

Lecture 26: Summary and Outlook

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What Have We Done? (1)

What Have We Done?

- | | | |
|---|------------|---|
| 1. Introduction | Lecture 1 | 2 |
| 2. Linear (Homogeneous) Diffusion | | 3 |
| ◆ Basic Concepts | Lecture 2 | |
| ◆ Numerics, Limitations, Alternatives | Lecture 3 | |
| 3. Nonlinear Isotropic Diffusion | | 4 |
| ◆ Modelling and Continuous Theory | Lecture 4 | |
| ◆ Semidiscrete and Discrete Theory | Lecture 5 | |
| ◆ Efficient Algorithms | Lecture 6 | |
| 4. Nonlinear Anisotropic Diffusion | | 7 |
| ◆ Modelling | Lecture 7 | |
| ◆ Theoretical and Numerical Aspects | Lecture 8 | |
| 5. Parameter Selection for Diffusion Filters | Lecture 9 | 8 |
| 6. Variational Methods | | 9 |
| ◆ Basic Ideas | Lecture 10 | |
| ◆ Discrete Aspects | Lecture 11 | |
| ◆ TV Denoising, Equivalence Results | Lecture 12 | |
| ◆ Functionals of Two Variables | Lecture 13 | |

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What Have We Done? (2)



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|--|------------|----|
| 7. Vector- and Matrix-Valued Images | Lecture 14 | 1 |
| 8. PDE-Based Interpolation | Lecture 15 | 2 |
| 9. Image Sequence Analysis | | 3 |
| ◆ Models for the Smoothness Term | Lecture 16 | |
| ◆ Models for the Data Term | Lecture 17 | |
| ◆ Large Displacements, High Accuracy Methods | Lecture 18 | 4 |
| ◆ Numerical Methods | Lecture 19 | 5 |
| 10. Classical Continuous-Scale Morphology | | 6 |
| ◆ Basic Ideas | Lecture 20 | |
| ◆ Shock Filters and Nonflat Morphology | Lecture 21 | |
| 11. Curvature-Based Morphology | | 7 |
| ◆ Mean Curvature Motion | Lecture 22 | |
| ◆ Affine Morphological Scale-Space | Lecture 23 | 8 |
| 12. Self-Snakes and Active Contours | Lecture 24 | 9 |
| 13. Unification of Denoising Methods | Lecture 25 | 10 |

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Current Research Directions



Current Research Directions

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|---|----|
| ◆ simplified methods with less parameters | 1 |
| ◆ inclusion of specific a-priori-knowledge | 2 |
| ◆ non-local models and integrodifferential equations | 3 |
| ◆ algorithmic improvements | 4 |
| ◆ relations to other image processing techniques:
statistical methods, wavelets, simple linear or nonlinear filters, ... | 5 |
| ◆ applications to other image processing problems:
data compression, demosaicing, superresolution, tomographic reconstruction,
segmentation ... | 6 |
| ◆ applications in computer vision:
optic flow, structure-from-motion, stereo, shape-from-shading, ... | 7 |
| ◆ applications outside the image processing field:
computer graphics, numerical analysis, medical imaging, ... | 8 |
| ◆ performance evaluation | 9 |
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Projects for Bachelor / Master / Diploma Theses

Image Processing

- ◆ dithering using error diffusion
- ◆ demosaicking methods
- ◆ compression of high dynamic range images
- ◆ iterated simple linear and nonlinear filters
- ◆ models with different conservation assumptions (moments)
- ◆ anisotropy beyond orthogonality
- ◆ evaluation of bilateral filtering and related methods
- ◆ diffusion and regularisation on graphs

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Computer Vision

- ◆ comparison of PDE-based and graph-based segmentation methods
- ◆ structure-from-motion: recovering 3-D information from optic flow
- ◆ optic flow versus tracking
- ◆ incorporation of illumination effects into stereo reconstructions
- ◆ image stitching
- ◆ registration of high dynamic range images
- ◆ photometric stereo

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Numerical Analysis and Scientific Computing

- ◆ stability notions for nonlinear diffusion filters
- ◆ numerical schemes with higher accuracy (automatic stencil computation)
- ◆ PDEs and variational methods on alternative architectures: Playstation 3, mobile phones, GPUs, ...

Applications

- ◆ audio-visual speech recognition
- ◆ ophthalmology: fusing images with different focus
- ◆ finding line-like structures in cell biology
- ◆ flow visualisation

... and many others. Just tell us your specific interests.

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Lectures in the Next Semester

- ◆ Image Processing and Computer Vision
(Joachim Weickert; 4 hours classroom, 2 hours tutorial, 9 CP)
- ◆ Probabilistic Methods in Image Analysis
(Bernhard Burgeth; 3 hours classroom, 1 hour tutorial, 6 CP)
- ◆ Numerical Methods for Visual Computing II
(Michael Breuß; 2 hours classroom, 2 hours tutorial, 6 CP)
- ◆ Introduction to Image Acquisition Methods
(Andrés Bruhn; 2 hours classroom, 4 CP)
- ◆ Modern Methods in Image Analysis
(Andrés Bruhn, Joachim Weickert; seminar)

Suitable for students of visual computing, computer science, and mathematics.
The language of instruction is English (seminar talks in German possible).

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Written Exam (1)



Written Exam

- ◆ Tuesday, July 22, in **E2.5**, Lecture Hall 1.
- ◆ From 2:00 to 5:00 pm. Please be there at 1:45 pm.
- ◆ Second chance:
Tuesday, October 14, in **E2.5**, Lecture Hall 1, from 2:00 to 5:00 pm.
If you participate in both exams, the better grade counts.
- ◆ 6 problems in total
- ◆ similar in style to the self-test problems
- ◆ recommendations:
 - try to solve the self-test problems
 - go through the assignments
 - get an overview of the topics that we treated

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Written Exam (2)



- ◆ **Please Do Not Forget To Bring**
 - student identity card with photo (Studierendenausweis)
 - course material from lectures and tutorial groups
 - dictionary, if required (all questions are both in German and in English)
- ◆ **Please Do Not Bring**
 - cellular phones
 - pocket calculators
 - books or copies of parts of books
 - formulary (Formelsammlung), but handwritten notes are okay
 - other aids

Everybody should have the same chances.

- ◆ Much success and thanks for your interest in this class !

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Self-Test Problems

- ◆ A problem sheet that contains 6 problems which are intended to be similar in style and difficulty to the 180-minutes written exam is available on the web page as of today, 2 pm.
- ◆ Solutions will be downloadable as of Monday.
- ◆ If you encounter problems, please feel free to discuss them in your tutorial group next week.

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