THE UNIVERSITY OF WESTERN ONTARIO
FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ECE 9023 – Random Signals, Adaptive and Kalman Filtering (M.Eng. only)

COURSE OUTLINE

OBJECTIVE:

This course will introduce to the students the theoretical and implementation aspects of adaptive and Kalman filters. Students will gain a deeper understanding of random signals and the analysis of linear systems in a stochastic framework. Students will understand the theory behind various adaptive Finite Impulse Response (FIR) filtering techniques such as the Least Mean Square (LMS), Recursive Least Squares (RLS), and Affine Projection Algorithm (APA). In addition, students will grasp the practical aspects of adaptive and Kalman filters through implementation and simulation studies.

CONTACT HOURS: 3 lecture hours/week, half course

ANTIREQUISITE: None

PREREQUISITES: ECE 4429 or equivalent. Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

COURSE CONTENT:

- Random signals and stochastic processes
- Linear optimum filtering theory
- Method of Steepest Descent
- The Least Mean Square (LMS) algorithm and its analysis
- The Recursive Least Squares (RLS) algorithm and its analysis
- The Affine Projection Algorithm (APA) and its analysis
- Kalman filters
- Other adaptive filters – subband adaptive filters and IIR adaptive filters.

SPECIFIC LEARNING OBJECTIVES:

1) To understand the effects of linear filtering on random signals through the analysis of correlation and power spectral density functions.
2) To understand the conceptual framework of linear optimum filtering theory and the derivation of Wiener-Hopf equations.

3) To understand the theory behind popular adaptive algorithms such as the Least Mean Square (LMS), Recursive Least Squares (RLS), and Affine-Projection Algorithm (APA).
4) To understand Kalman filter theory and its relation to RLS adaptive filters.
5) To understand the convergence and tracking characteristics of the LMS, RLS, and APA adaptive filters.

TEXTBOOK:

[1] S. Haykin, "*Adaptive Filter Theory*", Prentice Hall Inc., Upper Saddle River, New Jersey, USA, 4th edition, 2002.

COURSE PROJECT:

The students in the course will be required to perform a project either using MATLAB or the Texas Instruments C6713 DSP chip on an assigned topic related to adaptive filters and submit a report.

EVALUATION:

For the purpose of evaluation, the course is divided into three components, namely

a) project report
b) assignments, and
c) mid-term

The assignments will include both theoretical analysis of adaptive filters and practical implementation of the adaptive filtering algorithms using MATLAB. It is assumed that students have the ability to program in MATLAB. The midterm will be an open book examination held during the regular class hours.

In order to pass the course, a student must obtain a passing grade in each component. A student who fails one of the components shall receive a final grade not greater than 48%. The weighting of each of these components will be as follows:

		Maximum Penalties*	
Component	**Value**	**English**	**Presentation**
Project Report	40%	10%	10%
Assignments	25%	10%	10%
Midterm	35%	10%	10%

*In accordance with the policy of the University, the grade assigned to all written and oral work presented in English shall take into account syntax, diction, grammar and spelling. In the professional life of an engineer, the manner in which oral and written communications are presented is extremely important. An engineering student must develop these skills as an integral part of the undergraduate program. To encourage the student to do so, the grades

assigned to all written and oral work will take into account all aspects of presentation including conciseness, organization, neatness, use of headings, and the preparation and use of tables and figures.

All work will be marked first for content after which a penalty not to exceed the maximum shown above may be applied for lack of proficiency in English and/or presentation.

ATTENDANCE:

Any student, who in the opinion of the instructor is absent too frequently from class in this course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.

CHEATING:

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

PLAGIARISM:

Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage of text from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar). The following web site provides some clear examples that will help avoid plagiarism:
http://www.hamilton.edu/writing/writing-resources/using-sources

COURSE INSTRUCTOR:

Professor Vijay Parsa
Elborn College, Room 2262E
661-2111 ext. 88947
parsa@nca.uwo.ca