Image Processing 10 Summary and Outlook Part 1

SS 2020

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Computer Vision Group, Department of Informatics
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Outline

- Part 1: Summary of lecture content
- Part 2: Outlook

1 - Intro

- What is image processing?
- Image Processing vs Computer Vision
- Why is image processing of interest?
- History of image processing
- Applications of image processing
- Why is image processing hard?

2 - HVS and Image Fundamentals

- Human Visual Perception
- Image Sources, Light and the Electromagnetic Spectrum
- Components of Image Processing Systems, Sensors, Image Sensing and Acquisition
- Sampling & Quantization
- Image Representations (Matrices and Signals)
- Frequencies and Noise

3 - Basic Tools in Image Processing

- Element-wise vs Matrix Operations
- Arithmetic Operations: Addition, Subtraction, Multiplication & Division
- Set Operations
- Logical Operations
- Overview Spatial Operations

4 - Transformations

- Intensity transformations 1 & 2
    - Contrast stretching
    - Log transformations (e.g. for Fourier spectrum)
    - Gamma correction
    - Intensity-level slicing

- Geometric transformations 1 & 2
    - Scaling
    - Rotation
    - Shearing
    - Translation
    - Forward mapping
    - Inverse mapping

5 - Colors and Color Spaces

- Overview color & color spaces
- RGB, CMY & CMYK
- Hue-Saturation color spaces: HSI/HSV/HSL
- Color image processing & color transformations

6 - Histograms

- Histograms: Motivation and unnormalized h.
- Normalized & cumulative histograms
- Mean and Variance
- Histogram Equalization

7 - Digital Filters, Spatial Domain

- Spatial filters – introduction
- Correlation & convolution
- Properties of correlation/convolution & treatment of image borders
- Smoothing filters (box filter and Gaussian filter)
- Comparison of box and Gaussian filter and applications

8 - Edge Detection

- Edge models and derivatives
- Derivatives and edge detection in 1D
- Partial derivatives, gradient, and edge detection in 2D
- The effect of noise, Sobel & Prewitt filter
- 2nd order derivatives and the Laplacian filter
- Using the Laplacian for sharpening and line detection

9 - Digital Filters in the Frequency Domain

- Spatial Filters in the frequency domain:
- Frequency domain – motivation
- Signals as sum of sinusoids
- Discrete Fourier Transform (DFT): 1D
- Discrete Fourier Transform (DFT): 2D
- Understanding the 2D Spectrum
- Filtering in the frequency domain: Lowpass & Highpass
- Selective filters: Bandpass & Notch filters

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Image Processing 10 Summary and Outlook Part 2

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Klausur

- 1. Klausur: 23.7. 9:30 – 11:30 (ESA A, ESA B)
- 2. Klausur: 24.9. 9:30 – 11:30 (D 125/129)

Vorbereitung:

- Vorlesungsfolien und Videos
- Zugehörige Literatur (insb. Gonzales/Woods)
- Übungsaufgaben verstanden und anwendbar
- Fragen?
  - Letztes Zoom Meeting mit Christian
  - Moodle Foren
  - Email an Christian

Additional courses

Bachelor:

- Seminar Computer Vision (WS)
- Praktikum Computer Vision (WS)

Master:

- Lecture Computer Vision 1 (WS)
- Lecture Computer Vision 2 (SS)
- Master project Computer Vision (WS/SS)

Bachelor/Master thesis: contact us

Additional courses

- Useful related courses from other groups:

Bachelor:
- Digitale Mediensignalverarbeitung
- Data-driven Intelligent Systems

Master:
- Machine Learning
- Neural Networks
- Bio-inspired Artificial Intelligence
- Intelligent Robots
- Multi-dimensional and multi-modal signals
- Speech signal processing
- Knowledge processing

More on Computer Vision

Interested in computer vision topics? Here you get more:

- **Mailing list at Informatikum:** announces talks on computer vision topics
  subscribe here:
  https://mailhost.informatik.uni-hamburg.de/mailman/listinfo/cv-talks

- **Computer Vision News** – the magazine of the algorithm community
  subscribe here:
  http://www.rsipvision.com/computer-vision-news/

- **Imageworld-digest:** International Mailing list announces worldwide events (conferences/workshops) and open jobs in computer vision. Subscribe here (in case you are interested in PhD positions):
  https://list.ku.dk/listinfo/sci-diku-imageworld

- **Initiative Bildverarbeitung e.V.** in Hamburg und Schleswig-Holstein (if you are looking for local job opportunities):
  http://www.initiative-bildverarbeitung.de/home/

Good luck for the exam!