Digital Image Processing

Part 0: General Introduction

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0 General Introduction – Teaching Staff

Teachers

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- Marco Trincavelli
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Lab Assistant

- Todor Stoyanov
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Some Course Administration ...
0 General Introduction – WWW

Course Web Page

http://aass.oru.se/Research/Learning/courses/dip/2011/

- download lecture presentations
- announcements → check regularly!
- errata
Lectures

? [week 13: Tue, Mar 29, 2011, 15:15 - 17:00 o'clock, T111]
1. week 13: Thu, Mar 31, 2011, 10:15 - 12:00 o'clock, T127
2. week 14: Tue, Apr 5, 2011, 15:15 - 17:00 o'clock, T111
3. week 14: Wed, Apr 6, 2011, 10:15 - 12:00 o'clock, T127
4. week 15: Tue, Apr 12, 2011, 15:15 - 17:00 o'clock, T111
5. week 15: Thu, Apr 14, 2011, 10:15 - 12:00 o'clock, T127
6. week 16: Mon, Apr 18, 2011, 10:15 - 12:00 o'clock, T129
7. week 16: Tue, Apr 19, 2011, 10:15 - 12:00 o'clock, T129
8. week 17: Tue, Apr 26, 2011, 15:15 - 17:00 o'clock, T111
9. week 17: Thu, Apr 28, 2011, 10:15 - 12:00 o'clock, T127

blue = lecture given by Todor Stoyanov
0 General Introduction – Schedule

Lectures

10. week 18: Tue, May 3, 2011, 15:15 - 17:00 o'clock, T111
11. week 18: Thu, May 5, 2011, 10:15 - 12:00 o'clock, T127
12. week 19: Tue, May 10, 2011, 15:15 - 17:00 o'clock, T111
13. week 19: Thu, May 12, 2011, 10:15 - 12:00 o'clock, T127
14. week 20: Tue, May 17, 2011, 15:15 - 17:00 o'clock, T111
15. week 20: Thu, May 19, 2011, 10:15 - 12:00 o'clock, T127
16. week 21: Tue, May 24, 2011, 15:15 - 17:00 o'clock, T111

- blue = lecture given by Todor Stoyanov
- green = lecture given by Marco Trincavelli
Grading – Theory

- passed (G) = ?
  - you understood the course content
  - you are able to explain the basic image processing techniques

- top student (VG) = ?
  - you can apply image processing techniques out of the original context
  - you are able to decide which of a set of possible approaches is most suitable for a given task

- outstanding students (VG) = ?
  - you are able to read and critically review research papers
  - you can reproduce approaches described in contemporary scientific literature
0 General Introduction – Examination

- Grading – Praxis
  - labs x 4
    - all need to be passed
0 General Introduction – Examination

- Grading – Praxis
  - labs x 4
    - week 14: Thu, Apr 7, 2011, 13:15 - 17:00 o'clock, T120
deadline for report: Thu, Apr 14, 2011
    - week 17: Thu, Apr 28, 2011, 13:15 - 17:00 o'clock, T120
deadline for report: Thu, May 5, 2011
    - week 18: Thu, May 5, 2011, 13:15 - 17:00 o'clock, T120
deadline for report: Thu, May 12, 2011
    - week 20: Thu, May 19, 2011, 13:15 - 17:00 o'clock, T120
deadline for report: Thu, May 26, 2011
0 General Introduction – Examination

- Grading – Praxis
  - labs x 4
    - all need to be passed
    - assignments that are well-done give extra points for the exam
    - how many?
      - 1/20 of the exam per lab
      - exam with 100 points → max. extra 20 points from the labs
General Introduction – Examination

Grading – Praxis

- labs x 4
  - all need to be passed
  - assignments that are well-done give extra points for the exam
    - 1/20 of the exam per lab
  - what is well-done?
    - clear in its form
    - individual solutions
    - you can answer questions regarding your solution
    - submission in time
      → no extra points if submission is late

NOTE: no assignments will be accepted more than 3 days late!
Grading – Praxis

- labs x 4
  - all need to be passed
  - assignments that are well-done give extra points for the exam
    - 1/20 of the exam per lab
  - what is well-done?
    - clear, individual, in time
  - who assigns the points?
    - the lab assistant (Todor)
  - can one split the extra points within the group?
    - no
0 General Introduction – Extra Points

- Labs ...
  - ... are done in groups of two ...
  - ... randomly selected
  - so what if I end up with the "dumb guy"?
    - you have to work harder because you need to teach as well (= you will learn more)
  - what if I end up with the DIP superman?
    - you will have to work harder to catch up (= you will learn more)
  - works also the other way around ☺
0 General Introduction

Random Groups for the Labs

1. Alexander Sherikov, Muhammad Abdullah
2. Daniel Ricao Canelhas, Roberto Nanga Martinez
3. Asif Moinul Islam, Subrahmanyam Chebrolu
4. Mohammad Najafi, Kodanda Ramareddy Tadi
5. Santhi Priya Thamma, Sina Nakhostin
6. Irshad Ullah, Ramakrishna Patchamantla
7. Desislava Tsvetkova, Nima Behzad
8. Teodora Kokalova, Gergana Nacheva
9. Golnaz Nozari, Nushka Kehayova, Prakash Chandra Sekaran
0 General Introduction – Examination

- **Grading – Praxis**
  - labs x 4
    - all need to be passed
    - extra points for the exam possible (1/20 of the exam per lab)
  - exam
    - counts 100%
    - > 50% of the points to pass
    - example
      - exam has 100 points
      - you manage to get 43 points
      - → you pass with +15 points from the labs
### General Introduction – Examination

#### Grading – ECTS

- **labs x 4**
  - all need to be passed
  - extra points for the exam possible (1/20 of the exam per lab)

- **exam**
  - counts 100%
  - > 50% of the points to pass
  - another example
    - exam has 100 points, you have $63 + 15 = 77$ points

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<th>50 – 59</th>
<th>60 – 69</th>
<th>70 – 79</th>
<th>80 – 89</th>
<th>90 – 100</th>
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<td>&lt;50</td>
<td>50 – 74</td>
<td>G</td>
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<td>75 – 100</td>
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</tbody>
</table>
What will be in the exam?

- content defined by ...
  - ... the lectures
  - ... the labs
0 General Introduction – Examination

- When will the exam be?
  - week 22: Fri, Jun 3, 2011, 08:00 – 13:00 o'clock, room tbd
Collaboration and Cheating

- you may NOT share written work
- you may NOT use Google, or solutions to previous years' homework
- you must identify all your sources
  - I copied the first two advices from Lois von Ahn's course 15-251 on "Great Theoretical Ideas in Computer Science" and …
  - ... used an iconic image found using Google search ("cheating")
0 General Introduction – Interaction!

Feel Free to Ask Questions!
- image also from Lois von Ahn's course 15-251
0  General Introduction – Literature

Course Book

- Gonzalez Woods
  "Digital Image Processing"
  - 12 chapters, 954 pages (3rd edition)
  - "DIP/3e": 2008
  - ISBN: 9780131687288

- 12 chapters, 624 pages
- "DIPuM": 2004
- ISBN: 0130085197

- http://www.imageprocessingplace.com/
Additional Resources

- Joseph Bigun
  "Vision with Direction: A Systematic Introduction to Image Processing and Computer Vision"
  - 18 chapters, 396 pages
  - Springer; 1st edition, 2006
  - ISBN: 978-3540273226
0 General Introduction – Literature

Additional Resources

- Joseph Bigun
  "Vision with Direction: A Systematic Introduction to Image Processing and Computer Vision"
  

- Per-Erik Forssén
  "Visual Object Recognition"
  
  - Linköping, HT2008

- ...
Teaching Philosophy
0 Teaching Philosophy

- Quality of Learning?
  - result = "booksmart"?
  - did you make similar experiences?

- Good learning?
  - ability to apply knowledge
  - ability to solve problems

[Steve Hall, MIT]
Course Design to Achieve Good Learning Quality

- emphasis on learning activity (→ "deep learning")
  - to some degree in the lectures in the form of brief discussions
- less coverage, more self-study (outside the lectures)
- use of pictorial information to indicate the current context
- further structural design choices …
Your Approach to Achieve Good Learning Quality

- taking notes is a mnemonic technique!
- learning activities (also during the lectures)
- be aware how you learn
  - beyond memorizing the previous slide?

Approach to Achieve Good Learning Quality

- emphasis on learning activity (→ "deep learning")
  - in the lectures: group discussions, short presentations, ...
- less coverage, more self-study (outside the lectures)
- objectives in terms of learning outcomes
  - expectations should be clear
- aligned course design
  - objectives, learning activities, assessment
- assessment as an extension of the learning activities
  - course objectives and aims define the threshold for the grades
- use of pictorial information to indicate the current context
0 Teaching Philosophy

Your Approach to Achieve Good Learning Quality

- taking notes is a mnemonic technique!
- learning activities (also during the lectures)
- → be aware how you learn
  - beyond memorizing the previous slide?

Examples

- what was the essential point in the topic just explained?
- what was different compared to my expectations?
- (group) discussion about how to apply algorithm XY
- which was the most important point mentioned today?
- where would you like to have seen more about?
Course Objectives (Very High-Level)

After this course, you will be able to ...

- compare and apply image processing techniques (image filtering, image restoration, color image processing)
- interpret images in terms of their power spectrum (Fourier transform)
- describe techniques used in image interpretation (morphological image operations, segmentation) and compare systems that use this techniques
- apply classification and pattern recognition techniques (connection to the Machine Learning course) to image processing problems
Objectives versus Aims

- you should achieve all the objectives
- you can reach the aims

If you mastered this course, you will be able to ...

- combine image processing techniques given a DIP task
- explain relations between image processing techniques in terms of Fourier transform theory
- design image interpretation systems
- create solutions to image processing problems combining Machine Learning and Digital Image Processing techniques
0 Course Objectives

- Not so obvious Course Objectives and Aims
  - improve team working capabilities
  - improved communicative skills
  - English presentation and writing skills
  - work with original scientific literature
AASS
Mobile Robotics & Olfaction Lab
The AASS Research Centre
1 AASS Research Centre

Sweden's largest research center in intelligent robotics
AASS Mobile Robotics and Olfaction Lab
The AASS Learning Systems Lab – Research Directions
1 AASS LS Lab – Research

Grasping and Manipulation
- intuitive programming of grasping skills
  - demonstration of tasks, environment features and object features (tactile exploration)
- grasp stability analysis
1 AASS LS Lab – Research

- Grasping and Manipulation

- Artificial Olfaction with Open Sampling Systems
  - mobile gas discrimination
  - gas distribution modelling
  - gas source localization
  - etc.

Achim

Marco

Achim
1 AASS LS Lab – Research

- Grasping and Manipulation
- Artificial Olfaction with Open Systems
- Rich 3D Perception

point cloud

NDT representation

Martin
Henrik
Todor

\( \sim 300,000 \Rightarrow \sim 4,000 \)
1 AASS LS Lab – Research

- Grasping and Manipulation
- Artificial Olfaction with Open Sampling Systems
- Rich 3D Perception
  - Fusion of Visual + Range Information
1. AASS LS Lab – Research

- Grasping and Manipulation
- Artificial Olfaction with Open Sampling Systems
- Rich 3D Perception
  - Fusion of Visual + Range Information
1. AASS LS Lab – Research

- Grasping and Manipulation
- Artificial Olfaction with Open
- Rich 3D Perception
  - Fusion of Visual + Range Information
  - Robot Vision
Machine Learning and Simulation

Rich 3D Perception

Mobile Robot Olfaction
1. AASS LS Lab – Research

- Grasping and Manipulation
- Artificial Olfaction with Open Sampling Systems
- Rich 3D Perception
  - Fusion of Visual + Range Information
  - Robot Vision
- Navigation (Registration, SLAM, Planning, ...)

AASS Learning Systems Lab, Mar 8, 2011
1 AASS LS Lab – Research

- Grasping and Manipulation
- Artificial Olfaction
- Rich 3D Perception
  - Fusion of Visual + Range Information
  - Robot Vision
- Navigation (Registration, SLAM, Planning, ...)

Professional Service Robots for Autonomous Transportation (PSR$^4$AT)