GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (COMMUNICATION SYSTEMS ENGG) (05)
ADAPTIVE SIGNAL PROCESSING
SUBJECT CODE: 2720505
M.E. SEM-II

Type of course: Major Elective - II

Prerequisite: Digital Signal Processing

Rationale:
There are number applications of Digital Signal Processing in various areas. The number keeps on growing with different requirements. The typical requirements nowadays require the system to keep track of the changing environment. This requires adaptations in the system characteristics.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Linear Prediction and Optimum Linear Filters SIgnals,Correlation Functions and Power Spectra,Innovations Representation of a Stationary Random Process,Forward and Backward Linear Prediction,Solution of Normal Equations,Properties of Linear Prediction – Error Filters,AR Lattice and ARMA Lattice-Ladder Filters,Wiener Filters for filtering and Prediction	8	20
2	Algorithms for Adapting FIR Filters Search Techniques,Gradient search Approach,Least Mean Square Algorithm,Recursive Least Squres Algorithms	8	15
3	Algorithms for Adapting IIR Filters IIR Modeling,Gradient Descent Minimization of squared Prediction Error,Parameter Identification format and Stability theory Interpretation,Filtered Error and Filtered-Regressor Algorithms,Steiglitz-McBridge Algorithm,IIR whitner,ARMAX modeling	8	15
4	Frequency-Domain and Subband Adaptive Filters Block Adaptive Filters,Fast Block-LMS algorithm,Unconstrained Frequency-Domain Adaptive Filters,Self-Orthogonalising Adaptive Filters,Adaptive Equalization,Subband Adaptive Filters,Classification of Adaptive Filtering Algorithms	8	15
5	Kalman Filters Innovations Process, Estimation of the State Using the Innovations ProcessKalman Filter as the Unifying Basis for RLS filters,Variations of the Kalman Filter	8	15
6	Applications	8	20

	Hum Removal for an ECG, Multipath Correction for Troposcatter Signals and Digital TV signal, Enhancing Signal Reception Quality using an Array of Antenna		
	Total	48	100%

Reference Books:

1. S.Haykin,"Adaptive Filter Theory",Pearson,2003
2. B.Widrow and S.D.Stearns,"Adaptive Signal Processing", Pearson,2009
3.J.Treichler,C.R.Johnson,M.G.Larimore,"Theory and Design of Adaptive Filters",PHI,2002
4.J.G.Proakis,D.G.Manolakis,"Digital Signal Processing:Principles,Algorithms, and Applications",2011

Course Outcome:

By the end of this course, the student should be able to do the followings

1. To Analyze and implement Wiener filters
2. To Analyze and implement LMS and normalized LMS Adaptive filterssignals.
3. To Analyze and implement frequency domain Adaptive filters
4. To Analyze and implement Recursive Adaptive filters
5. To apply adaptive signal processing to various applications

List of Experiments:

Based on the above syllabus

Design based Problems (DP)/Open Ended Problem:
1. Examine the transient behaviour of steepest –descent algorithm applied to 2-tap predictor that operates on real valued Autoregressive process.
2. Apply LMS algorithm for adaptive equalization of a linearly dispersive channel that produces (unknown distortion) with all real valued data.
3. Illustrate step-size control for Acoustic echo cancellation
4. Compare the ensamble average error performance of the DCT-LMS algorithm to LMS and RLS for different values of channel parameters.
5. Use LMS and RLS algorithms to an adaptive minimum variance distortionless response (MVDR) beamformer consisting of a linear array of five uniformly spaced sensors. Examine the evaluation with time of the adapted spatial response (pattern) of the MVDR beamformer for a prescribed target signal-to-interference ratio and evaluate the effect of varying target signal-to-interference ratio on the interference nulling performance of the beamformer

Major Equipments:

DSP Processor Kit TMS6713

List of Softwares:

MATLAB,CCS

List of Open Source Software: SCILAB

Learning website:

www.nptel.ac.in

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.