ADAPTIVE SIGNAL PROCESSING

Course Code: 13EC2112

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Course Outcomes:

After completion of the course, the student is able to

CO1: Comprehend design criteria and modeling adaptive systems and theoretical Performance evaluation.

CO2: Design a linear adaptive processor.

CO3: Apply mathematical models for error performance and stability.

CO4: Apply adaptive modeling systems for real time applications.

CO5: Comprehend the estimation theory for linear systems and modeling algorithms.

CO6: Design based on Kalman filtering and extended Kalman filtering.

UNIT – I

ADAPTIVE SYSTEMS:

Characteristics, Areas of application, general properties, open and closed loop adaptation, applications of closed loop adaptation, Example of an Adaptive System, The Adaptive Linear Combiner: Description, Weight Vectors, Desired Response, Performance Function; Gradient and Minimum Mean-Square Error.

Approaches to the Development of Adaptive Filter Theory: Introduction to Filtering Smoothing and Prediction-Linear Optimum Filtering, Problem Statement, Principle of Orthogonality, Minimum–Mean-Squared Error, Wiener –Hopf Equations, Error Performance, Normal Equation.

UNIT – II

GRADIENT SEARCHING AND ESTIMATION:

Searching the Performance Surface – Methods and Ideas of Gradient Search Methods, Gradient Searching Algorithm and its Solution, Stability and Rate of Convergence, Learning Curves, Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.

Gradient component estimation by derivative measurement, the performance penalty, derivative measurement and performance penalties with multiple weights, variance of the gradient estimate, effects on the weight vector solution

UNIT-III

LMS & RLS ALGORITHMS:

Overview, LMS Adaptation Algorithms, Stability and Performance Analysis of LMS Algorithms, LMS Gradient and Stochastic Algorithms, Convergence of LMS Algorithms, RLS algorithms

UNIT-IV

ADAPTIVE MODELING AND SYSTEM IDENTIFICATION: general description, adaptive modeling of multipath communication channel, adaptive modeling in geophysical exploration, adaptive modeling in FIR digital filter synthesis, general description of inverse modeling, some theoretical examples.

UNIT-V

KALMAN FILTERING THEORY:

Introduction, Recursive Mean Square Estimation for Scalar Random Variables, Statement of Kalman Filtering Problem, Innovation Process. Estimation of State using the Innovation Process, Filtering, Initial Conditions, Summary of Kalman Filters, Variants of the Kalman Filtering, the Extend Kalman Filtering, Identification as a Kalman Filtering Problem.

TEXT BOOKS:

1. BernandWidrow, Samuel D. Stearns, "*Adaptive Signal Processing*", Pearson Education, Asia.2009.

2. Simon Haykins, "*Adaptive filter Theory*", PHI.2003.

REFERENCES BOOKS:

1. Sophocles J. Orfamidis, "*Optimum Signal Processing – An Introduction*", 2nd Edition, McGraw Hill.

2. S. Thomas Alexander, "*Adaptive Signal Processing – Theory and Applications*", SpringerVerlag.

3. TulayAdali, Simon Haykin, "*Adaptive Signal Processing – Next Generation Solutions*", Wiley Publications, 2012.