Assignment 5 Question 1 Report

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1 Deriving the formulas

We are given two equations,

- $g_1 = f_1 + h_2 * f_2$
- $g_2 = h_1 * f_1 + f_2$

Taking the Fourier Transform on both sides, we have,

- $G_1(f) = F_1(f) + H_2(f)F_2(f)$
- $G_2(f) = H_1(f)F_1(f) + F_2(f)$

Hence we have 2 linear equations for $F_1(f)$ and $F_2(f)$ in terms of known constants. Solving them, we get,

$$G_2(f) = H_1(f)[G_1(f) - H_2(f)F_2(f)] + F_2(f), \text{ or,}$$
$$G_2(f) - G_1(f)H_1(f) = F_2(f)(1 - H_2(f)H_1(f)), \text{ giving us,}$$
$$F_2(f) = \frac{G_2(f) - G_1(f)H_1(f)}{1 - H_1(f)H_2(f)}, and,$$
$$F_1(f) = \frac{G_1(f) - G_2(f)H_2(f)}{1 - H_1(f)H_2(f)}$$

Therefore, we have,

$$f_2 = F^{-1}(\frac{G_2(f) - G_1(f)H_1(f)}{1 - H_1(f)H_2(f)}), and,$$
$$f_1 = F^{-1}(\frac{G_1(f) - G_2(f)H_2(f)}{1 - H_1(f)H_2(f)})$$

These are our formulas for f_1 and f_2.

2 Problems with the formula

- The problem with the formula is the term of $1 - H_2(f)H_1(f)$ in the denominator.
- When this term becomes 0, the Fourier transform will becomes infinity at that point.
- The term is likely to become 0 at low frequencies as normally a blurring filter would attenuate the high frequencies but leave the lower frequencies relatively intact.