Enhancement Filter (LEC 10)

The enhancement filters or called (***high pass filters***) can be used for edge enhancement because it pass only high frequency information, corresponding to places where gray levels are changing rapidly (edge in image are characterized by rapidly changing gray levels).

High pass filtering is accomplished using a kernel containing a mixture of positive and negative coefficients. An Omni directional high pass filter – that is, on whose response is the same, whatever the direction in which gray level varies – should have positive coefficients near its center and negative coefficients in the periphery of the kernel.

The classic 3×3 high pass filter are the laplacian masks that shows below:

$$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix} \quad \begin{bmatrix} 1 & -2 & 1 \\ -2 & 4 & -2 \\ 1 & -2 & 1 \end{bmatrix} \quad \begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

The sum of the coefficients in this kernel is zero. This mean that, when the kernel is over an area of constant (back ground area) or slowly varying gray level, the result of convolution is zero or some very small number . However, when gray level is varying rapidly within the neighborhood, the result of the convolution can be large number. This number can be positive or negative, because the kernel contains both positive and negative coefficients; we therefore need to choose an output image representation that supports negative number.

If we wish to display or print the filtered image, we must map the pixel values On to (0 – 255) range. This is usually done in such a way that filter response of (0) maps on to the middle of the range. Thus negative filter responses will show up as dark tones, where as positive responses will be represented by light tones. This can be seen in figure (10-1).

The main advantage of the high pass filter is to increase the degree of sharpening .It enhance details in all directions equally.

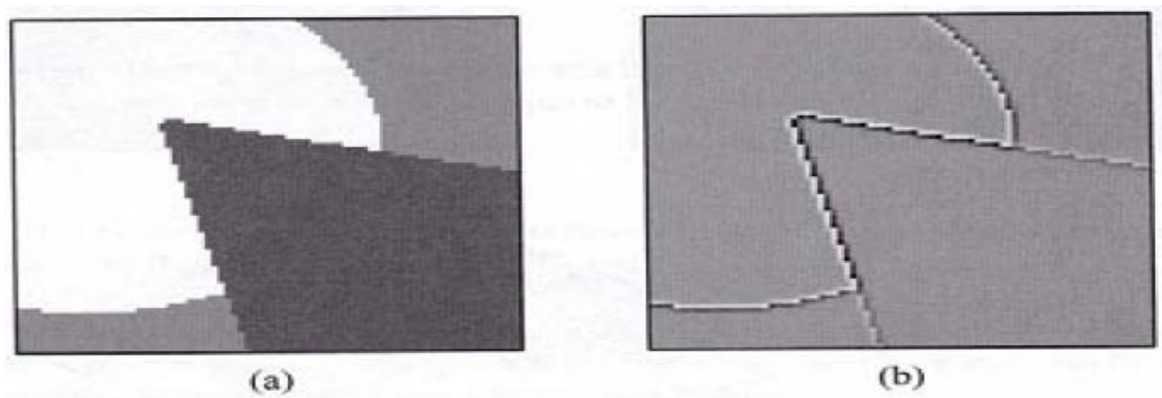


Figure (10-1): high pass filter (a) original image (b) result of high pass filter

10-1 *High frequency emphasis:*

The high pass filter a lone will accentuate edge in the image but loses a large portion of the visual information by filtering out the low spatial frequency components.

This problem is solved with the high – frequency emphasis filter, it is a special type of high pass filter, which retains some of the low – frequency information, so we do not loss the overall image information. By applying this type of filters we can see that the edges enhanced, but there is no loss in the overall contrast of the image.

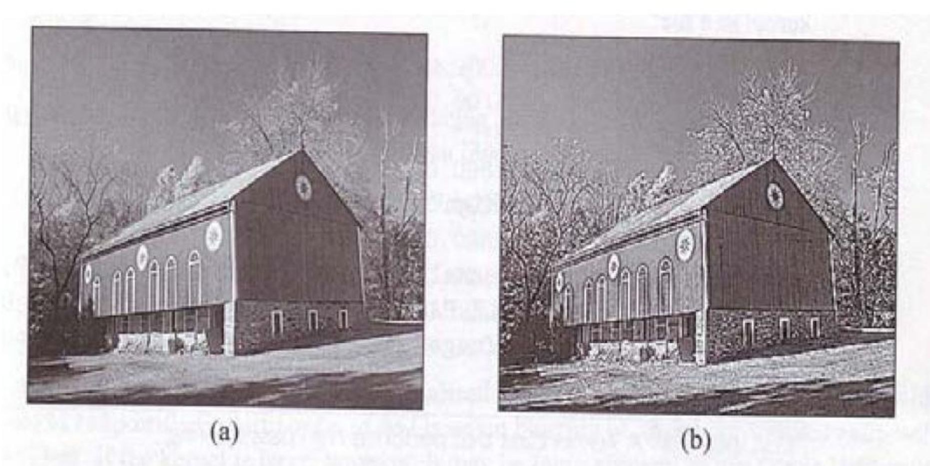
By applying this filter we can compute a weighted sum of the original image and the output from a high pass filter. The result is an image in which high spatial frequencies are emphasized relative to lower frequencies.

In spatial domain, a similar result can be obtained by using a high boost spatial filter. We can perform high boost filtering in a single convolution operation, using the kernel.

$$\begin{bmatrix} -1 & -1 & -1 \\ -1 & C & -1 \\ -1 & -1 & -1 \end{bmatrix} \quad \text{Where } C>8$$

The value of C determines the amount of low – frequency information retained in the resulting image. When the central coefficient, C, is larger. Convolution will have little effect on the image (will retain more of the original image). As C gets closer to 8, the degree of sharpening increases. When C=8 the kernel becomes the high pass filter

(The output image will contain only the edge). If values of less than 8 are used for C the resulting image will appear as a negative of the original. Figure (10-2) shows the result from using various values of C for high boost spatial filtering.



Figure(10-2) result of using high boost filter with c=12 (a) original image (b) result image