

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (WIRELESS COMMUNICATION TECHNOLOGY) (44)

SMART ANTENNAS FOR WIRELESS COMMUNICATION SYSTEM

SUBJECT CODE: 2724405

M. E. Semester – II

Type of course: Major Elective-II

Prerequisite: Fundamental of Electromagnetic theory and Antenna Engineering. Fundamental of Fading Channels.

Rationale: Aim is to provide a comprehensive and detailed treatment of various antenna array processing schemes, adaptive algorithms to adjust the required weighting on antennas, direction-of-arrival (DOA) estimation methods including performance comparisons, diversity-combining methods to combat fading in mobile communications, and effects of errors on array system performance and error-reduction schemes. The use of smart antennas in mobile communications to increase the capacity of communication channels has reignited research and development in this very exciting field.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
		ESE			OEP	PA	RP			
3	0	2#	4	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction: Antenna Gain, Phased Array Antenna, Power Pattern, Beam Steering, Degree of Freedom, Optimal Antenna, Adaptive Antenna, Smart Antenna	02	5%
2	Narrowband Processing: Signal Model, Conventional Beamformer, Null Steering Beamformer, Optimal Beamformer, Optimization Using Reference Signal, Beam Space Processing	05	15%
3	Adaptive Processing: Sample Matrix Inversion Algorithm, Unconstrained Least Mean Squares Algorithm, Normalized Least Mean Squares Algorithm, Constrained Least Mean Squares Algorithm, Improved Least Mean Squares Algorithm, Recursive Least Squares Algorithm, Neural Network Approach, Adaptive Beam Space Processing, Signal Sensitivity of Constrained Least Mean Squares Algorithm, Implementation Issues	06	20%
4	Broadband Processing: Tapped-Delay Line Structure, Partitioned Realization, Derivative Constrained Processor, Correlation	05	10%

	Constrained Processor, Digital Beam-forming, Frequency Domain Processing		
5	Correlated Fields: Correlated Signal Model, Optimal Element Space Processor, Optimized Post beam-former Interference Canceler Processor, Signal-to-Noise Ratio Performance, Methods to Alleviate Correlation Effects, Spatial Smoothing Method, Structured Beam-forming Method, Correlated Broadband Sources	06	20%
6	Direction-of-Arrival Estimation Methods:Spectral Estimation Methods,Minimum Variance Distortion-less Response Estimator,Linear Prediction Method,Maximum Entropy Method,Maximum Likelihood Method,Eigen structure Methods	06	15%
7	Diversity Combining:Selection Combiner,Switched Diversity Combiner, Equal Gain Combiner, Maximum Ratio Combiner, Optimal Combiner, Generalized Selection Combiner, Cascade Diversity Combiner,Macroscopic Diversity Combiner	06	15%

Reference Books:

(1) SMART ANTENNAS: Lal Chand Godara, CRC Press

Course Outcome:

After learning the course the students should be able to know various antenna array processing schemes, adaptive algorithms to adjust the required weighting on antennas, direction-of-arrival (DOA) estimation methods including performance comparisons, diversity-combining methods to combat fading in mobile communications, and effects of errors on array system performance and error-reduction schemes.

List of Experiments:

Based on Syllabus

Design based Problems (DP)/Open Ended Problem:

1. Write Matlab code for optimal beam-former.
2. Implement Optimal beam space processor.
3. Obtain OUTPUT SNR vs INPUT SNR of post beam-former interference canceler using conventional interference beam-former.
4. Obtain output noise power (dB) vs the iteration number for a 10-element linear array with one half wavelength spacing using 1) Structured Gradient Algorithm, b) Standard LMS Algorithm. Assume appropriate two interferences.

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.