EE433 Real-time Applications of Digital Signal Processing

Course Description: This course teaches the theory and practice of signal processing on real world problems. Particular emphasis is given to the practical applications and real-time processing in embedded systems. Students will apply the Signal Processing theory in MATLAB and LabVIEW and hence this course will provide extensive hands-on experience for real-time processing with embedded systems. The course aims to strengthen the student's understanding of the foundations of Digital Signal Processing. Students will get acquainted with the professional hardware and software. This course allows students to gain knowledge and experience to implement complete DSP projects and improve skills on embedded platforms through intense laboratory experiments. Interactive teaching of the DSP applications and practical evaluation of the students' progress will improve students' background continuously. Students are expected to gain important engineering skills by implementing signal processing systems in MATLAB and real-time embedded hardware by writing efficient programs in LabVIEW and C.

Instructor: T.Engin Tuncer [office: E-109] Office Hour: Thursday 8:30-9:30

Course Assistant: Can Deniz Bezek [office: D-227]

Grading: Class Attendance %5, Midterm 20%, Final 25 %, Project 15 %, Preliminary 15%, Laboratory Performance(inc.quiz) 20 %.

Requirement: Students should take all the labs, midterm and final exams. Those who do not satisfy the above conditions will be graded as NA.

Textbook: Digital Signal Processing System-Level Design Using LabVIEW, N.Kehtarnavaz, N. Kim Elsevier, 2005.

References:1. 1.LabVIEW Signal Processing, M.L.Chugani, A.R.Samant, M.Cerna, 1998.
2.Hands-On Introduction to LabVIEW for Scientists and Engineers,John Essick,2013.
3.LabVIEW Digital Signal Processing and Digital Communications, C. L. Clark, 2005.

Matlab Ref.: Mastering MATLAB: A Comprehensive Tutorial and Reference, D. Hanselman, Prentice Hall,1996.

Other References:
1. Discrete-time Signal Processing, A. V. Oppenheim, R.W. Schafer, 2014.
2. Discrete Random Signals and Statistical Signal Processing, C.W. Therrien,1992.
3.Adaptive Filter Theory, S.O.Haykin, 1996.
4. Digital Image Processing, R.C.Gonzalez,R.E.Woods, 2008.

Course Outline and Schedule

WEEK	LECTURE TITLE (Section from the textbook)
1.	Experiment 1: Programming simple functions in LabVIEW on a PC
2.	Experiment 2: Programming both myRIO CPU and FPGA
3.	Experiment 3 Part1Signal generation, filtering, cross correlation, A/D, D/A, DMA, MATLAB implementation.
4.	Experiment 3 Part2: Realization of the experiment in real-time, demo and evaluation.
5.	Experiment 4 Part1: Decimation, Interpolation, Phase-Locked Loop, MATLAB implementation.
6.	Experiment 4 Part 2: Realization of the experiment in real-time, demo and evaluation
7.	Experiment 5 Part 1: Optimum filtering: FIR Wiener filter implementation for noise removal, MATLAB implementation.
8.	Experiment 5 Part 2: Realization of the experiment in real-time, demo and evaluation.
9.	Experiment 6 Part1: System Identification with Adaptive Processing, design and implementation of LMS filter. MATLAB implementation.
10.	Experiment 6 Part 2: Realization of the experiment in real-time, demo and evaluation
11.	Experiment 7 Part 1: Image processing, 2D FFT, filtering, edge detection, MATLAB implementation.
12.	Experiment 7 part 2: Realization of the experiment in real-time, demo and evaluation

Software and Hardware: In this course, MATLAB, LabVIEW and C are used for implementing the signal processing tasks on PC and real-time embedded platform NI myRIO.