Image Analysis

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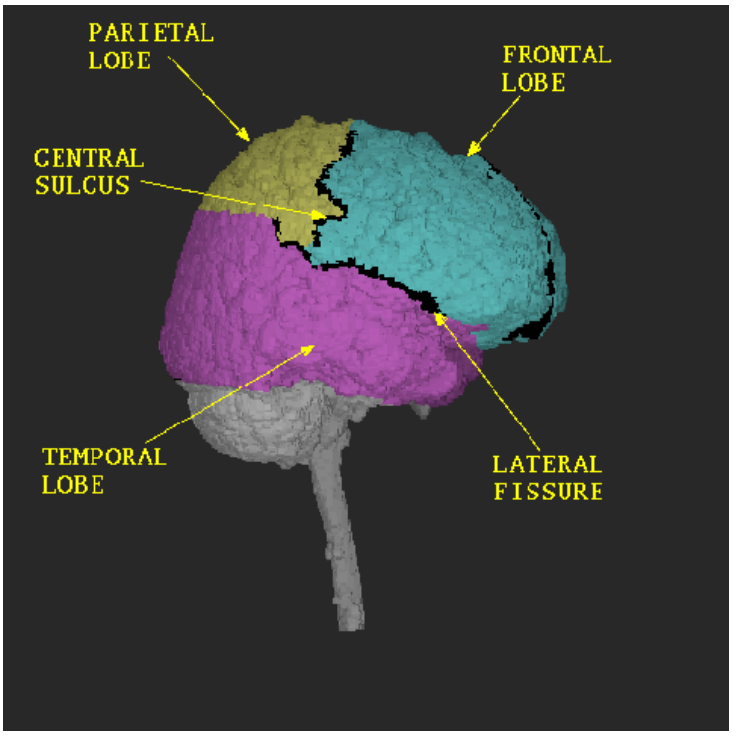
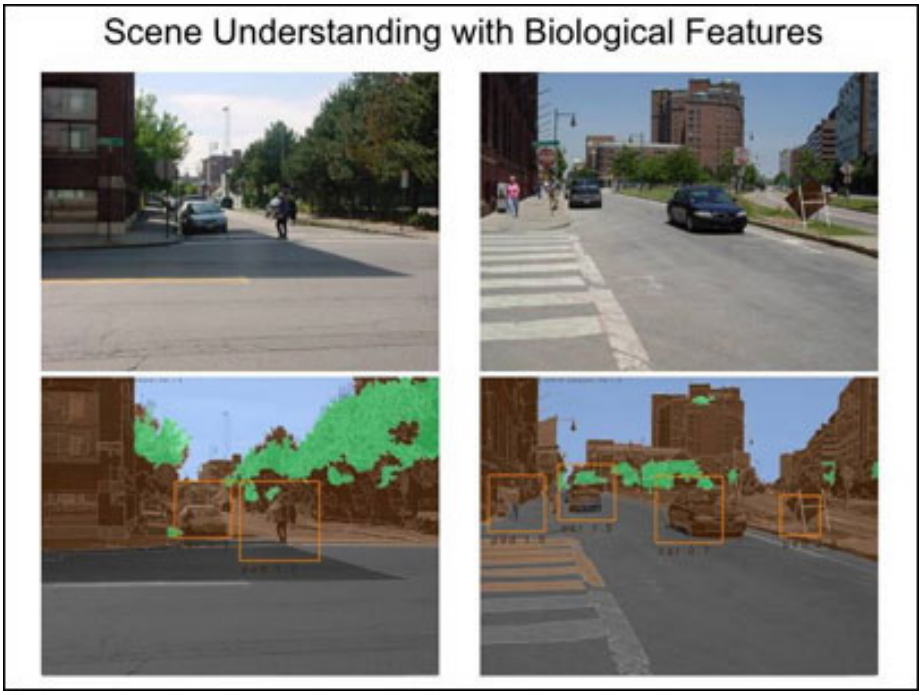
Medical Image Analysis



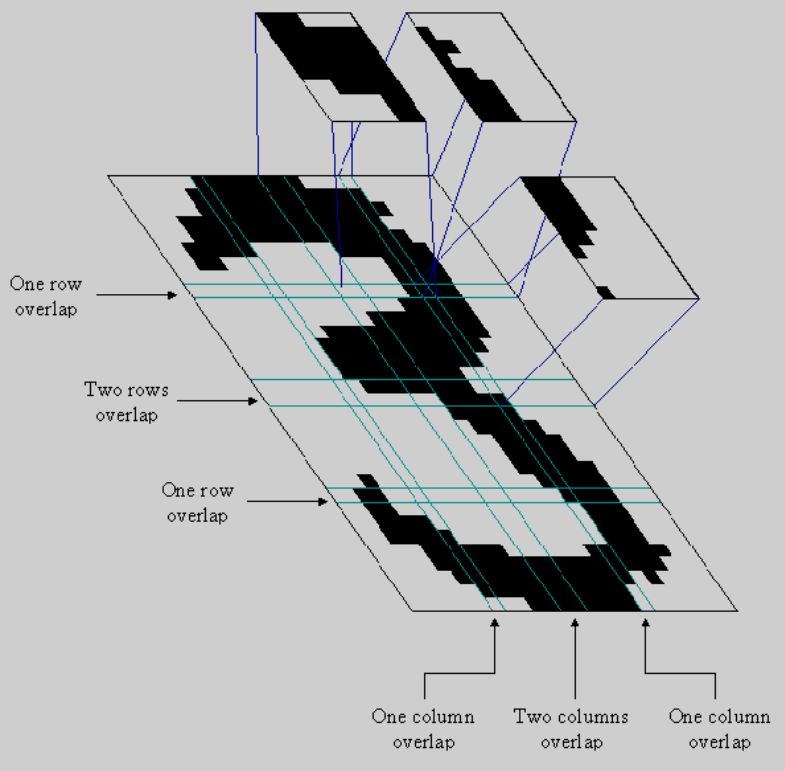
from: T. McInerney, D. Terzopoulos (1996): *Deformable Models in Medical Image Analysis: A Survey*, Medical Image Analysis, 1(2), 1996, 91-108.

Robot Vision



from: Jhuang H., T. Serre, L. Wolf and T. Poggio (2007): *A Biologically Inspired System for Action Recognition*, Proceedings of the Eleventh IEEE International Conference on Computer Vision (ICCV), 2007.

Optical Character Recognition (OCR)



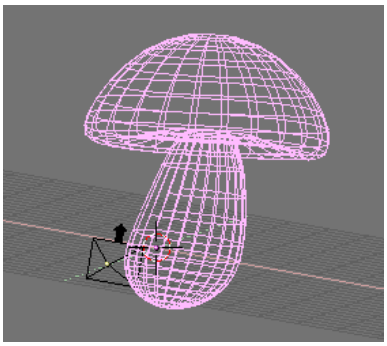
from: http://www.micro.dibe.unige.it/Research/OCR.htm

Example Applications

- **Medical Image Analysis**:
  – detect anomalies in MRT images.
- **Robotics**:
  – detect the road, other vehicles, passer-bys and traffic signs.
- **Document Processing**:
  – recognize text from scanned images (optical character recognition; OCR), e.g., to allow searching, editing, etc.
- **Manufacturing**:
  – optical quality control for parts, e.g., jet engine blades.
- **Defense** and **Security**:
  – recognize faces, vehicles etc.

Rendering in Computer Graphics

image model

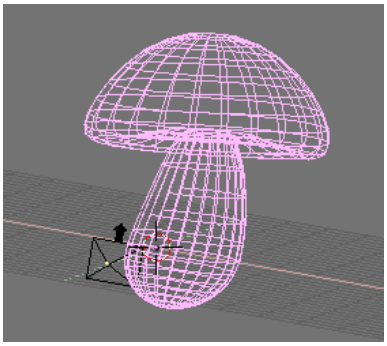


raster / digital image

- geometry
- viewpoint
- texture
- lighting
- shading
- etc.

Image Analysis: Inverse Rendering

image model



raster / digital image

- geometry
- viewpoint
- texture
- lighting
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- etc.

Different Names – Common Research Problems

- **Image Processing**:
  – origin in signal processing; sometimes used to focus on low-level tasks and image-to-image transformations.
- **Image Analysis**:
  – stresses inverse rendering problem.
- **Pattern Recognition**:
  – stresses usage of machine learning methods.
- **Imaging**:
  – stresses specific application context as in **Medical Imaging** (and includes image production, storage etc.).
- **Computer Vision** (also **Artificial, Robot or Machine Vision**):
  – stresses overall application problem and 3d.

A First Look at Image Classification

Given

- **images** and
- some (global) **annotation**, e.g., if the image shows a person or not,

try to learn the annotated concept, so that the annotation can be done automatically in future.

Useful for

- image retrieval (search by keyword/tag).
- many applications (e.g., sort tomato plants).

image	person?
	no
	yes
	no
	yes
	?

Image Restoration / Contrast Enhancement

If the image has low contrast,

enhance the contrast of the image.

Image Restoration / Deblurring

If the image is blurred,

deblurr the image.

Image Restoration / Denoising

If the image is corrupted by noise,

denoise the image.

Edge Detection

From the original image

detect edges.

Line Detection / Hough Transform

From the original image

detect lines.

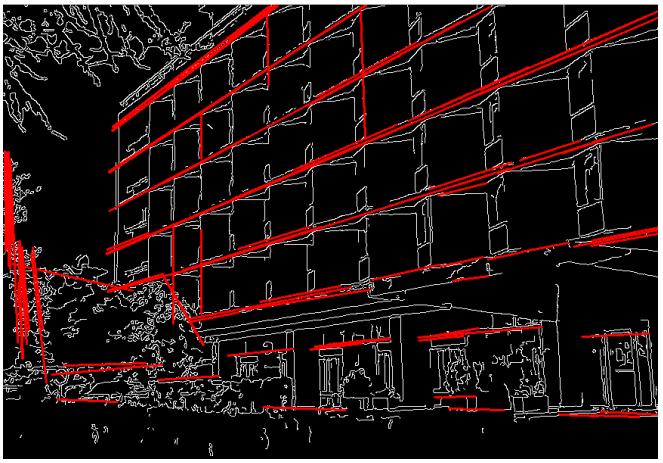

Image Segmentation

From the original image

detect regions.

Methods

Different methods introduced and/or touched in the lecture:

- Fourier transformation,
- Wavelets,
- Random Fields,
- Variational Methods,
- Partial Differential Equations

1. What is Image Analysis?

2. Course Outline

3. Organizational stuff

Exercises and tutorials

- There will be a weekly sheet with two exercises handed out **each Tuesday** in the lecture.
  1st sheet will be handed out **Tue. 29.4.**
- Solutions to the exercises can be submitted until **next Tuesday before the lecture**,
  1st sheet is **due Tue. 6.5.**
- Exercises will be corrected.
- Tutorials **each Thursday 2pm-4pm**,
  1st tutorial at **Thur. 8.5.**
- Successful participation in the tutorial gives up to 10% bonus points for the exam.

Exam and credit points

- There will be a written exam at end of term (2h, 4 problems).
- The course gives 8 ECTS (3+2 SWS).
- The course belongs to Informatik-Gebiet KI & ML, and thus can be used in
  - Wirtschaftsinformatik MSc / Informatik / Gebiet KI & ML
  - IMIT MSc. / Informatik / Gebiet KI & ML
  - as well as in any BSc program.

Text books

- Milan Sonka, Vaclav Hlavac, Roger Boyle (2008): *Image Processing, Analysis, and Machine Vision*, Thomson.
- David A. Forsyth, Jean Ponce (2007): *Computer Vision, A Modern Approach,* Prentice Hall.
- John C. Russ, J. Christian Russ (2008): *Introduction to Image Processing and Analysis*, CRC Press.
- G. Aubert, P. Kornprobst (2006): *Mathematical Problems in Image Processing. Partial Differential Equations and the Calculus of Variations*, Springer.
- J. R. Parker (1997): *Algorithms for Image Processing and Computer Vision*, Wiley.

Slides will be available online at the course webpage:

http://www.ismll.uni-hildesheim.de/lehre/ip-11w/

First Software

Open source:

- Open Computer Vision Library (OpenCV; C++ library, originally developed by Intel; has wrappers for Python & Octave; v2.3.1, 9/2011)
  `http://sourceforge.net/projects/opencvlibrary/`
- CImg (C++; 1.3.6; 6/2010)
  `http://cimg.sourceforge.net/download.shtml`
- Octave (MatLab like; 3.4.3; 10/2011)
  `http://www.gnu.org/software/octave/`
- ImageJ (Java library; 1.45o; 9/2011)
  `http://rsbweb.nih.gov/ij/`

Commercial software:

- MatLab (with Image Toolbox; student versions available for ca. 80 EUR)
  `http://www.mathworks.com/`

Example Images

- TRECVID
  `http://www-nlpir.nist.gov/projects/trecvid/`
- PASCAL VOC:
  `http://pascallin.ecs.soton.ac.uk/challenges/VOC/`
- LabelMe `http://labelme.csail.mit.edu/`
- N-S dataset `http://vis.uky.edu/~stewe/ukbench/`
- `http://muscle.prip.tuwien.ac.at/data_links.php`
- `http://peipa.essex.ac.uk/benchmark/databases/`
- MIT/CBCL:
  `http://cbcl.mit.edu/software-datasets/index.html`