STATISTICAL SIGNAL PROCESSING

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TYPE OF COURSE : Rerun | Core | PG
COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22)
EXAM DATE : 23 Apr 2022

PRE-REQUISITES : A Basic Course in Probability

INTENDED AUDIENCE : PG and UG students

COURSE OUTLINE :
Many practical signals are random in nature or modelled as random processes. Statistical Signal Processing involves processing these signals and forms the backbone of modern communication and signal processing systems.This course will the three broad components of statistical signal processing: random signal modelling, estimation theory and detection theory.

ABOUT INSTRUCTOR :

Prof. Prabin Kumar Bora received his Ph.D from IISc Bangalore. He joined IIT Guwahati in 1997. Presently he is working as Professor in Department of Electrical and Electronics Engineering at IIT Guwahati.

COURSE PLAN :

Week 1 & 2 : Introduction; Stationary processes: Strict sense and wide sense stationarity; Correlation and spectral analysis of discrete-time wide sense stationary processes, white noise, response of linear systems to wide-sense stationary inputs, spectral factorization

Week 2, 3 & 4 : Parameter estimation: Properties of estimators, Minimum Variance Unbiased Estimator (MVUE Cramer Rao bound, MVUE through Sufficient Statistics, Maximum likelihood estimation- properties. Bayseaen estimation-Minimum Mean-square error(MMSE) and Maximum a Posteriori(MAP) estimation

Week 5 : Signal estimation in white Gaussian noise– MMSE, conditional expectation; Linear minimum mean-square error(LMMSE) estimation–, orthogonality principle and Wiener Hoff equation

Week 6 : FIR Wiener filter, linear prediction-forward and backward predictions, Levinson-Durbin Algorithm, application –linear prediction of speech

Week 7 : Non-causal IIR wiener filter, Causal IIR Wiener filtering

Week 8, 9 & 10: Iterative and adaptive implementation of FIR Wiener filter: Steepest descent algorithm, LMS adptive filters, convergence analysis, least-squres(LS) method, Recursive LS (RLS) adaptive filter, complexity analysis, application- neural network

Week 10 & 11: Kalman filters: Gauss -Markov state variable models; innovation and Kalman recursion, steady-state behaviour of Kalman filters

Week 12: Review; Conclusions.