The University of Texas at Tyler
Department of Electrical Engineering

EENG 5353.031: Special Topics in EE (Elective)

Adaptive Filters

Syllabus

Catalog Description:

Introduction to discrete-time signal processing, Impulse response, z-transform, FIR, IIR filters, Stochastic Processes, Correlation functions and power spectral density, Wiener Filters, Introduction to gradient search algorithms, steepest-descent algorithm, LMS algorithm, Recursive Least Squares algorithm, Introduction to Noise Cancelation and Echo Cancelation.

Prerequisites: EENG 4311 – Signals and Systems, EENG 4312 – Communication Theory

Credits: (3 hours lecture)

Text(s):

1. Behrouz Farhang-Boroujeny, Adaptive Filters: Theory and Applications, 2nd Edition, ISBN: 978-1-119-97954-8
2. Simon O. Haykin, Adaptive Filter Theory, 5th Edition, ISBN: 978-0-132-67149-1
3. Saeed V. Vaseghi, Multimedia Signal Processing Theory and Applications in Speech, Music and Communications, 1st Edition, ISBN 978-0-470-06201-2.

Additional Material: Lecture Handouts, MATLAB

Course Coordinator: Ali Ghorshi, PhD

Topics Covered: (paragraph of topics separated by semicolons)

Introduction to discrete-time signal processing, Impulse response, z-transform, FIR, IIR filters, Stochastic Processes, Correlation functions and power spectral density, Wiener Filters, Introduction to gradient search algorithms, steepest-descent algorithm, LMS algorithm, Recursive Least Squares algorithm.

Evaluation Methods: (only items in dark print apply):

1. Examinations / Quizzes
2. Homework
3. Report
4. Computer Programming
5. Project
6. Presentation
7. Course Participation
8. Peer Review

Course Learning Outcomes[1]: By the end of this course students will be able to:

1. Explain the core principles and mathematical foundations of adaptive filters.
2. Explain the Wiener Filter Theory: normal equations; error performance surfaces; orthogonality; minimum mean square errors.
3. Analyze the behavior, convergence, and stability of LMS, NLMS, RLS, and related adaptive algorithms.
4. Design adaptive filters for applications such as noise cancellation, system identification, and channel equalization.
5. Implement adaptive filtering algorithms using MATLAB or Python and evaluate their performance.
6. Compare adaptive algorithms in terms of convergence speed, accuracy, and computational complexity.
7. Apply adaptive filtering techniques to advanced problems in communications, audio/speech, or biomedical signal processing.
8. Present and document adaptive filter designs and results clearly in technical reports and presentations.

[1]*Numbers in brackets refer to method(s) used to evaluate the course learning outcome.*

Relationship to Student Outcomes (only items in dark print apply)[2]: This course supports the following Electrical Engineering Student Outcomes, which state that our students will possess:

1. Apply advanced knowledge of mathematics, science, and engineering to solve complex engineering problems. [1-7]
2. Design solutions for complex engineering problems that meet specified needs. [2,3,4,6,7]
3. Communicate effectively with a range of audiences. [8]
4. Recognize ethical and professional responsibilities in engineering practice. [8]
5. Conduct experimentation and analyze data. [2-7]
6. Acquire and apply new knowledge using appropriate learning strategies. [2-7]

[2]*Numbers in brackets refer to course learning outcome(s) that address the Program Outcome.*

Contribution to Meeting Professional Component: (in semester hours)

Mathematics and Basic Sciences:		hours
Engineering Sciences and Design:	3	hours
General Education Component:		hours

Prepared By: Edited By:	Ali Ghorshi, PhD	Date:	18 August 2019 21 April 2020 26 December 2020 01 January 2026