Computer vision

Credits: 5 Semester 1 Compulsory: No

Format	Lectures 24h	Tutorials/examples 16h	Private study 85h

Lecturers: W.Kasprzak (WUT), P. Martinet (ECN), F. Solari/S. Sabatini (UNIGE), F. Pla (UJI)

Objectives:

This course presents the fundamentals in computer vision. Topics include camera modelling, camera calibration, image processing, pose estimation, multi view geometry, visual tracking, and vision based calibration.

Contents:

Image formation and auto-calibration. Low-level image processing: image normalization, colour spaces, image compression and image filtering. Image segmentation: edge detection, chain and line segment detection, Hough transforms, homogeneous region-, shape- and texture description. Object classification: the potential functions-, Bayes-, k-NN, SVM- and MLP- classifiers. Object recognition: dynamic programming, hypothesis generation-and-test, model-to-image matching and graph search. Image motion estimation: gradient- and block-based optical flow, discrete feature motion and active contour tracking. Camera technology and vision sensor, Camera model (pinhole, omnidirectional, fisheye, …), Visual geometry, Pose estimation (DeMenthon, Lowe…), Multi view geometry (homography, epipolar geometry, …), Visual tracking, calibration (camera, robots…), Computer vision applications, Computer vision tools

Practical Work: Exercises will involve image processing, multi view geometry, camera calibration, pose estimation, visual tracking, Face recognition.

Abilities: The students will be able to:

Know the different image processing methods,
Understand the different properties of images, cameras and geometry
To select the image processing method for the specific purpose.
Process the images for the purpose of getting the required information.
To use the vision for objects recognition and robot localization and guidance
Understand practical applications of the mathematical modelling of visual geometry

Assessment: 30% continuous assessment, 70% from end-semester examination

Recommended texts:

- I. Pitas, *Digital Image Processing Algorithms*, Prentice Hall, New York, 1993.
- O. Faugeras, *Three-dimensional computer vision. A geometric viewpoint*, The MIT Press. Cambridge, Mass. 1993, ISBN: 0262061589
- Richard Hartley, Andrew Zisserman, *Multiple View Geometry in Computer Vision*, Barnes&Nobles, 2nd edition 2004 , ISBN-10: 0521540518
- Quang-Tuan Luong, Olivier Faugeras, *The Geometry of Multiple Images- The Laws That Govern the Formation of Multiple Images of a Scene*, MIT Press, March 2001, ISBN: 0-262-06220-8
- T S Huang, *Multiple Calibration and Orientation of Cameras in Computer Vision*, Springer, 2001, ISBN: 3 540 65283 3
- Yi MA, Stefano Soatto, Jana Kosecka, S. Shankar Sastry, *An invitation to 3D vision: from images to geometric models*, Springer, 2004, ISBN 978-0-387-00893-6
- Gari Bradski, Adfrian Kaebler, *Learning OpenCV: Computer vision with openCV library*, O'Reilly Media, 2008, ISBN: 978-0-596-51613-0

Further readings: will be provided by lecturer