Take-Home Exam (Due 5/4/12)

Introduction
Many types of image and video degradations produced both during acquisition and transmission are due to impulsive noise contamination. Hence, suppression of impulsive noise is one of the important tasks in image and video restoration. Several nonlinear spatial filters have been proposed for the restoration of video sequences contaminated by impulsive noise. Among these, the median filters and their variants can be considered as the most popular types used for impulsive noise suppression. Mean filters have been also used, although they are not as efficient as the median filters. Figure 1 shows a general description of how the contamination and filtering occurs. Notice that the filtered image has the main features of the original one, but is slightly blurred due to the filtering process. Salt-and-pepper noise has been added to an image, to simulate the contamination process.
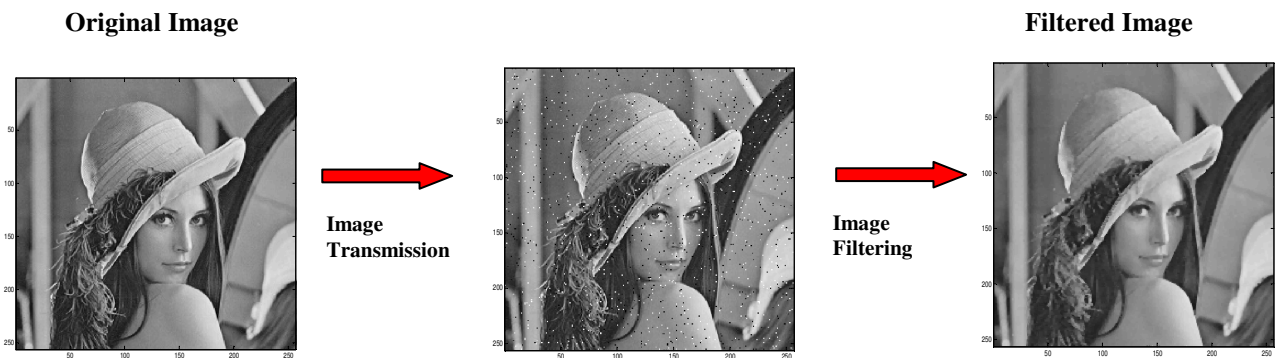
Original Image   **Filtered Image**

Image Transmission   **Image Filtering**

Figure 1. Image contamination and filtering.

Background on the Mean and Median Filters
In the first take-home exam we used the mean and median filters to filter out a one dimensional (1D) audio signal. The same process can be generalized to two dimensional (2D) signals, like B&W images. For example, Figure 2 shows a small area of the upper left corner of the original image shown in Figure 1 (red rectangle). The mean filter would replace the pixel in the center (red circle) for the value (162+161+159+163+160+158+163+161+158) / 9 = **161** (rounded to the next integer). Similarly, the median filter would replace the center pixel by the value *median*{158,158,159,160,**161**,161,162,163,163} = **161**. In this example the mean and the median produce the same result, but in general this is not the case. The window is then moved to the right (green rectangle) and a new filtered value is computed (green circle). The process is repeated until the entire image is filtered.

162	161	159	160
163	160	158	160
163	161	158	160
158	159	158	159

Figure 2. Pixels used to compute a filtered pixel value.

Procedure
Download the CorruptedImage.txt file from the website http://www.ee.nmt.edu/~erives/289_12/EE289.html. This is a file in text format and can be viewed with a text editor. You may use the MATLAB command: *Im=textread*('*CorruptedImage.txt*') to load it into MATLAB. Also, you can view the image by executing the following MATLAB commands*: imagesc*(*Im*) and *colormap*(*gray*). These commands will display the matrix in the *Im* variable as an image, using black and white (B&W) color.

You are required to implement <u>a mean and a median filter in C</u>, and observe the performance of these at cleaning impulse noise. You might want to prototype the program in MATLAB, before implementing it in C.

Items to hand in

A report that includes the following items:

(10 %) An introduction and short description of the project (as you understand it).

(10 %) A flow chart of the program.

(20 %) Results and conclusions that describe things you tried and worked, and things that did not.

(60 %) A modular and well commented C program used to filter the image.

Academic honesty

All students are expected to demonstrate personal integrity. Interaction among students regarding homework assignments are strongly encouraged, however each student *must show individual effort*. Exchange of information during in-class or take-home examinations, as well as copying homework solutions from each other is strictly prohibited. Students exhibiting any form of academic dishonesty will be subject to penalties in accordance with NMT policies.