

ECE 245 ADAPTIVE FILTER THEORY
TENTATIVE COURSE OUTLINE

OPTIMAL FILTERING

- Wide-sense stationary signals
- Wiener-Hopf equation
- Noncausal Wiener filter
- Causal Wiener filter
- Mean-square-error (MSE) expressions

PERFORMANCE SURFACE

- Natural, translated, and rotated coordinate systems
- Normal form of the correlation matrix R
- Interpretation of eigenvalues and eigenvectors
- Stochastic normal equation
- Stochastic orthogonality principle

STEEPEST DESCENT AND NEWTON'S METHOD

- Gradient vector and Hessian matrix
- Stability conditions for convergence
- One-step convergence
- Geometric ratio and time constants

GRADIENT ESTIMATION

- Weight-misadjustment method
- Perturbation P
- Gradient noise model
- Misadjustment M

LEAST-MEAN-SQUARE (LMS) ALGORITHM

- Convergence in the mean
- Convergence of the MSE
- Stability conditions on the step-size parameter μ
- Misadjustment expressions
- Modified LMS algorithms

METHOD OF LEAST SQUARES (LS)

- Nonrecursive (block) solution
- Windowing of the data
- Deterministic normal equation
- Deterministic orthogonality principle
- Minimum sum of squared errors
- Properties of LS estimates

RECURSIVE LEAST SQUARES (RLS)

- Exponential weighting λ
- Prewindowed data
- Matrix inversion lemma
- Weight and error recursions
- Initial conditions
- Convergence in the mean (bias)
- Convergence in the mean square
- Sliding window form

LINEAR PREDICTION

- Forward and backward prediction errors
- Augmented normal equation
- Levinson-Durbin recursion
- Reflection coefficients (time-invariant)
- Lattice realization
- Step-up and step-down recursions
- Correlation properties
- Joint-process estimation
- Burg formula

ADAPTIVE LATTICE FILTERS

- Gradient methods
- Least-squares approach
- Augmented normal equation: prewindowed form
- A priori and a posteriori estimation errors
- Order updates
- Gain vector, likelihood variable γ
- Time updates
- Joint-process estimation
- Correlation properties

APPLICATIONS

- Linear prediction
- Adaptive noise canceling
- System identification
- Inverse modeling