SOUTHERN METHODIST UNIVERSITY  
DEPARTMENT OF ELECTRICAL ENGINEERING  
EE8368  
SIGNAL PROCESSING FOR WIRELESS COMMUNICATION  
SPRING 2006  

Instructor:  
Prof. Scott C. Douglas  
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Classroom:  
Caruth 128  

Meeting Time:  
T H 5:00 – 6:20 pm  

Meeting Dates:  
January 17 – March 9, March 21 – May 2  

Office Hours:  
T 1:30-2:30pm, W 4-5pm, H 10-11am. If you are not able to meet with the instructor during the scheduled office hours, please send an e-mail to make an appointment.  

Course Materials:  


Course Description and Objectives:  

From cell phones to base stations, digital signal processing (DSP) is a fundamental design component in all modern wireless communication systems. This course provides a careful study of the most-important concepts, algorithms, and signal processing methods used in modern wireless communication systems today. An emphasis is placed on the details of the implementations and how they relate to fundamental statistical signal processing and linear algebra concepts.  

As part of the course, you will learn about and apply simple techniques for spectral estimation, beamforming, direction finding and inverse filtering to synthesized single- and multi-channel signal sets. You will also gain an understanding of how signal processing is used in the front-end of digital receivers to improve signal-to-interference-and-noise ratios for more accurate signal detection. At the end of the course, you should be able to simulate and evaluate methods for array processing and inverse filtering tasks published in the signal processing literature. You should also have a practical feel as to the strengths and weaknesses of competing signal processing approaches as applied to wireless communication tasks.  

Course Outline:  

This course shall cover the following material in the course text:  

- Chapter 3: Random Variables, Vectors, and Sequences  
- Chapter 4: Linear Signal Models  
- Chapter 5: Nonparametric Power Spectrum Estimation  
- Chapter 6, Sections 6.1, 6.2: Linear Estimation Basics  

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• Chapter 11, Sections 11.1–11.4: Introduction to Array Processing
• Chapter 9, Sections 9.5, 9.6: Minimum-Variance Spectrum Estimation
• Chapter 11, Section 11.5–11.7: Adaptive Arrays and Direction Finding
• Chapter 6, Sections 6.6–6.9: Inverse Filtering and Deconvolution
• Chapter 12, Sections 12.1-12.4: Higher-Order Statistics and Blind Deconvolution

Prerequisites:
• EE5372/EE7372, or equivalent understanding of basic signal processing concepts; and basic understanding of random variables and processes (EE5375/7375 is not required but is recommended as a co-requisite if you have no previous experience with random signals).

Course Grading and Organization:

Grading in this course will be based on:
• six homework assignments (25% total);
• two 80-minute in-class examinations (45% total); and
• a final exam (30% total).

Each of these components are discussed in more detail below.

Homework: Homework assignments will be available on the Web on the following dates: January 17, January 31, February 14, February 28, March 21, and April 4. All homeworks except that assigned on February 28 are due at 5:00pm two weeks after these dates, and the homework assigned on February 28 is due at 5:00pm on March 21. The assignments could consist of (i) written mathematical problems and (ii) computing and simulation exercises. The written problems are designed to help you explore and understand the concepts discussed in-class and within the course text. The computing and simulation exercises give you the opportunity to implement and study various techniques used in spectral estimation, array processing, and equalization tasks. You must use MATLAB to solve the computing and simulation exercises. MATLAB is available in the computer labs within the Junktins Building; please contact the instructor for more information.

While completing these homework assignments, you may discuss any aspects of the problems with anyone you wish, including other classmates. The work that you hand in, however, should be your own, i.e., your own written mathematical solutions, file program listings, and figures/plots. Only a select set of problems or portions of problems from each homework assignment will be graded, and solutions to all of the problems will be made available shortly after the homework due date. No late homeworks will be accepted.

In-Class Examinations: There will be two 80-minute in-class examinations that will be given on Thursday, March 9 and Thursday, April 27. The examinations shall be designed to test your mastery of the course materials presented and homeworks completed in the prior weeks of the course. Note that reasonable extensions of any and all topics explored on any homework are “fair game” for the in-class exams. To ease the pressure on you somewhat on any one exam day, I will count your best exam score towards 25% of your total grade, and your next-best exam score will count towards 20% of your total grade.
Final Praxis: As part of the class, you are to complete a study or praxis of an important algorithmic or implementation issue that is related to a wireless communications application and that has a significant relationship to the material presented in the course. This praxis shall include:

- **Proposal:** This written document should be at least two pages. It should briefly outline the problem area or topic and provide three references to technical conference or journal papers that appear in the scientific literature. No two students can pick the same paper or papers, and papers will be allotted on a first-come, first-served basis as determined by when you hand in your proposal. The proposal counts as one-sixth of your praxis grade, or 5% of your total grade. The deadline for handing in this document is 5:00pm, Thursday, March 2.

- **Report:** This written document should be at least 7 pages single-spaced not including figures or tables, with all figures and tables appearing at the end of the document. It should discuss the important issues facing designers of systems within the problem area or topic and how the work contained in the three chosen technical papers relates to the problem area. Some form of numerical calculation or computer simulation must be included within the report. Copies of the three referenced papers must be included in an appendix to this report. The report counts as one-half of your praxis grade, or 15% of your total grade. The due date for this document is 3:00pm, Monday, May 8. All students, including off-campus and videotape students, will be required to hand in their reports at this time without exception.

- **Presentation:** This presentation should outline the results of your report. The presentation style should be formal, with computer-generated viewgraphs or slides detailing the issues addressed. The length of the presentation should not exceed 12 minutes, and you will be expected to both ask and answer questions after your presentation. The presentation counts as one-third of your praxis grade, or 10% of your total grade. Your presentation will be given on a Presentation Day to be held during the scheduled Final Examination Period from 3:00pm to 6:00pm, Monday, May 8. All students, including off-campus and videotape students, will be required to participate in the Presentation Day at this time without exception.

**Off-Campus and Videotape Students:** Due to the time lag associated with videotape delivery, off-campus students who are taking the course by videotape are required to hand in their homework assignments by 5:00 pm one week after the regular class due dates. In addition, these students must take each of the midterm exams within one week of their in-class counterparts. As stated above, however, all videotape students will participate in the Presentation Day on May 8, as scheduled, and they will hand in their Report at that time.