Welcome to Advanced Image Analysis – 02506 Spring 2024

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DTU Compute

Advanced Image Analysis

January 2024

Course aim

Image analysis

- Analysis – quantify structures that are measured by imaging system
- This course will
  - introduce you to some methods in image analysis
  - give you an approach for solving image analysis problems
  - allow you to implement analysis methods
- You will get general competences within quantitative image analysis
  - identify problem
  - find relevant method
  - structured approach for carrying out experiment

Course instructors





People

- Course responsibles:
  - Professor Anders Bjorholm Dahl – abda@dtu.dk – building 324, room 113
  - Associate professor Vedrana Andersen Dahl – vand@dtu.dk – building 324, room 120
  - Researcher Hans Martin Kjer as guest lecturer – hmkj@dtu.dk – building 324, room 120
- Teaching assistants
  - Jakob Lønborg Christensen – jloch@dtu.dk
  - Andreas Abildtrup Hansen – andab@dtu.dk

What to learn

- Central topics in image analysis including feature and texture representations, image segmentation and classification, geometric models, and deep learning in image analysis
- Implement advanced image analysis methods using Python
- Scientific reading

Course structure

- Lecture introducing the topic: Wednesdays 13.00 - approximately 14.00
- Exercise: Wednesdays 14.15 - 17.00
- TAs will be available from 15.00
- Lectures and exercises – Auditorium 13, Building 308

Lectures

Plan

1. Introduction and small exercises (Anders & Vedrana)
2. PART I – Exercise on scale-space blob detection (Anders)
3. PART I – Feature-based registration (Hans Martin Kjer)
4. PART I – Feature-based segmentation (Anders)
5. PART II – Markov Random Fields (Vedrana)
6. PART II – Deformable models (Vedrana)
7. PART II – Geometric analysis (Vedrana)

Lectures

Plan

8. Part III – Multi-layer perceptron classification (Anders)
9. Part III – Convolutional neural networks (Vedrana)
10. Part III – Quantitative analysis with neural networks (Vedrana & Anders)
11. Part IV – Project work (Vedrana & Anders)
12. Part IV – Project work (Vedrana & Anders)
13. Part IV – Project pitches (Vedrana & Anders)

Relation to other courses

Introductory courses

- 02502 Image analysis (5 ECTS, spring and fall semesters)

Specialized courses

- 02509 High-Performance Computing for Analysis of Experimental 3D Imaging Data (10 ECTS, spring semester)
- 02510 Deep Learning for Experimental 3D Image Analysis (5 ECTS, spring semester)
- 22525 Medical image analysis (5 ECTS, fall semester)

Advanced courses

- 02504 Computer vision (5 ECTS, spring semester)
- 02516 Introduction to deep learning in computer vision (5 ECTS, 3-week, January)
- 02501 Advanced deep learning in computer vision (5 ECTS, 3-week, June)

Course execution

Information and material

- All information and material avaliable or referenced on DTU Learn
- Open course homepage: `http://www2.compute.dtu.dk/courses/02506/`
- Note with exercise descriptions and supporting explanations to the reading material
- Last years material is available – samte topics so still relevant
- Change with more hints for soluitions in Python and more supporting code
- Weekly updates of course note just before lecture
- Expect to write much code and become experienced in Python for advanced image analysis

Exercises

Exercises

- Described in the lecture note *Advanced Image Analysis – Selected Topics* available on DTU Learn
- Exercise feedback:
  - Ask the TAs during exercises
  - Solutions will be made available
  - Quizzes to be handed in (optional)

Exercises

Doing exercises

- Exercises: In groups of 2-3 persons
- Why groups?
  - You will learn from each other
  - You will need to discuss the exercises
- Carrying out the exercises is core to your learning – basis for exam
- Quizzes will reflect for format of the written exam

Exam

Procedure

- Written exam on the 30th of May
- Multiple choice
- Tasks similar to exercises and quizzes. Old exams are available.
- Grade based on the 7-scale

Preparation for exam

- Carry out the exercises!
- Take active part of the lectures – ask questions and discuss
- Read the reading material!

Exercise

Three small exercises and optionals

- Image convolution
- Boundary length – fuel cell segmentation
- Curve smoothing – object boundary
- Exercise description: `https://learn.inside.dtu.dk/d2l/home/145388`