

3D Computer Vision

<https://cv.inf.elte.hu/>

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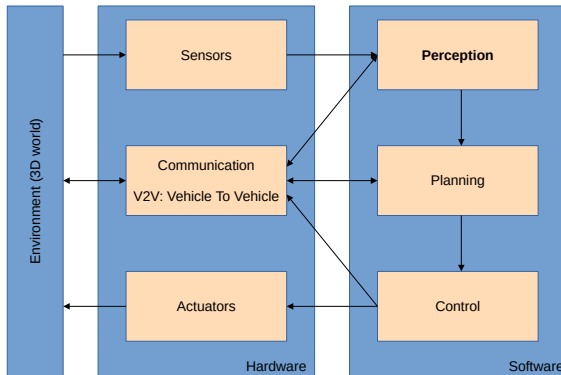
2024 fall (2024-2025-1)

Motivation 1/2

- 3D vision is a very important domain within computer engineering/science
 - Tasks are usually very challenging
 - Results are very spectacular
 - Needs both high theoretical and practical skills
- Several sensors can be connected to computers, we apply here
 - digital camera images and
 - point clouds recorded by 3D Lidars

Motivation 2/2

System Overview of an Autonomous Vehicle



Subject Overview

- Goal: overview of (i) (basic) 3D vision and (ii) point cloud processing methods
- We also need knowledge in estimation theory.
- Geometric problems
 - Least-squares fitting (inhomogeneous/homogeneous problems)
 - Robust fitting → Outlier filtering
- Point Cloud Processing
 - Plane fitting
 - Sphere fitting (?)
- Introduction to Computer Vision
 - Camera models, Projections, Single-view vision, stereo vision, multi-view vision

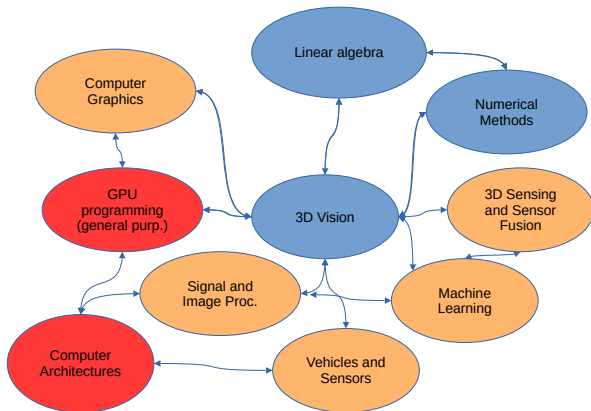
3D Vision Content – Lecture

- Introduction to estimation theory
 - Homogeneous/inhomogeneous linear systems
- Robust estimation (RANSAC method)
- Transformations, projections
- Homography: definition, estimation, applications
- Camera calibration
- Stereo vision
 - Theoretical background
 - Fundamental/essential matrices, their estimations
 - Planar motion (vehicle-mounted cameras)
- Multi-view reconstruction
 - Bundle Adjustment
 - Tomasi-Kanade factorization
- Special hardwares for 3D vision

3D Vision Content – Practice

- Demonstration of sensors
- Affine transformations
- Pinhole camera model
- Robust fitting, multi-model fitting
- Homography estimation: panoramic images
- Camera Calibration
 - using 3D object
 - or chessboard pattern
- Stereo Vision: 3D Reconstuction
- fundamental mtx estimation, essential decomposition, triangulation
- 3D Reconstruction by weak perspective camera model
 - Tomasi-Kanade factorization

Related Subjects



3DVision Teachers

- Levente Hajder
- Tamás Tófalvi
- Tarlan Ahadli



3DVision Demonstrators

- Máté Poór
- Muhammad Rafi Faisal



Our forums

- Canvas <https://canvas.elte.hu>
 - Materials
 - Assignments
- Webpage <https://cv.inf.elte.hu>
 - Under construction
 - <https://cv.inf.elte.hu/index.php/education/3d-computer-vision/>
- Teams
 - It will be created next week.

3D Vision Requirements

- Lecture
 - Oral exam in examination period
 - Topics will be published before exam-period
- Practice
 - Three assignment in termtime
- Combined mark is given: 50-50% from oral exam and assignment
 - 40-40% should be received for both oral exam and assignments
- Final grade
 - 5 (excellent): $\geq 85\%$
 - 4 (good): 70 ... 84 %
 - 3 (satisfactory): 55 ... 69 %
 - 2 (pass): 40 ... 54 %
 - 1 (fail): $< 40\%$

First (Irregular) Practice

- Demonstration of our vehicles and sensor-kit
- We gather at the 'Danube entrance' of South Building
 - Wednesday, 11th September, 17:45

