Department of Electrical & Computer Engineering
University of California, Santa Barbara

ECE 245
Spring 2008
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H.O. #2

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