

## ECE 178 HW #2

Due: Friday, Oct 9, 2009

### Chapter 2

Problems 2.11-2.19, except 2.14

#### Programming assignment

This is a MATLAB programming question. You need to familiarize yourself with the MATLAB environment first. It is strongly encouraged that you go through one of the many online MATLAB tutorials (see, for example, the book's web site) and the exercises included in the class handout. Submit MATLAB code and results (you can use *publish*) for the following:

#### a) For years and years everyone has loved Lena



Read in `lena.gif` (download from <http://www.ece.ucsb.edu/~manj/ece178/lena.gif>) as a grayscale intensity image, `S`. Pay attention to the data type of `S` (uint8 vs. double) for consistency with your work in the following parts of the problem.

#### b) But Lena only has eyes for MATLAB

Add a special noise matrix, `N`, to the Lena image, `S`. The noise at each pixel is zero-mean Gaussian with variance as a function of its spatial position  $(x, y)$  as:

$$\sigma^2(x, y) = 1 - e^{-\frac{x^2 + y^2}{W}}$$

`W` is a constant scaling factor equal to  $100 * R * C$ , the number of rows and columns in the input image `S`, respectively. Use of `for` or `while` loops is not permitted in computing the noise matrix `N`. *Hints*: Recall for a random variable `G` that  $\text{var}(\alpha G) = \alpha^2 \text{var}(G)$ . Also review the functions `meshgrid` and `randn` for help in creating a variance matrix.

#### c) Average SNR

Compute the signal-to-noise ratio (a scalar value) averaged over all the pixels of the noised image `O = S + N` as:

$$SNR = \frac{1}{|X||Y|} \sum_{x \in X} \sum_{y \in Y} \frac{\mu(x, y)}{\sigma^2(x, y)}$$

$\mu$ , the matrix of mean values of `O` is equal to `S` since the noise matrix `N` has zero means. Plot the SNR as you vary `W` from  $(10 * R * C)$  to  $(100 * R * C)$  over 10 equal points (see the `plot` and `linspace` functions.)

Submit your plot along with a few examples of the noised image `O` for different values of `W`.