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FACULTY OF ENGINEERING

Digital Image Processing LECTURE-10

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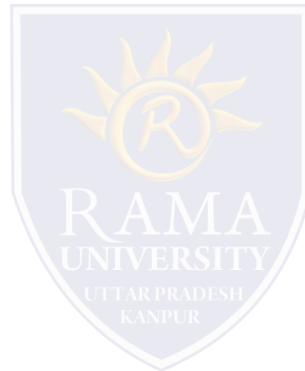
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OUTLINE

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Homomorphism Filtering

An image can be modeled as the product of an illumination function and the reflectance function at every point.

Based on this fact, the simple model for an image is given by

$$f(m1,n2)=i(n1,n2)\times r(n1,n2)$$

This model is known as illumination-reflectance model. The illumination-reflectance model can be used to address the problem of improving the quality of an image that has been acquired under poor illumination conditions.

In the above equation, $f(m1,n2)$ represents the image, $i(m1,n2)$ represents the illumination component and $r(m1,n2)$ represents the reflectance component. For many images, the illumination is the primary contributor to the dynamic range and varies slowly in space, while the reflectance component $r(m1,n2)$ represents the details of the object and varies rapidly in space.

Homomorphism Filtering

If the illumination and the reflectance components have to be handled separately, the logarithm of the input function $f(m_1, n_2)$ is taken. Because $f(m_1, n_2)$ is the product of $i(m_1, n_2)$ with $r(m_1, n_2)$, the $\log f(m_1, n_2)$ separates the two components as illustrated below:

$$\ln[f(m_1, n_2)] = \ln[i(m_1, n_2) \cdot r(m_1, n_2)] = \ln[i(m_1, n_2)] + \ln[r(m_1, n_2)]$$

Taking Fourier transform on both sides, we get

$$F(k, l) = F_I(k, l) + F_R(k, l)$$

where $F_I(k, l)$ and $F_R(k, l)$ are the Fourier transform of the illumination and reflectance components respectively.

Then, the desired filter function $H(k, l)$ can be applied separately to the illumination and the reflection component separately as shown below:

$$F(k, l) \times H(k, l) = F_I(k, l) \times H(k, l) + F_R(k, l) \times H(k, l)$$

In order to visualize the image, inverse Fourier transform followed by exponential function is applied. First, the inverse Fourier transform is applied as shown below:

$$f'(n_1, n_2) = \mathcal{I}^{-1}[F(k, l) \times H(k, l)] = \mathcal{I}^{-1}[F_I(k, l) \times H(k, l)] + \mathcal{I}^{-1}[F_R(k, l) \times H(k, l)]$$

Homomorphism Filtering

The desired enhanced image is obtained by taking the exponential operation as given below:

$$g(n_1, n_2) = e^{f(n_1, n_2)}$$

Hence, $g(m_1, n_2)$ represents the enhanced version of the original image $f(m_1, n_2)$. The

sequence of operation can be represented by a block diagram as shown in fig

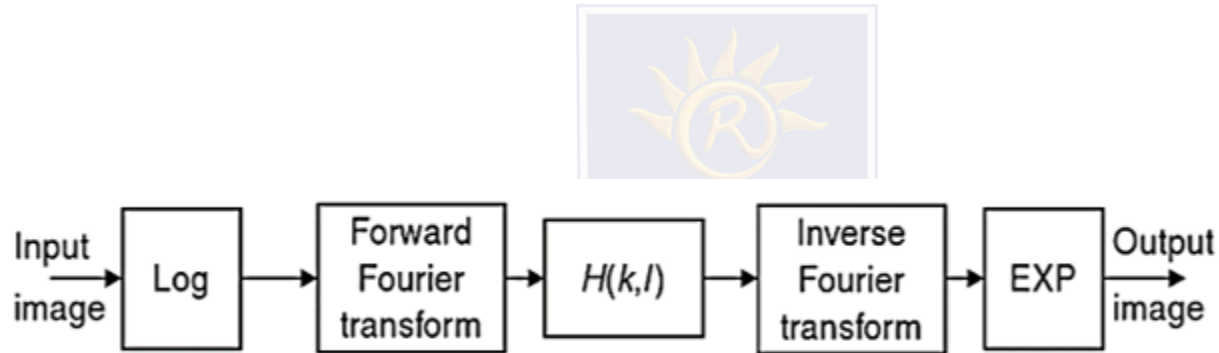
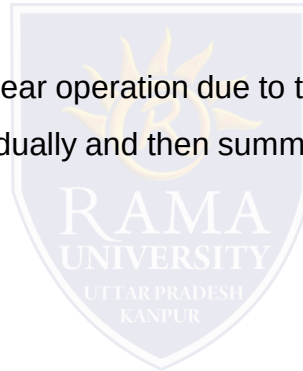


Figure 1. Homomorphic Filter

1. How is array operation carried out involving one or more images?
 - a) array by array
 - b) pixel by pixel
 - c) column by column
 - d) row by row
2. The property indicating that the output of a linear operation due to the sum of two inputs is same as performing the operation on the inputs individually and then summing the results is called _____
 - a) additivity
 - b) heterogeneity
 - c) homogeneity
 - d) None of the Mentioned
3. The property indicating that the output of a linear operation to a constant times as input is the same as the output of operation due to original input multiplied by that constant is called _____
 - a) additivity
 - b) heterogeneity
 - c) homogeneity
 - d) None of the Mentioned

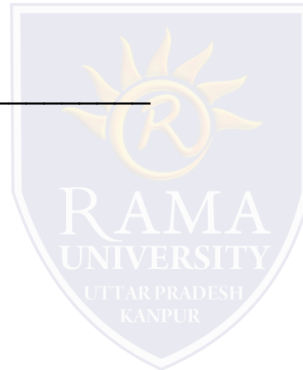


4. Enhancement of differences between images is based on the principle of _____

- a) Additivity
- b) Homogeneity
- c) Subtraction
- d) None of the Mentioned

5. A commercial use of Image Subtraction is _____

- a) Mask mode radiography
- b) MRI scan
- c) CT scan
- d) None of the Mentioned



References

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