KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
ELECTRICAL ENGINEERING DEPARTMENT
Second Semester (062)

EE 662 Adaptive Filtering and Applications

Overview: Adaptive filters are systems that respond to variations in their environment by adapting their internal structure in order to meet certain performance specifications. Such systems are widely used in communications, signal processing, and control. This course will introduce the fundamental concepts in the design and analysis of adaptive filters. Roughly speaking the course is divided into three parts. The first part introduces the problem of (non-adaptive) linear estimation. The second part introduces the class of stochastic gradient algorithms while the third part focuses on recursive least squares. The course will various tools in linear algebra and multivariate Gaussian random variables. The application and project part of the course will deal with signal processing problems in geophysics and oil exploration and will be done in collaboration with Schlumberger Dhahran Center for Carbonate Research.

Course Outline:

1. **Week 1: Introduction, Review and background**
2. **Week 2: Linear estimation and Wiener filters**
3. **Week 3: Signal processing for geophysics and oil exploration: An introduction (Dr. Wail Mousa and Dr. Cesar Barajas-Olalde, Schlumberger Dhahran Center for Carbonate Research)**
4. **Week 4: Constrained linear estimation**
5. **Week 5: Steepest descent algorithms**
6. **Week 6: Stochastic gradient algorithms 1**
7. **Week 7: Stochastic gradient algorithms 2**
8. **Week 8: Steady state and tracking performance of adaptive filters (1)**
9. **Week 9: Steady state and tracking performance of adaptive filters (2)**
10. **Week 10: Transient performance of adaptive filters**
11. **Week 11: The least-squares criterion**
12. **Week 12: Recursive least-squares (1)**
13. **Week 13: Recursive least-squares (2)**
14. **Week 14: RLS array algorithms**
15. **Week 15: Project presentations**

Textbook: Ali H. Sayed, "Fundamentals of Adaptive Filtering," IEEE Press 2003

Grading Policy: 1) Quizzes and Homeworks 20% 2)Major Exam 25 % 3) Project 25 % 4) Final Exam 30 %

Project: The project will be done in collaboration with Dr. Wail Mousa and Dr. Cesar Barajas-Olalde, Schlumberger Dhahran Center for Carbonate Research.

- Adaptive beamforming for coherent noise attenuation
- Adaptive predictive deconvolution for improving temporal seismic resolution
- Multiple attenuation using adaptive linear prediction error filters
- Eigendecomposition interference canceling adaptive algorithm with application to coherent noise cancellation
- Adaptive noise suppression on land seismic data

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