ELEC421
Digital Signal and Image Processing
Sep. 2021 – Dec. 2021

Z. Jane Wang

Electrical and Computer Engineering

University of British Columbia, BC

Canvas course page

zjanew@ece.ubc.ca

ELEC421

Lecture-Week-1

Course material available on
canvas.ubc.ca

Introduction to DSP and DIP

Partially based on Maria Elena Angoletta's 2003 DSP lecture notes.

http://humanresources.web.cern.ch/humanresources/external/training/tech/special/DISP2003.asp

Partially based on Prof. Hossein Sameti's 2012 DSP lecture notes and my EECE466 lecture notes.

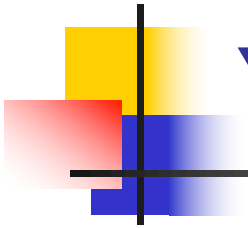
Practical Information

- Lectures:
  - Tue/Thu: 10:00 am – 11:00 am
  - ESB 2012
- Tutorial:
  - Fri: 11:00 am – 1:00 pm
  - School of Population and Public Health B151

Important Clarification: Both lectures and tutorials are *mandatory* and equally treated. They are actually merged together.

Practical Information

- Instructor: *Z. Jane Wang*
  - Tel: *604 822-3229*
  - email: *zjanew@ece.ubc.ca*
- Office Hours:
  - KAIS 4015, Tue, 11am – 12pm
  - Or by appointment
- Teaching Assistant
  - TBD
  - Office Hours: TBD



Your Instructor

- B.S., Tsinghua, China, 1996
- 1996-1998, Apple Computer, Software Engineer
- M.S.,Ph.D., UConn, 2000 and 2002
- Post doc., UMD, 2002-2004
- Since 2004, Assistant Prof. in ECE@UBC
- Since 2009, Associate Prof. in ECE@UBC
- Since 2014, Full Prof. in ECE @UBC

Research

- Statistical signal processing
- Machine learning
- Information security and forensics
- Biomedical imaging and processing
- Research website:

  http://ece.ubc.ca/~zjanew

Practical Information

- Recommended reading:
  - John G. Proakis, Dimitris Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th Edition, Prentice Hall.
  - Robert D. Strum and Donald E. Kirk, First *Principles of Discrete Systems and Digital Signal Processing*, Addison Wesley.
  - On-line textbook: Steven W. Smith, *The Scientist and Engineer's Guide to Digital Signal Processing*.
    http://www.dspguide.com/
  - Bovik's handbook of Image & Video Processing, Academic Press, 2000.
- **Some Useful links:**
  - Free DSP books on the Internet: http://www.dsprelated.com/showarticle/56.php
  - Digital Signal Processing Tutorial, Notes, Downloads

http://www.onesmartclick.com/engineering/digital-signal-processing.html

  - Matlab Tutorial: http://www.engin.umich.edu/group/ctm/

Course Objectives

By the end of the course, we will develop a solid understanding of DSP/DIP fundamentals and basics including:

- Analog vs. digital signal representation and processing
- *Why DSP?* advantages, limitations and fundamental tradeoffs
- Relationship between frequency and time representations
- Analysis and processing of signals in the temporal/spatial as well as in the frequency domain
- Image basics (gray, color images, histograms)
- Image processing basics: 2D transforms, filtering etc.
- Practical applications of DSP and DIP
- Implementation of DSP/DIP algorithms using MATLAB

Course Outline

- Mainly follow Proakis book closely for the DSP topics (Chapters 1-7,11-12)
- Major topics:
  - DFT; DT systems; sampling and reconstruction; multirate DSP; Filter design
  - Linear prediction; Correlation
  - Introduction to Wavelet analysis
  - Speech/image basics
  - Image processing basics
  - (Possible) extensions: introduction to pattern recognition
- Quickly Review the basics of discrete-time signals and systems. Problems and small Matlab assignments will be assigned.
- Matlab project(s): small assignments focusing on the major concepts; projects based on a particular application (e.g. speech analysis, wavelet analysis, image operations).

Practical Information

- Midterm: around Oct. 24 (TBD)

  (Note: Midterms to be held at times and locations to be announced)
- Final: Dec. 11 to Dec. 22 (TBD)
- Grade:
  - Take-home assignments (textbook problems + small Matlab assignments): 20%
  - Mid Term Exam: 25%
  - Final Exam (written exam + Matlab project): 55%