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CS 663: Assignment 5

Question 1.

Q] Given g_1 and g_2 and assuming h_1 and h_2 are known, derive a formula to determine f_1 and f_2. assuming that there was no relative motion between the camera and the scene outside while the two pictures are being acquired and there is no change in the scene.

A]
$$g_1(x,y) = f_1(x,y) + h_2 * f_2(x,y) \quad \text{--- (1)}$$
$$g_2(x,y) = h_1 * f(x,y) + f_2(x,y) \quad \text{--- (2)}$$

Taking fourier Transforms of (1) and (2) ~~we get~~ and using convolution thm we get,

$$G_1(u,v) = F_1(u,v) + H_2(u,v) \cdot F_2(u,v) \quad \text{--- (3)}$$
$$G_2(u,v) = H_1(u,v) F_1(u,v) + F_2(u,v) \quad \text{--- (4)}$$

Multiplying (3) by $H_1(u,v)$ and subtracting (4) from it, we get

$$H_1(u,v) G_1(u,v) - G_2(u,v) = H_1(u,v) H_2(u,v) F_2(u,v) - F_2(u,v).$$

$$\therefore \hat{F}_2(u,v) = \frac{G_2(u,v) - H_1(u,v) G_1(u,v)}{1 - H_1(u,v) H_2(u,v)}$$

[Here while dividing by $(1 - H_1(u,v) H_2(u,v))$ we need to check if it is not zero; will be used later] ;

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Now taking the inverse fourier transfer of $\hat{F}_2(u,v)$, we get

$$f_2(x,y) = \mathcal{F}^{-1}(\hat{F}_2(u,v))$$

Similarly we can get f_1

$$\hat{F}_1(u,v) = \frac{G_1(u,v) - H_2(u,v)\,G_2(u,v)}{1 - H_2(u,v)H_1(u,v)}$$

Taking IFT, we get

$$f_1(x,y) = \mathcal{F}^{-1}(\hat{F}_1(u,v))$$

Note:- Even with all these assumptions; there is something inherently problematic.

We know that h_1 and h_2 are blur ~~filters~~ kernels and hence H_1 and H_2 are low pass filters; ∴ at low frequencies both H_1 and H_2 will tend to 1. Hence $H_1(u,v) \cdot H_2(u,v)$ will tend to 1, and $1 - H_1(u,v) \cdot H_2(u,v)$ will tend to 0. Hence, we wont be able to extract the low frequency components of accurately $H_1(u,v)$ and $H_2(u,v)$ since this will blow up. And the low frequency components calculated inaccurately affects the overall perception of natural images, since low frequency components are perceived by the humans ~~as the base of~~ prominently.