Adaptive Signal Processing
EENG 5630
Fall 2016

Class Timings: TR 2:30 PM – 3:50 PM, Discovery Park B242

Instructor: R. Thomas Derryberry (Email: tom.derryberry@unt.edu, Office: NTDP A154)

Office Hours: TR 2:00 PM – 2:30 PM, TR 4:00 PM – 5:00 PM, or by appointment.

Grader: Kiran Ambekar, Email (KiranAmbekar@my.unt.edu)

Course Webpage: All the course related material will be posted on the course webpage which is available through blackboard (https://learn.unt.edu).

Course Outcomes:
• Understand first-principle fundamentals, e.g.
  o Discrete-Time Signal Processing
  o Stationary Processes and Models
  o Spectrum Analysis
  o Eigenanalysis
• Understand Linear Optimum Filtering, e.g.
  o Wiener Filters
  o Linear Prediction
  o Kalman Filters
• Understand Linear Adaptive Filtering, e.g.
  o Least Squares Estimation
  o LMS and RLS Algorithms
• Understand Applications and limitations of Adaptive Filters
  o Tracking, System Identification, Beamforming
  o Numerical stability

Supplemental text: MATLAB 7 R14 Student Edition.

Recommended Prerequisites by Topic:
Random processes, digital signal processing, linear algebra, MATLAB coding

Catalog Description: Adaptive filters of one form or another are utilized in most all systems employing signal processing, e.g. radar/sonar systems, communications systems, automotive systems, control systems, etc. This course both mathematically and practically examines many popular adaptive filters, adaptations/variants of these adaptive filters, and applications along with convergence and tracking properties including performance measures and the implementation.
Topics:
- Introduction
- Background Material
- Wiener Filters
- Linear Prediction
- Kalman Filters
- Steepest Descent
- Least Mean Squared Algorithm
- Frequency Domain Adaptive Filters
- Method of Least Squares
- Recursive Least Squares Algorithm
- Square Root Adaptive Filters
- Tracking of Time Varying Systems
- Nonlinear Adaptive Filtering
- Numerical Stability

Secret to Success in this Course (Shsssh, don’t tell anyone!):
To do well in this course, you should be thoroughly familiar with this material. However, several years of research and practice including many trial and error attempts have resulted in the development of this long sought after but elusive recipe to success. The best kept secret to achieving success in this course is cordially shared with you below:
1. Read and comprehend the required text (Yes, you have to read!).
2. Know and explain how to correctly solve the homework assignments independently.
3. Know and explain how to correctly solve the programming assignments independently.
4. Arrive on time, engage in, and practice active listening for all of the class lectures.
By the way, there are rumors this recipe works very well when applied to other courses.

Grading:
Note: You MUST achieve PASSING PERFORMANCE for BOTH Parts 1 and 2 of the course grading in order to PASS the course, i.e. your grades for Parts 1 and 2 will not be merged together to yield a composite course score without FIRST achieving passing performance for both Parts 1 and 2 separately. Failure to achieve passing performance in either Part 1 or Part 2 will result in a final course grade of F.

<table>
<thead>
<tr>
<th></th>
<th>PART 1</th>
<th>PART 2</th>
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<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
<td>Midterm Exam 25%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>10%</td>
<td>Final Exam 35%</td>
</tr>
<tr>
<td>Programming Assignments</td>
<td>20%</td>
<td>-</td>
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<tr>
<td>Totals</td>
<td>40%</td>
<td>60%</td>
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</tbody>
</table>

Homework: Homework will be in the form of problem sets with a due date 1 week after it is assigned. No late homework will be accepted. Homework must be done individually (you will learn the most from this). Any evidence of group participation will be interpreted as academic dishonesty. There will be at least six homework assignments.

Programming Assignments: The programming assignments are an integral part of the course and are intended to provide experience in the application of the design techniques discussed in lecture. There will be at least six or seven programming assignments assigned. Your programming write-ups/solution(s) are due at the beginning of the class on the day the assignment is due. Additionally, you are to comment your Matlab code and make sure it’s working. It will be checked! If there is a runtime error, you will received a grade of 0 for the programming assignment. Create a readme file that describes the working and usage
of the code. Programming assignments must be done individually and can be done on your own PC. Any evidence of group participation will be interpreted as academic dishonesty.

**Quizzes:** There will be at least six or seven pop quizzes given throughout the semester. These will be to reward students who consistently show up to class, but rest assured it will be more than just attendance points.

**Exams:** There will be a midterm exam and a final exam. **Mobile phones are not permitted.** Exams will include material from the lecture, the readings, homework, and programming assignments. Final exam will be comprehensive. Exam dates are:

- **Midterm exam:** October 20, 2016, 2:30 PM – 3:50 PM, Discovery Park B242
- **Final exam:** December 13, 2016, 1:30 PM – 3:30 PM, Discovery Park B242

**Missing Classes/Assignments/Exams:** Attendance at all exams is mandatory. Throughout the semester, a student may miss classes, assignments, quizzes, or exams due to many reasons. Most of the reasons will not be accepted as an "excused" absence. Assignments, quizzes, or exams can be made-up only under extraordinary circumstances and only when notification is given to me before the quiz or exam is administered. A no-show for a quiz or exam without prior notification and a verifiable excuse (appropriate official documentation) results in a grade of 0 for that quiz or exam.

**Disputing Grades:** If you have a disagreement with how an assignment, quiz, or exam is graded, you should first get the solution to the assignment, quiz, or exam off the Blackboard course page and examine it. If you really believe that your answer is correct (matches the answer given in the solution), contact the grader and discuss it with him. The grader will listen to your concern, and act on it, at their discretion. In any case, they will sign the assignment verifying that they saw it again. Note that instructor or grader addition errors should follow the above procedure. Assignment, quiz, exam, and homework grades are disputable for **1 week** from the day the grades were assigned on Blackboard or when they were returned to you in person.

**Syllabus Revisions:** This syllabus may be modified as the course progresses. Notice of such changes will be by email, Blackboard, or announcement in class.

**Class Policies:** Please note that portable phones, pagers, and late arrivals are disruptive to the instructor and to your peers. The use of cell phones, beepers, or communication devices is disruptive and is therefore absolutely prohibited during class or while taking exams or quizzes. Turn off your cell phone while in class. If I catch you using these devices, your final grade will be reduced by 10% for each and every transgression and you will be asked to leave the class. Except in emergencies, students using such devices must leave the classroom for the remainder of the class period. I know that some of you may wish to take notes directly on your computer and I have no problem with that. If however, you choose to access your email, search the web, play games, or instant messenger your friends during class, you will have 5% deducted from your final grade for each and every transgression. This penalty will be at the sole discretion of the instructor. If for some reason I am late arriving to class, it will be because of circumstances beyond my control. You are expected to remain for 15 minutes past the scheduled class start time while I attempt to communicate my situation and relay instructions.

**Course Policies:** Keep all of your graded assignments, quizzes, and tests for study and review. You should track your own progress using Blackboard or other appropriate means and be aware of current grades throughout the term however the **official gradebook** will be my Excel spreadsheet. I will make all the effort to return the graded assignments, but it’s your responsibility to collect back the graded assignments from the grader or the instructor if it is not given back to you. A composite course score will be computed only for those students that achieve passing performance for both Part 1 and Part 2 of the grading assessment. Failure to achieve passing performance in either Part 1 or Part 2 will result in a final course grade of F.
Once passing performance has been achieved in BOTH Parts 1 and 2 of grading, the final grading for the composite (merging of Part 1 and Part 2 grading) course score will be done as follows: A > 90%, 90% > B > 80%, 80% > C > 70%, 70% > D > 60% and F < 60%. Grades will be curved if deemed necessary. Grades cannot be changed after they have been electronically entered into the university’s system except for instructor error. Any extenuating circumstances that may adversely affect your grade must be brought to my attention before the final course grades are recorded. To be considered, such circumstances must be unusual, unavoidable, and verifiable.

Disability Services/Special Needs: UNT complies with all federal and state laws and regulations regarding discrimination including the Americans with Disability Act of 1990 (ADA). If you have a disability and need a reasonable accommodation for equal access to education or services please contact the Office of Disability Accommodation. Please initiate this process and inform me during the first two weeks of class.

Academic Dishonesty: All the provisions of the University code of academic integrity apply to this course. In addition, it is my understanding and expectation that your signature on any test or assignment means that you neither gave nor received unauthorized aid. For homework and lab assignments, while discussion is allowed, direct copying is not and students must turn in individual submissions. Realize that mastery of the material in the homework and lab assignments will be essential for a good performance on the exams! All students are required to know, observe and help enforce the UNT Code of Student Academic Integrity. Cheating will result in disciplinary action according to UNT Policy 18.1.16. The penalty for a first offense can range from a formal warning to an ‘F’ for the course. Regardless of the penalty imposed, a record of the offense will be kept in the Office of the Dean of Students.

Tentative Course Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction and Background</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Background</td>
<td>Homework 1</td>
</tr>
<tr>
<td>3</td>
<td>Wiener Filters</td>
<td>Programming Assignment 1</td>
</tr>
<tr>
<td>4</td>
<td>Linear Prediction</td>
<td>Homework 2</td>
</tr>
<tr>
<td>5</td>
<td>Steepest Descent Method</td>
<td>Programming Assignment 2</td>
</tr>
<tr>
<td>6</td>
<td>Least Mean Squared Adaptive Filters</td>
<td>Homework 3</td>
</tr>
<tr>
<td>7</td>
<td>Frequency Domain Adaptive Filters</td>
<td>Programming Assignment 3</td>
</tr>
<tr>
<td>8</td>
<td>Method of Least Squares</td>
<td>Midterm Exam</td>
</tr>
<tr>
<td>9</td>
<td>Recursive Least Squares Adaptive Filters</td>
<td>Programming Assignment 4</td>
</tr>
<tr>
<td>10</td>
<td>Kalman Filters</td>
<td>Homework 4</td>
</tr>
<tr>
<td>11</td>
<td>Square Root Adaptive Filters</td>
<td>Programming Assignment 5</td>
</tr>
<tr>
<td>12</td>
<td>Tracking of Time Varying Systems</td>
<td>Homework 5</td>
</tr>
<tr>
<td>13</td>
<td>Nonlinear Adaptive Filtering: Extended Kalman Filter</td>
<td>Programming Assignment 6</td>
</tr>
<tr>
<td>14</td>
<td>Numerical Stability / Finite Precision Effects</td>
<td>Combined: Homework 6 / Programming Assignment 7</td>
</tr>
<tr>
<td>15</td>
<td>Wrap up</td>
<td>TBD</td>
</tr>
<tr>
<td>16</td>
<td>Final Exams</td>
<td>Comprehensive Final Exam</td>
</tr>
</tbody>
</table>