NOTES:

• Reminder, midterm exam on Wednesday, February 21, 2007.

• Sections covered for the midterm: 2.3.4, 2.4 (except 2.4.4), 3.1, 3.2 , 3.3, 3.4.1, 3.4.1, 3.4.2, 3.5, 3.6, 3.7, Chapter 4 (except 4.3.4, 4.6.3, 4.6.6, 4.6.7). Definitions and proofs of properties of various filters and transforms will be asked (some formulas of Fourier Transform will be given to you). There will be no programming questions.

• Examples of theoretical questions:
- explain the histogram equalization technique
- explain zooming or shrinking using bilinear interpolation
- what is the nth moment of a random variable r, about its mean ?
- explain the spatial linear filtering method with a 3x3 mask (or with an nxn mask).
- explain the median filter
- explain enhancement using the Laplacian
- How is the Laplacian defined ? Give an example of an approximation of it
- Give an example of edge detector
- questions about the definition and properties of the Fourier transform
- describe filtering in the frequency domain
- What is the convolution theorem ?
- give an example of a lowpass frequency filter
- give an example of a highpass frequency filter
- etc.

Additional questions and exercises from the problems from the end of each chapter and from the homework assignments.

• Extra office-hours will be scheduled on Tuesday, February 20, starting with 2pm, at MS 7620-D.

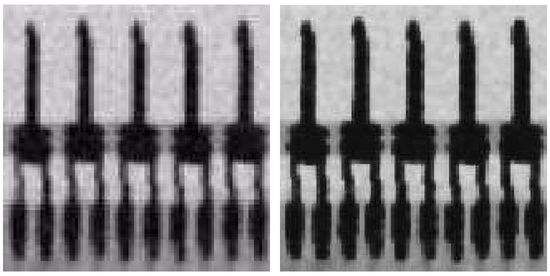
• Solutions to selected exercises posted on the class webpage.

Homework # 6, due on <u>Monday, February 26</u>

[1] The two subimages shown were extracted from the top, right corners of Figs. 5.7(c) and (d), respectively. Thus, the subimage on the left is the result of using an arithmetic mean filter of size 3x3; the other subimage is the result of using a geometric mean filter of the same size.

(a) Explain why the subimage obtained with geometric mean filtering is less blurred. *Hint:* Start your analysis by examining a 1-D step edge profile (see Fig. 3.38 for an example of a step edge).

(b) Explain why the black components in the right image are thicker.



[2] Download from the class web page the image Fig5.07(b).jpg (X-Ray image corrupted by Gaussian noise).

(a) Write a computer program to implement the arithmetic mean filter of size 3x3. Apply the program to the image Fig5.07(b).jpg

(b) Write a computer program to implement the geometric mean filter of size 3x3. Apply the program to the image Fig5.07(b).jpg

(c) Explain your results.

[3] Refer to the contraharmonic filter given in Eq. (5.3-6).

(a) Explain why the filter is effective in eliminating pepper noise when Q is positive.

(b) Explain why the filter is effective in eliminating salt noise when Q is negative.

(c) Explain why the filter gives poor results (such as the results shown in Fig. 5.9) when the wrong polarity is chosen for Q.

(d) Discuss the behavior of the filter when $Q = -1$.

(e) Discuss (for positive and negative Q) the behavior of the filter in areas of constant gray levels.

[4] (a) Download from the class web page the image Fig5.08(a).jpg (X-Ray image corrupted by pepper noise). Write a computer program that will filter this image with a 3x3 contraharmonic filter of order 1.5.

(b) Download from the class web page the image Fig5.08(b).jpg (X-Ray image corrupted by salt noise). Write a computer program that will filter this image with a 3x3 contraharmonic filter of order -1.5.