EE641-Digital Image Processing II
Spring 1996

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References:

1. R. Chellappa and A. Jain, *Markov Random Fields: Theory and Application,* Academic Press, 1993.
2. A. K. Jain, *Fundamentals of Digital Image Processing,* Prentice-Hall, 1989.
3. A. Rosenfeld and A. Kak, *Digital Picture Processing,* volumes 1 and 2, Academic Press, 1982.
4. R. Kindermann and J. L. Snell, *Markov Random Fields and their Applications,* Providence: American Mathematical Society, 1980.
5. R. Szeliski and T. Kanade, *Bayesian Modeling of Uncertainty in Low-Level Vision,* Kluwer Academic Publishers, 1989.
6. W. Briggs, *A Multigrid Tutorial,* Society for Industrial and Applied Mathematics, Philadelphia, 1987.
7. A. Tikhonov V. Arsenin and F. John, *Solutions of Ill-Posed Problems,* V. H. Winston & Sons, 1977.

This course will cover topics in image processing at the level of current research. Reference material will be primarily in the form of journal publications. The course will include computer homework assignments, one computer project, one take home midterms and a final. Final grades will use the following weighting.

Homework and computer project	30%
Midterm #1	30%
Final exam	40%

Course Outline

1. Random Variables
2. Whitening
3. Autoregressive Process
    a. 1D, 2D
    b. Matrix Representation of 2D Autocovariance
    c. Computing optimal predictors
4. Gauss-Markov Random Field
5. Simultaneous AR
6. Image Restoration
    a. GMRF
    b. Optimization
        i. Gauss-Seidel,ICM,Coordinate Decent
        ii. Gradient Search
        iii. Convexity
    c. MAP vs. MMSE
7. Markov Chains
    a. Matrix Representation
    b. Parameter estimation
    c. Dynamic programming
8. MRF's
    a. Gibb's Distributions
    b. Hammersley Clifford Theorem
    c. Simmulation
9. Segmentation
    a. Bayesian Model
    b. Simulated Annealing
    c. MPM
    d. Multiscale Techniques
10. EM algorithm
    a. Derivation
    b. Clustering
    c. Convergence
    d. Hidden Markov Models
11. Emission/Transmission Tomography
    a. Derivation of model
    b. EM algorithm
    c. MRF prior
    d. Influence functions
12. Multiscale Stochastic Models
    a. Stochastic Trees
    b. Estimation-ML,MPM,SMAP
    c. Fast algorithms
13. High level Models
    a. Template matching
    b. Image interpretation