Assignment 3
Old But Gold: Fourier Transform Applications in Image Processing (Hint)

- In the frequency domain, Equation (4) of problem 5 can be rewritten as:

$$\hat{\mathbf{x}}_{LS} = \mathcal{F}^{-1}\left(\frac{\overline{\mathcal{F}(k)} \circ \mathcal{F}(\mathbf{y})}{\overline{\mathcal{F}(k)} \circ \mathcal{F}(k)}\right)$$

where $\mathcal{F}$ and $\mathcal{F}^{-1}$ are the Fourier and inverse Fourier transform operators, respectively. Also, $\overline{(\cdot)}$ denotes the conjugate transpose operation, whereas $\circ$ is the pointwise product operator. Note that the division operator in the equation is also an element-wise operator.

Similarly, one can write Equation (6) such that:

$$\hat{\mathbf{x}}_{TRLS} = \mathcal{F}^{-1}\left(\frac{\overline{\mathcal{F}(k)} \circ \mathcal{F}(\mathbf{y})}{\overline{\mathcal{F}(k)} \circ \mathcal{F}(k) + \lambda\left(\overline{\mathcal{F}(\mathbf{A})} \circ \mathcal{F}(\mathbf{A})\right)}\right)$$

in which the above definitions also apply.

Considering the fact that k and $\mathbf{y}$ (and also $\mathbf{A}$) are of different sizes, a preprocessing step is required before the above element-wise calculations become possible.

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