KFUPM

EE 570 **EE Department** Sep. 12, 2011

FINAL PROJECT

The intention of this project is to develop your ability of self-learning from published literature and enhance your capability to analyze conflicting results. Specifically, a student will work on some topic in signal processing or communication and provide a tutorial-like report of that topic. The tutorial should NOT be based on an existing tutorial of the topic but rather on collecting various papers on the topic and trying to summarize their findings in a tutorial manner.
Please note that you need to take my consent before deciding on the topic that will serve as your project.

Term Paper and Oral Presentation The term paper should be clearly written and should describe the topic in a somewhat tutorial manner. It should be understandable by the non-expert.

The report should be between 15 and 20 typed pages using one and a half line spacing and font size 12 (I prefer that you use LATEX to typeset your paper, as this is the package used by the scientific community, but the choice is yours). The final report is due at the end of week 14 of the semester. In the final week of the semester, each student is required to make a 15 minutes presentation.

Grade Distribution

Proposal (2%): Proposal is due on Oct. 3rd.

Presentation (6%): Presentations will be held in the last week of classes.

Presentation (12%): Written reports are due in class on Sat. Dec. 24, 2011.

Project topics Consider the following points as you look for a class project

- To maximize the usefulness of the project, it is best that each student think about topics that might be in line with their research.
- Alternatively, the topic could also be something not covered in the class (or only partially covered), is of interest to the student and related to digital communication and/or signal processing.
- You could also select a topic from the list below. I have tried to provide a brief description of each topic and when possible I also provided some references.

Sum of squares of Gaussian random variables : Let $x_1, x_2, \cdots, x_n$ be jointly Gaussian random variables. Many applications depend on the random variables $S = \sum_{i=1}^{n} x_i^2$ or ratios of such variables $\frac{\sum_{i=1}^{n} x_i^2}{\alpha + \sum_{i=1}^{n} y_i^2}$ (which represents some form of Signal to noise and Interference ratio (SINR)). Your task to identify applications where such random variables are used.

Free Probability in Random Matrix Theory Random matrix theory has attracted a lot of attention recently as a tool for evaluating the behavior of communication systems. Free probability is an important concept in random matrix theory. You are to study the approach of free probability in random matrix theory and explore some of its applications.

1. Antonia M. Tulino and Sergio Verd, Random Matrix Theory and Wireless Communications

Compressive Sensing: Compressive sensing is an emerging technique for identifying sparse signals and has attracted a lot of attention recently. Your task is summarize the basic results that have appeared in literature on this subject.

Vector Calculus: Vector Calculus is the tool associated with optimization of vectors and matrices. You are to study and summarize the main tools used in vector calculus.

1. John A. Eisele and Robert M. Mason, Applied matrix and tensor analysis, Wiley-Interscience, 1970.
2. Graham, Alexander, Kronecker products and matrix calculus : with applications, E. Horwood New York, Halsted Press, 1981.
3. Jan R. Magnus and Heinz Neudecker, Matrix differential calculus with applications in statistics and econometrics, 1999.
4. Kaare Brandt Petersen and Michael Syskind Pedersen, The Matrix Cookbook, Version: February 16, 2006 (Chapters 2,3)

Alternative representation of the Q function: Most of the probability of error results that we will get will be in terms of the Q function. Recently, a new representation of the Q function (as a definite integral) has been used and it has been shown to be very useful in evaluating the probability of error performance for various modulation schemes. You are to study this new representation and use it to evaluate the performance of some modulation system.

S. Alouini and M. Simon, 'A Unified Approach to the Performance Analysis of Digital Communication over Generalized Fading Channels', Proceedings of IEEE, pp. 1860-1879, 1998.

Othe Topics: Expectation-Maximization Algorithm and its Applications, VBLAST, Saddle-Point Theorem & its Applications, Belief Propagation/Message Passing Algorithms, Interference Alignment, Total Least Squares.