EECS203A: HOMEWORK #6 Solution
Spring 2022

1. a) No. Since $h(x, y)$ is an ideal bandreject filter, we cannot compute $G(u, v)/H(u, v)$ for frequencies where $H(u, v) = 0$. Frequency information where $H(u, v) = 0$ will be lost by the filtering process.

b) No. Since $G(u, v)$ contains no information about $F(u, v)$ for (u, v) where $H(u, v) = 0$, we cannot recover $f(x, y)$ from $g(x, y)$ using Wiener filtering or any other method.

c) Let $f(x, y)$ have Fourier Transform $F(u, v)$. The set of images is all images that have a Fourier Transform that is the same as $F(u, v)$ for frequencies where $H(u, v) \neq 0$. Images in the set can have any frequency content for frequencies where $H(u, v) = 0$.

2. a) We have $H_1(u, v) < H_2(u, v)$ for $(u^2 + v^2) > 0$. Therefore $H_1(u, v)$ reduces more noise.

b) The filters are equivalent at DC $(u, v) = (0, 0)$ and $H_1(u, v)$ reduces high frequencies more. Therefore $H_1(u, v)$ will blur the image more.

3. We have

$$\begin{array}{ll} f'(6,5) = f(7,3) & f'(12,11) = f(12,11) \\ f'(6,13) = f(7,11) & f'(12,3) = f(12,3) \end{array}$$

$$\begin{array}{llll} x'(7,3) = 6 & x'(12,11) = 12 & x'(7,11) = 6 & x'(12,3) = 12 \\ y'(7,3) = 5 & y'(12,11) = 11 & y'(7,11) = 13 & y'(12,3) = 3 \end{array}$$

$$x'(x, y) = c_1x + c_2y + c_3xy + c_4 \qquad y'(x, y) = c_5x + c_6y + c_7xy + c_8$$

$$\begin{array}{lll} \text{at } (7,3) & 6 = 7c_1 + 3c_2 + 21c_3 + c_4 & 5 = 7c_5 + 3c_6 + 21c_7 + c_8 \\ \text{at } (7,11) & 6 = 7c_1 + 11c_2 + 77c_3 + c_4 & 13 = 7c_5 + 11c_6 + 77c_7 + c_8 \\ \text{at } (12,11) & 12 = 12c_1 + 11c_2 + 132c_3 + c_4 & 11 = 12c_5 + 11c_6 + 132c_7 + c_8 \\ \text{at } (12,3) & 12 = 12c_1 + 3c_2 + 36c_3 + c_4 & 3 = 12c_5 + 3c_6 + 36c_7 + c_8 \end{array}$$

$$c_1 = 1.2, c_2 = 0.0, c_3 = 0.0, c_4 = -2.4 \qquad c_5 = -0.4, c_6 = 1.0, c_7 = 0.0, c_8 = 4.8$$