!

Your lecturer

- Janez Perš, email: janez.pers@fe.uni-lj.si
- Office hours
  - by appointment (best by email): anytime
- My classes this year:
  - Computer Vision (basic),
    - 1st year of 2 year MSc programme, winter semester
  - Imaging Technologies (advanced)
    - 2nd year of 2 year MSc programme, winter semester
  - Embedded systems
    - 1st year of 2 year MSc programme, summer semester
  - Machine Vision (PhD course)
    - 1st year of 3 year PhD programme, winter semester

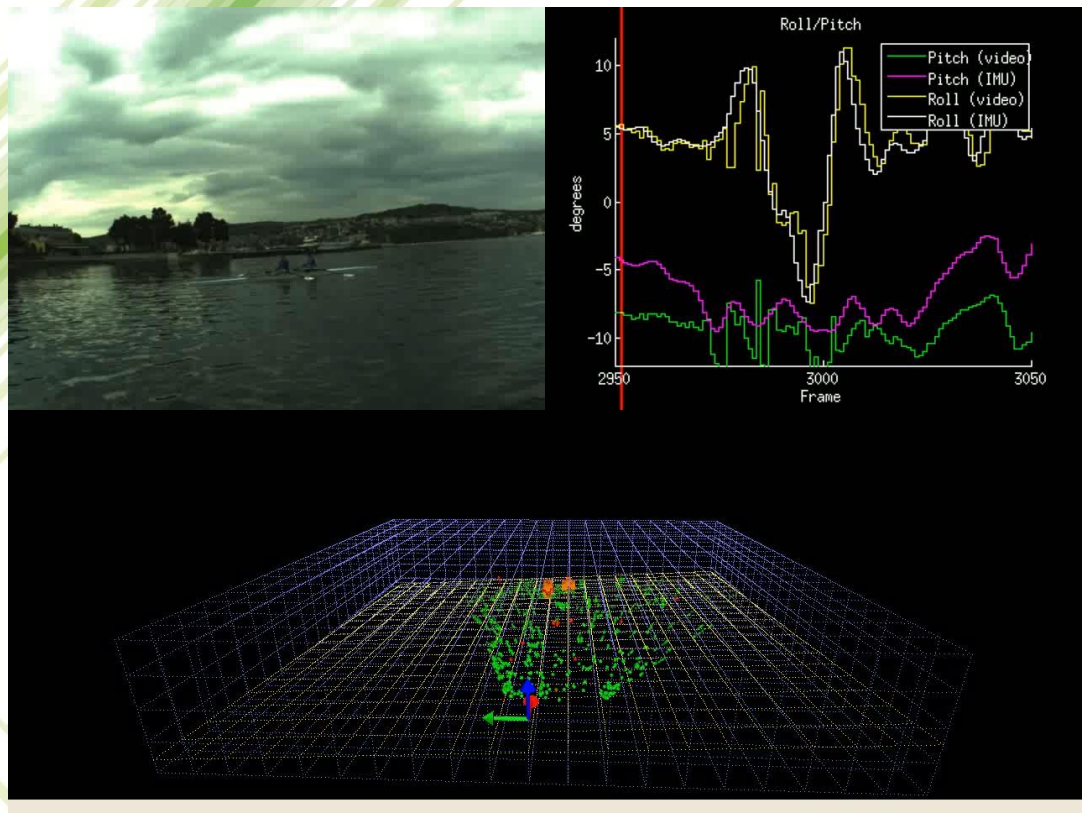
Your lecturer

- My primary area of work is computer vision
  - Analysis of human motion



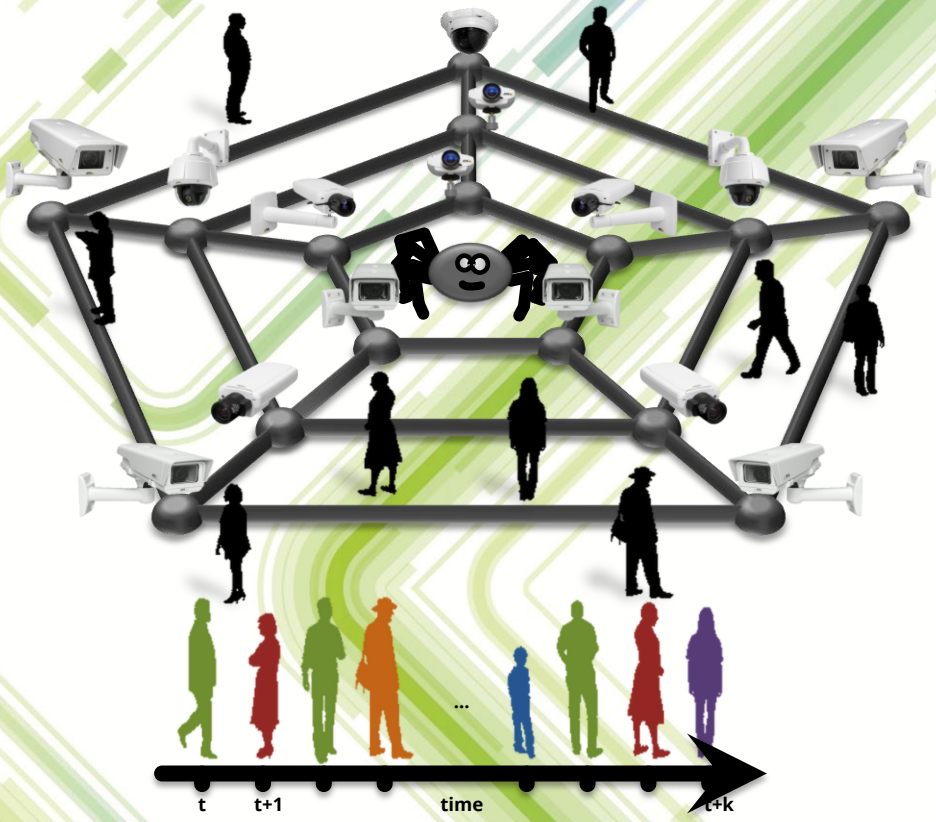
Your lecturer

- My primary area of work is computer vision
  - Robot vision, mainly Unmanned Surface Vehicles (USV)



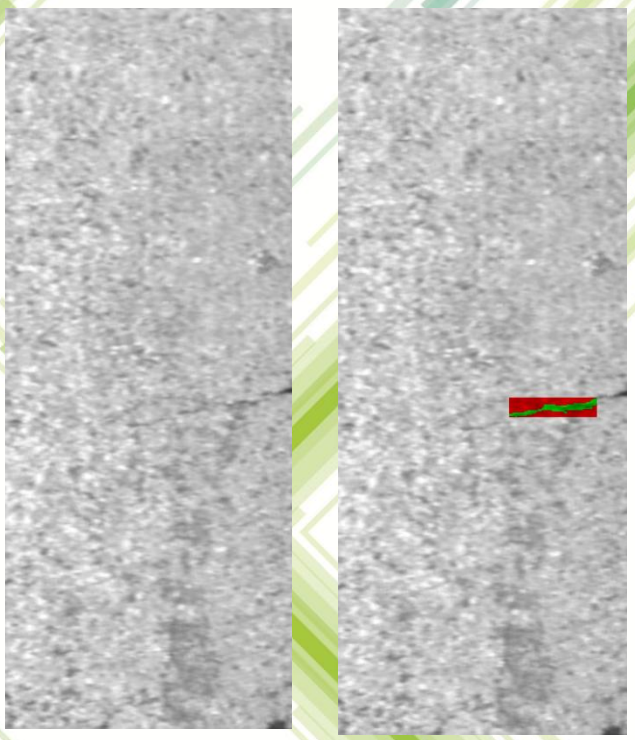
Your lecturer

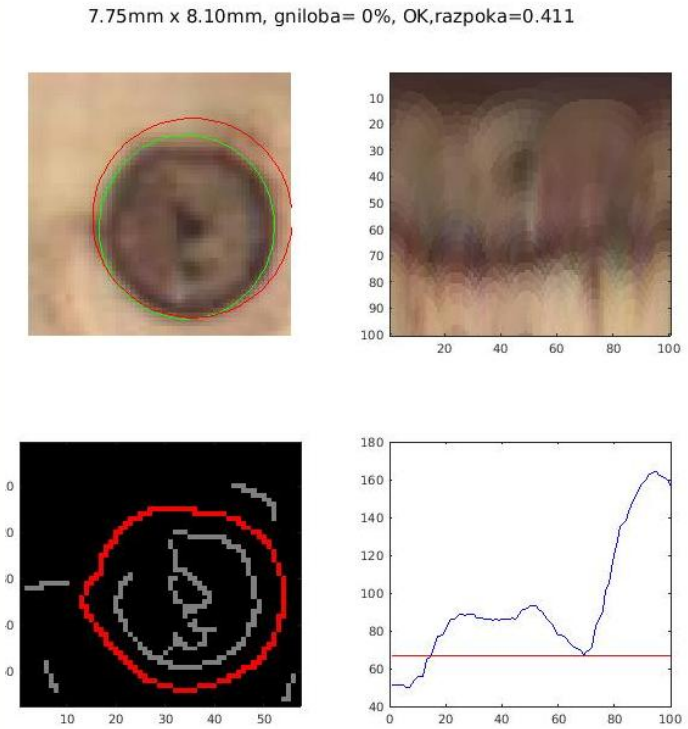
- My primary area of work is computer vision
  - Visual sensor networks (embedded camera networks)



Your lecturer

- My primary area of work is computer vision
  - Industrial vision & visual inspection (machine vision)





Our laboratory

- "Machine vision laboratory"
  - This was our previous laboratory, which ceased to exist 2017.
- "Laboratory for Machine Intelligence"
  - This is the new laboratory, created by joining
    - Machine Vision Laboratory (above) http://vision.fe.uni-lj.si
    - Laboratory of Artificial Perception, Systems and Cybernetics http://luks.fe.uni-lj.si
- So my official affiliation is "Laboratory of Machine Intelligence"
- But signs (doors, lab, etc) may say "Machine vision Laboratory"

In our lab, you will probably meet

- doc. dr. Janez Perš (lecturer)
- prof. dr. Boštjan Murovec (lecturer)
- Marko Gorjanc (technician)
- Prof. dr. Simon Dobrišek,
- prof. dr. Vitomir Štruc
- Janez Križaj, Klemen Grm, Martin Pernuš

The students

- 27 students from University of Ljubljana
- 16 Erasmus exchange students
- 3 hours per week English lectures
- 3 hours per week Slovenian lectures
- 2 hours of labs per week
  - 3 Slovenian groups, one English

- Several emails from Erasmus students
  - Will spend some time today for questions / answers

Computer Vision course

- 6 ECTS
  - 1 ECTS = 25-30 hours of student work
- This is basic class in computer vision
- Intended for students that want to learn basics of computer vision, such as:
  - Digital image basics (grayscale/RGB)
  - Camera geometry and camera calibration
  - Colors and color spaces
  - Edge detectors, thresholding, Hough transform
  - Morphological operations, blob features
- Let's talk about this…

Aims and goals of the course

- To cover
  - basic concepts,
  - underlying theory and
  - algorithms of computer vision.
- To develop
  - critical view how and where CV is used and
  - how and where it can or should be used.

Aims and goals of the course

- To prepare students for R&D* in academia and/or industry.
- To be able to solve basic computer / machine vision problems.
- To be able to implement basic computer / machine vision algorithms.

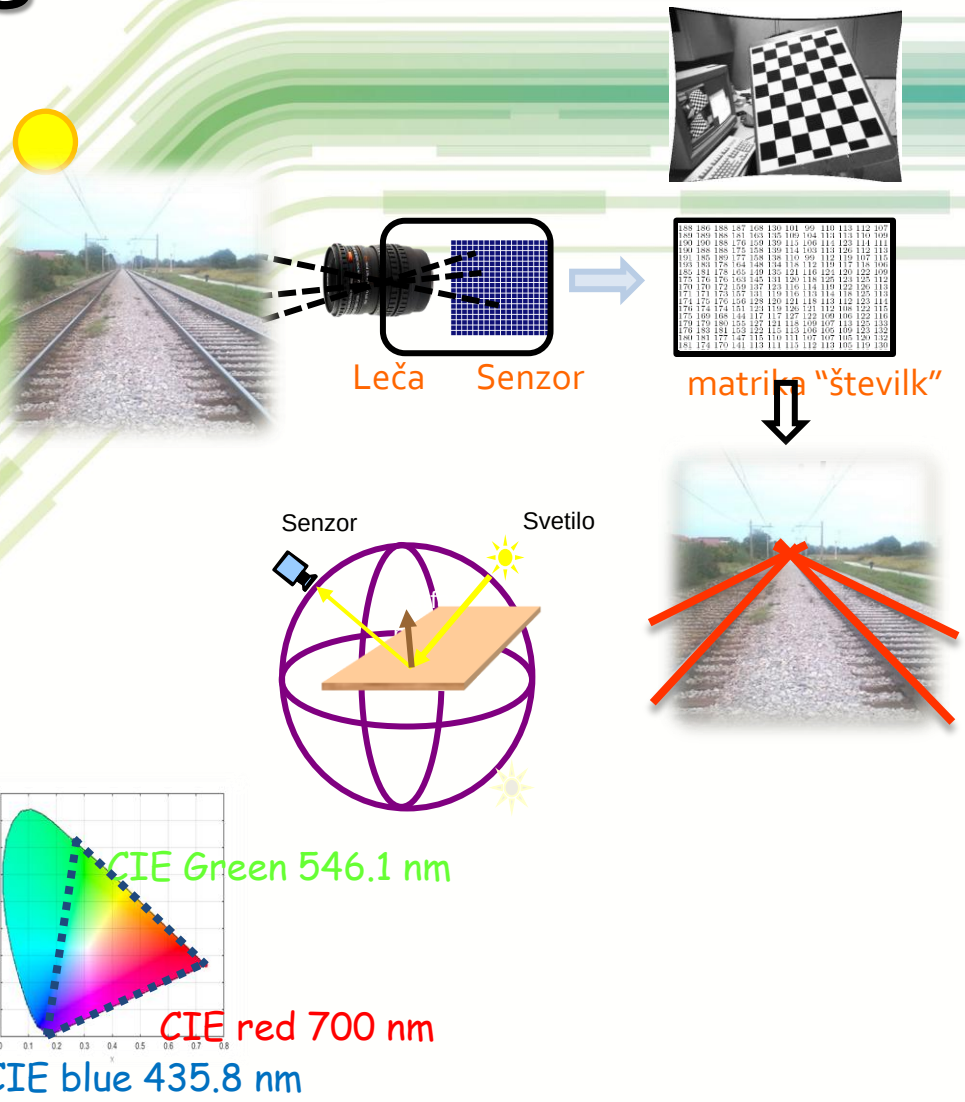
*R&D = Research and development!

Contents of the course

- Image formation
- Image analysis
- Stereo vision
- Motion

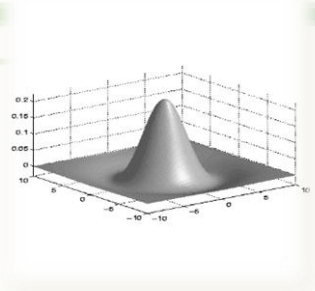
Part I: Image formation

- Perspective projection camera model
- Camera calibration, direct linear transform, lens distortion correction
- Propagation of light, photometry, photometric lens equation.
- Cameras and lenses, lighting techniques
- Human eye, color perception, reproducing color, color spaces.

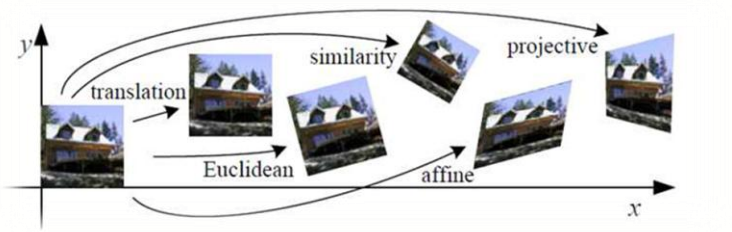


Part II: Image analysis

- Image filtering, histogramming
- Edge detection, corner detection
- Hough transform
- Connected components analysis
- Morphological filtering
- Active contour models (snakes)
- Shape description
- Scale space and image pyramids
- Geometric image transformations, similarity measures
- Image registration, model fitting, RANSAC



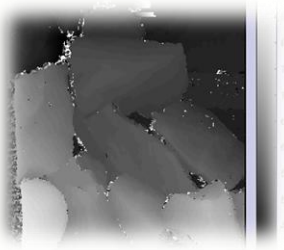
Model (line) fitting

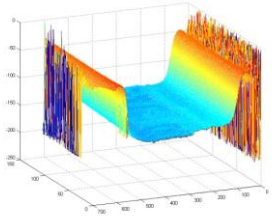


Part III: Stereo and 3D vision

- Basic concepts of stereo vision
- Stereo matching
- Modeling and calibration, epipolar geometry
- Active stereo, structured lighting

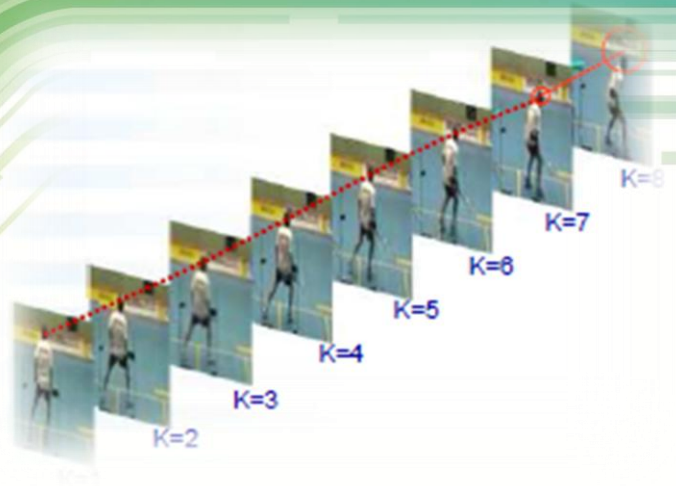


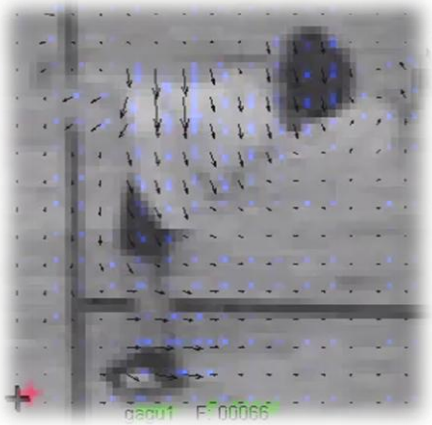





Part IV: Motion

- Motion detection
- Time to collision
- Optical flow, motion field, velocity field
- Visual tracking, Kalman filtering





Prerequisites for this course

- Basic programming skills
- Basic familiarity with Matlab
  - We will use it for the lab work
  - Familiarity with GNU Octave counts as well
  - If not, I can suggest literature/exercises to catch up before the labs start.
- For Erasmus students:
  - This is basic course in Computer Vision
  - If you are already familiar with Computer Vision then perhaps consider Imaging Technologies (advanced topics)

Course structure

- Lectures
  - ENG: Each Tuesday, 10.15 - 13.00
  - SLO: Each Wednesday, 8.15-11.00
- Lab work (RLSV classroom, elevator to M4!)
  - See the official timetable at http://wise-tt.com/wtt_fe/ !
- Note
  - Lab *attendance* mandatory (prerequisite for exams)
  - *Completion of lab work* is mandatory (prerequisite for exams)

Course: additional hours

- Assignments from previous year exams
- Students often:
  - Don’t understand what will be at the written exam
  - Underestimate the written exam
- So we will have extra hours
  - We will solve actual (!) exam assignments from previous years
  - Students, in front of the blackboard
  - I will help, no wories!
  - The idea: you will learn how to prepare for an exam.
- These hours will be announced via STUDIS

Grading

- Lab work (40% of the grade)
  - Five assignments. Attendance mandatory.
  - One grade = average of all assignment grades
  - Lab work not completed = no right to sit the exam
- Written exam (40% of the grade)
  - Computer vision algorithms on extremely small “images”
  - Calculations (camera geometry, interpolation, etc)
- Oral exam (10% of the grade)
  - Ensuring that you understand what you did in the written exam
- Lecture attendance (10% of the grade)

Lecture attendance

- Lectures at University of Ljubljana are not mandatory.
  - However, my experience shows that the attendance is beneficial.
- Last year: 3 short exams during the lectures.
  - Student feedback: “Exams were easy, by attendance alone you could gather those points”
  - So we are making it official!
- There are about 12 weeks of lectures
  - Each attendance adds 1% point to your final grade, max 10%
  - Consequence: if you never attend lectures your max grade is capped at 9!

Questions?