EE5410
Signal Processing

Department of Electrical Engineering
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Syllabus Outline

- Foundations of Signal Processing
  Signal Processing Overview, Analog Signal Analysis, Discrete-Time Signals and Systems, Sampling and Reconstruction of Analog Signals
- Discrete-Time Signal Analysis Tools
  z-Transform, Discrete-Time Fourier Transform (DTFT), Discrete Fourier Series (DFS), Discrete Fourier Transform (DFT)
- Digital Filters
  Response, Realization and Design of Finite Impulse Response (FIR) Filters and Infinite Impulse Response (IIR) Filters
- Application Case Studies
  Telephone Touch-tone Generation and Decoding, Sunspot Cycle Estimation, Interference Cancellation

Intended Learning Outcomes

On completion of this course, you will be able to

- Recognize properties of continuous-time and discrete-time signals and systems such as stability, causality, linearity and time-invariance
- Explain the relationship among different signal processing transforms
- Analyse discrete-time systems and calculate system parameters using appropriate transforms
- Design and realize digital filters according to predefined specifications such as filter shapes and cutoff frequency
- Develop signal processing techniques for engineering problems

Teaching Pattern

Date	3508 (LI)	Remark
15 Jan.	Lecture 1	
22 Jan.	Lecture 2	
5 Feb.	Lecture 3	
12 Feb.	Lecture 4	MATLAB Exercise 1 Due
19 Feb.	Lecture 5	Assignment 1 Due
26 Feb.	Lecture 6	Test 1
5 Mar.	Lecture 7	
12 Mar.	Lecture 8	
19 Mar.	Lecture 9	
26 Mar.	Lecture 10	MATLAB Exercise 2 Due
2 Apr.	Lecture 11	Assignment 2 Due
9 Apr.	Lecture 12	Test 2
16 Apr.	Lecture 13	

Assessment

Coursework: 50%

- 2 Assignments: 10%
- 2 MATLAB Exercises: 10%
- 2 Tests: 30%

Examination: 50%

To pass the course, at least 30% of coursework AND examination marks are required. All tests and examination are open book format.

Act of academic dishonesty (e.g., plagiarism, submission for assessment of material that is not your own work) will be liable to disciplinary actions

Book List

Textbook:

1. H.C.So, ***Digital Signal Processing: Foundations, Transforms and Filters, with Hands-on MATLAB Illustrations***, McGraw-Hill, 2010

References:

2. A.V.Oppenheim and R.W.Schafer, ***Discrete-Time Signal Processing***, 3rd Edition, Pearson, 2010
3. J.G.Proakis and D.G.Manolakis, ***Digital Signal Processing***, 4th Edition, Pearson Prentice-Hall, 2007
4. S.K.Mitra, ***Digital Signal Processing: A Computer-Based Approach***, 4th Edition, McGraw-Hill, 2011
5. V.K.Ingle and J.G.Proakis, ***Digital Signal Processing Using MATLAB***, 4th Edition, Cengage Learning, 2016

MATLAB Resources

Full suite can be downloaded at:

https://www.cityu.edu.hk/csc/deptweb/facilities/central-sw-tah.htm

S. Attaway, ***MATLAB: A Practical Introduction to Programming and Problem Solving***, 5th Edition, Butterworth-Heinemann, 2019

A. Gilat, ***MATLAB: An Introduction with Applications***, 5th Edition, John Wiley & Sons, 2015

https://help.eng.cam.ac.uk/software/matlab/

http://www.mathworks.com/matlabcentral/fileexchange/2189-digital-signal-processing-using-matlab

Prerequisites

Basic knowledge in linear algebra and calculus, e.g.,

A vector is one-dimensional array of scalars, e.g.,

$$\begin{bmatrix} 3 & -1 & 4 & -6 & 2 \end{bmatrix} \in \mathbb{R}^{1\times 5}$$

For a complex number $a+jb$, $j=\sqrt{-1}$, its magnitude and phase are $|a+jb|=\sqrt{a^2+b^2}$ and $\angle(a+jb)=\tan^{-1}(b/a)$

Euler formulas: $\cos(x)=\dfrac{e^{jx}+e^{-jx}}{2}$, $\sin(x)=\dfrac{e^{jx}-e^{-jx}}{2j}$

$$\frac{d(3x^n+2x+1)}{dx}=n\times 3x^{n-1}+2x^{1-1}=3nx^{n-1}+2$$

$$\int_{-T}^{T} e^{-jkt}dt=-\frac{1}{jk}e^{-jkt}\Big|_{-T}^{T}=-\frac{e^{-jkT}-e^{jkT}}{jk}=\frac{2\sin(kT)}{k}$$