EE 641 DIGITAL IMAGE PROCESSING II
Assignment #2 - Spring 1996
January 25, 1996

1) Let $\{Y_n\}_{n=0}^{N-1}$ be a 1-D order p GMRF with

$$\begin{aligned} \hat{Y_n} &= E[Y_n | Y_i \; i \neq n] \\ &= \sum_{j=-p}^{p} g_j Y_{n-j} \\ E[(Y_n - \hat{Y_n})^2] &= \sigma_{nc}^2 \end{aligned}$$

where Y_n is assumed 0 for $n < 0$ or $n \geq N$. Show that

$$p(y) = \frac{1}{(2\pi\sigma_{nc}^2)^{(N/2)}} |B|^{1/2} \exp\left\{ \frac{1}{2\sigma_{nc}^2} y^t B y \right\}$$

where

$$B_{i,j} = \delta_{i-j} - g_{i-j} \; .$$

2) Download the directory *HW2Dir* off the course web page. This directory will contain data and source code you will need to complete this homework.

3) Use the C source code provided to write a program that converts the full color tiff image to a monochrome tiff image of the same size by combining the three color planes using the formula

$$Y = 0.2125 * R + 0.7154 * G + 0.0721 * B$$

where R, G, and B are the three color components and Y is the monochrome image. Print both the color and monochrome images by using the application XV to convert them to postscript, and then sending the postscript to the color laser printer. Do not send the raw TIFF image to the printer!!!

3) Compute the optimal causal prediction filter of order $p = 1, \cdots, 3$ for the resulting monochrome image. Remember that the prediction filter equation derived in class assumed a zero mean image, so subtract off the mean first. Print out the prediction parameters that you compute.

4) Compute the image of prediction errors for $p = 1, \cdots, 3$. Add 127 to the prediction errors and write them out as a TIFF image. Then display and print the resulting image of prediction errors.

5) Compute the spatial autocorrelation for the prediction error images for $p = 1, \cdots, 3$.. Plot the autocorrelation functions using Matlab, and hand in a printout of your plots.