EE 662 Adaptive Filtering and Applications [3-0-3]

• **Introduction:**
  Adaptive filters have found many uses in today's technology. In signal processing, applications include noise cancellation, deconvolution, and adaptive beamforming. In telecommunications, applications include channel equalization and echo canceling. In control systems, applications include inverse control and cancellation of plant disturbance. In acoustics, applications include active control of sound and vibration. Many of these subjects will be discussed.

• **Objectives:**

• **Prerequisites:** Consent of Instructor.

• **Instructor:** Dr. Azzedine Zerguine,
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• **Course Outline:**

  • **Introduction, Review and Background** (2.5 weeks)
    • Review
    • Stochastic processes and power spectral density

  • **Wiener filters** (1.5 weeks)
    • Derivation of the Wiener-Hopf equations
    • Principle of orthogonality
    • Problems and applications
    • Solving the Wiener-Hopf equations

  • **Gradient-Based Adaptive Filters** (3.5 weeks)
    • Steepest descent
    • The LMS algorithm
    • Performance Analysis (Convergence, Transient Behaviour, Steady-State Behaviour, Tracking)
    • Variations on the LMS algorithm
    • The LMF algorithm
    • Mixed-Norm techniques
    • Examples and comparison of techniques
    • The LMS algorithm Using Lattice filters

  • **The method of least squares** (2.0 weeks)
    • Linear least squares estimation; Windowing; Orthogonality
    • Properties of least squares estimators

  • **Recursive least squares** (2.0 weeks)
    • Transversal filters (Exponentially weighted; Windowing; FTF algorithm)
    • Lattice filters (Order update recursions; Time update recursions)
• **Nonlinear adaptive filters** (1.5 weeks)
  • Blind deconvolution - decision directed feedback
  • Examples

• **Applications** (2.0 weeks)
  • Adaptive line enhancement
  • Adaptive spectrum estimation, frequency tracking
  • Adaptive interference cancellation


• **References:**

• **Homework Assignments** will be issued about once every two weeks.

• **Grading Policy**
  – Homework 20 %
  – Major Exam 25 %
  – Project 25 %
  – Final Exam 30 %