Digital Signal Processing

Dietrich Klakow
Lecture

- Lecture:
  - Monday 10:15-11:45
  - Location: -1.03 in building 13
  - Contact:
    - D. Klakow:
      - tel. 58122
      - dietrich.klakow@lsv.uni-saarland.de

Termin OK?
Exercises

- Exercises:
  - Time: by arrangement
  - Location: ??? in building A 53
  - First meeting will be arranged at the end of this lecture
  - Tutors: Jochen Britz and Najib Hadir
  - Exercises: Munir Georges

E-Mail:

Jochen.Britz@lsv.uni-saarland.de
Najib.Hadir@lsv.uni-saarland.de
Munir.Georges@lsv.uni-saarland.de
Exercises/Practicals

- Details will follow next week
- This week there is just a warm up
Mailing List

• We will set a mailing list
• All students + JB, NH, MG and DK will be on it
• Purpose:
  • Raise questions to everybody
  • Discuss questions
  • Announcements (!!! e.g. exam dates !!!)
  • … everything else …
• For changes contact:
  • Dietmar.Kuhn@lsv.uni-saarland.de

Important: use electronic course registration at
http://www.lsv.uni-saarland.de/Vorlesung/registration/eingabe.php
if you want to participate in this course before May 3!
Exam

- Planning of exam:
  - Oral exam (if number of participants < 20)
  - 30 minutes covering
    - lecture
    - practical implementation/exercise
  - Date and time: to be arranged
  - CuK, Mechatronik: 4.5 LP

- Written if 20 or more participants

- Note: CuK master students can only take it for “free points”
See:

- www.lsv.uni-saarland.de

Contains:

- Slides
- Exercises
- Literature
Prerequisites

- Some math
- Programming
  - E.g. C++, java, maple, matlab, ...
Rules of the Game

- In case you don't understand something:
  1. Ask!!!
  2. Ask!!!
  3. Ask!!!
1. Introduction
Outline of the Lecture

1. Introduction
2. Signal Representations
3. Microphone Arrays
4. Filtering and Smoothing
5. Feature Extraction from Images: Color, Texture, Edges
6. Feature Extraction from Speech Signals
7. Musical Genre Classification
8. Speaker Recognition
9. KL-Transform and Linear Discriminant Analysis
10. Wiener Filter
11. Spectral Subtraction
Learn how audio and video signals can be represented
Microphone Arrays

Use time delay to enhance signal from a certain direction.

\[ \tau = \frac{d}{c} \sin \theta \]
Linear Filters

With “salt-and-pepper” noise

→ blurring of the image
→ use other filters (e.g. median filter)

Gaussian 3x3-kernel
Basic Principle of Pattern Recognition

- Feature Extraction
- Classifier
- Model
- Training Data
  - Feature Extraction
  - Training Algorithm
  - \( \omega_1 \)
  - \( \omega_2 \)
  - \( \ldots \)
  - \( \omega_n \)

Test Data \( x_i \)
Feature Extraction from Images

Main features:
- Color
- Texture
- Edges
Feature Extraction from Speech

Standard feature extraction from speech: Mel-Frequency-Cepstral Coefficients
Musical Genre Classification

Classical → ?

Country

Rock → ?
or Speaker Recognition

Speaker verification:
is this Mary?

Speaker identification:
who is speaking?
or Classification

• A simple introduction
• Nearest Neighbor Classifier
KL-Transform and Linear Discriminant Analysis

Find the optimal subspace for feature vectors
Basic algorithm for speech coding
Spectral Subtraction and Wiener Filter

Suppress noise

From: http://www.tu-harburg.de/ft2/AktuForschungen/Bildverarbeitung/Bildverarbeitung.htm
Applied Pattern Recognition  
von Dietrich W. R. Paulus, Joachim Hornegger  
Vieweg  
**ISBN:** 3528355581  
Ca. 40 Euro  

- Speech and image analysis  
- Software oriented  
- Signal processing  
- …
Digitale Sprachsignalverarbeitung
by Peter Vary, Ulrich Heute, Wolfgang Hess
Teubner Verlag
ISBN: 3519061651
Ca. 45 Euro

• Spectral subtraction
• Wiener Filter
• Microphone arrays
• …
Spoken Language Processing
by Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, Xuedong Huang, Hsiao-Wuen Hon
Prentice Hall
ISBN: 0130226165

- very comprehensive
Questionnaire

• Take a sheet of paper
• Please give me your opinion of those questions:
  • All topic covered that you expect?
  • Is there a topic we could skip?
  • What do you expect in terms of teaching style
  • What should not happen in the lecture

Take yourself 5 minutes time