IMA4509 Visual content analysis

Period: S8 / P4 **ECTS:** 4 **Language:** English

Organization:

- Teaching Load / Total Load: 45/90
- Lectures/Exercices/Labs/Final Exam 1: 36/0/9/0

Objectives:

- To master the core techniques for low-level image & video analysis as a preliminary step to interpretation and content-based access.
- To understand related technological challenges and gain insight into emerging application issues.
- To turn into practice computer vision applications (*e.g.* human motion analysis, object detection, scene activity monitoring…) by means of image & video analysis, exploiting the industry-standard Matlab® platform capabilities.

Reference to CDIO Syllabus:

1.3 Advanced engineering fundamental knowledge, methods and tools
2.1 Analytical reasoning and problem solving
2.2 Experimentation, investigation and knowledge discovery
3.2.3 Written communication
4.7.1 Thinking creatively and imagining possibilities

Keywords:

Visual feature extraction; denoising, enhancement & restoration; segmentation & grouping; motion estimation & tracking; shape analysis.

Prerequisites:

None

Course outline:

- Digital imaging products, vision (sub)systems and visual media-based services: current industrial issues and technological challenges of image & video processing and understanding
- Image & video analysis: paradigms and models
  - Computational vision paradigms: hierarchical processing, low/mid/high-level vision, visual features, Gestalt principles
  - Image & video models: functional, stochastic, statistical, algebraic
- Still image analysis
  - Characterizing and exploiting global image properties: histogram techniques, frequency filtering
  - Extracting image local geometry: edge and corner detection
  - Binary and grey-level mathematical morphology
  - Inverse problems in image analysis: deterministic and stochastic regularization

- Deterministic image segmentation: variational methods and graph cuts
  - Active contours and level set methods
  - The Mumford-Shah model, deterministic & statistical region competition, multi-feature variational segmentation
- Scale-space and PDE image filtering
- Bayesian methods, Markov Random Fields
- Texture modeling and analysis

- Video analysis
  - Motion measurement and optical flow estimation
  - Spatio-temporal segmentation and object tracking

Assessment:

The assessment pattern involves 3 components: continuous evaluation via homework on selected topics (”coursework”) (CW), lab assignments (L), and a two-student group written final exam (E). The final grade is a weighted average of individual component grades. The 2nd session consists of a study with an oral defense (O).

- 1st session = Weighted Average (CW, L, E)) (S1)
- 2nd session = O (S2)
- Final grade = Max (S1, S2)

Learning materials and literature:

Learning materials: Documentation provided by lecturers

Literature:

- A. Bovik (Ed.). *Handbook of Image & Video Processing*. Academic Press, 2000
- L.G. Shapiro and J-C. Stockman. *Computer Vision*. Prentice Hall, 2001
- E.R. Davies. *Machine Vision: Theory, Algorithms, Practicalities*. Academic Press, 1997
- R. Jain, R. Kasturi and B.G. Schunck. *Machine Vision*. McGraw-Hill, 1995

Person in charge:

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Lecturers:

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