DIP assignment 5

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1 Ans2

1.1 Case 1 : 1D image

We have

$$g = f * h$$

Taking discrete Fourier transform on both sides (after zero padding to make the dimensions of matrices after DFT equal)

$$DFT(g) = DFT(f).DFT(h) \implies DFT(f) = \frac{DFT(g)}{DFT(h)}$$

where the division is pointwise. After this computation we get $DFT(f)$ and to get f we do $f = DFT^{-1}(DFT(f))$

Problems that we might face while following this approach are

1. When an entry of $DFT(h)$ is 0 we cant calculate the corresponding entry of $DFT(f)$, thus we have to assume some value for that point to calculate inverse DFT. This obviously leads to incorrect but close results.
2. Even if its not exactly 0, even close to 0 is problematic because small noise or errors in g can be magnified because of division be a small quantity.
3. The above cases when $DFT(h) \to 0$ is most likely to happen for lower frequency as the gradient filter is a high pass filter and hence through this method we are susceptible to lose information about the lower frequencies

1.2 Case 2 : 2D image

We have two equation

$$g_x = h_x * f$$

$$g_y = h_y * f$$

Take Discrete Fourier Transform on both equations on both sides with appropriate 0 padding so that the resultant matrices have the same dimensions. We get

$$DFT(g_x) = DFT(h_x).DFT(f)$$

$$DFT(g_y) = DFT(h_y).DFt(f)$$

Add both the equations and simlifying we get

$$DFT(f) = \frac{DFT(g_x) + DFT(g_y)}{DFT(h_x) + DFT(h_y)}$$

After calculating $DFT(f)$ we get f by taking inverse discrete Fourier Transform of $DFT(f)$ as $f = DFT^{-1}(DFT(f))$
Possible problems we might face while doing above is

1. When the sum $DFT(h_x) + DFT(h_y)$ is 0 at some point we cant calculate the corresponding entry of $DFT(f)$, thus we have to assume some value for that point to calculate inverse DFT. This obviously leads to incorrect but close results. This also points out that we chose to sum them becuase after summing them for $DFT(h_x) + DFT(h_y)$ to be 0 both of the summands should be individually zero which is less likely than one of them being zero.

2. Even if the sum $DFT(h_x) + DFT(h_y)$ is close to 0 at some point, it is problematic because small noise or errors in g_x, g_y can be magnified because of division be a small quantity.

3. The above cases when $DFT(h_x) + DFT(h_y) \to 0$ is most likely to happen for lower frequency as the gradient filter is a high pass filter and hence through this method we are susceptible to lose information about the lower frequencies