GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

ECE 6258
Digital Image Processing
Fall 2003

Problem Set #1

Issued: Friday, August 22, 2003
Due: Monday, September 1, 2003

Problem 1.1 (Quantization): On the class webpage
http://www.ee.gatech.edu/users/rmm/fall2003/ece6258/ece6258fall03.html
you will find a file containing a copy of the CAMERAMAN image, `cameraman.tif`. (It is also available in the Image Processing Toolbox in MATLAB.)

(a) Read the image into MATLAB and quantize it uniformly to ten levels. Turn in both the original image and the quantized image. Evaluate the mean squared error between the original image and the quantized image. Be careful to select the representative levels to make the mean squared error as small as possible.

(b) Generate random noise uniformly distributed over $[-d/2, d/2]$, where d is the step size for the quantization in part (a), and add this noise to the original image. Quantize this dithered image uniformly to 10 levels. Turn in this dithered and quantized image. Also, evaluate the mean squared error between the original and the dithered and quantized image.

(c) In which case ((a) or (b)) do you get a higher mean squared error? In which case do you get a higher subjective quality. Explain your answers briefly.

Problem 1.2 (Image Segmentation): Download the (color) aerial image of the Island of Jersey (`jersey.jpg`) from the class webpage.

(a) Write an image processing algorithm in MATLAB that measures the area of the island in pixels. If each pixel corresponds to a square surface patch that is 30m on a side, estimate the area of the island in square kilometers.

(b) Turn in a mask image in which the island pixels are colored white and the remainder of the image is black.

(c) (optional) Think about how you might derive an automatic procedure that will clean up the mask image in (b) so that the white pixels are confined to the main island.

Problem 1.3 (2-D Convolution): Consider the sequence x defined by

$$x[n_1, n_2] = \begin{cases} 1, & 0 \le n_1 \le n_2 \\ 0, & \text{otherwise.} \end{cases}$$

Determine the convolution of x with itself.