582412 Image Processing, Spring 2003

Exercise 3

1. Perform smoothing for the following image blocks. What happens if the operation is iteratively repeated for the image?

$$\begin{vmatrix} 10 & 10 & 10 & 10 & 10 \\ 10 & 10 & 10 & 10 & 10 \\ 10 & \mathbf{20} & \mathbf{20} & \mathbf{20} & 10 \\ 10 & 10 & 10 & 10 & 10 \\ 10 & 10 & 10 & 10 & 10 \end{vmatrix} \quad \begin{vmatrix} 10 & 10 & 10 & 10 & \mathbf{20} \\ 10 & 10 & 10 & \mathbf{20} & 10 \\ 10 & 10 & \mathbf{20} & 10 & 10 \\ 10 & \mathbf{20} & 10 & 10 & 10 \\ \mathbf{20} & 10 & 10 & 10 & 10 \end{vmatrix} \quad \begin{vmatrix} 10 & 10 & 10 & 10 & 10 \\ 10 & \mathbf{11} & \mathbf{11} & \mathbf{11} & 10 \\ 10 & \mathbf{11} & \mathbf{20} & \mathbf{11} & 10 \\ 10 & \mathbf{11} & \mathbf{11} & \mathbf{11} & 10 \\ 10 & 10 & 10 & 10 & 10 \end{vmatrix}$$

2. As above, but use median filtering this time.

3. Apply Sobel operator for the following 4×4 image blocks. What can you conclude on the basis of the result? Would the result (in general) be any different if the image was first operated by histogram equalization?

$$\begin{vmatrix} 10 & 10 & 30 & 30 \\ 10 & 10 & 30 & 30 \\ 30 & 30 & 30 & 30 \\ 30 & 30 & 30 & 30 \end{vmatrix} \quad \begin{vmatrix} 0 & 0 & 40 & 40 \\ 0 & 0 & 40 & 40 \\ 40 & 40 & 40 & 40 \\ 40 & 40 & 40 & 40 \end{vmatrix}$$

4. Give

   - impulse $\delta(n)$ as a function of unit step $u(n)$;
   - unit step as a function of impulse.

5. Build up a block diagram for the discrete system:

$$y(n) = \sum_{k=0}^{3} h(k)x(n-k).$$

6. Calculate the DFT of a periodic signal, whose period is given by the sequence $x(n) = (-1, 2, 3, 1)$.