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## Problem 2 Pre-filtering to Reduce Aliasing before Sampling

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```
close all; clc; clear;
barbara = read(Tiff('barbara.tiff', 'r'));

figure,
subplot(1,2,1), imshow(barbara), title('barbara original');

baby = read(Tiff('baby.tiff', 'r'));
subplot(1,2,2), imshow(baby), title('baby original');
```



```
close all;
barbBig = barbara(1:512,37:548);
figure,
subplot(1,2,1), imshow(barbBig), title('barbBig 512 x 512 section');
babyBig = baby(201:712,201:712);
subplot(1,2,2), imshow(babyBig), title('babyBig 512 x 512 section');
```

barbBig 512 x 512 section



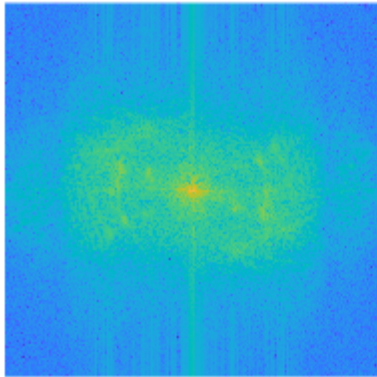
babyBig 512 x 512 section



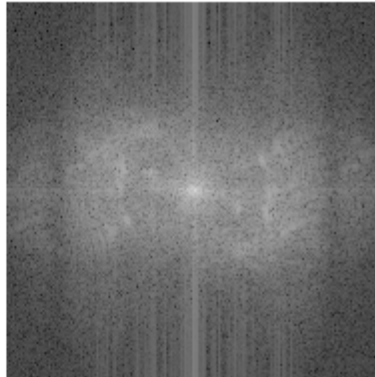
```
close all;
barbfft_1 = fftshift(abs(fft2(barbBig)).^2);
barbspectrum = log(barbfft_1 + 1);
figure,
subplot(1,2,1),
imshow(barbspectrum / max(max(barbspectrum))),
colormap("default"),
title('Power Spectrum of barbBig w/ color');

subplot(1,2,2),
imshow(barbspectrum / max(max(barbspectrum))),
title('Power Spectrum of barbBig');
```

Power Spectrum of barbBig w/ color



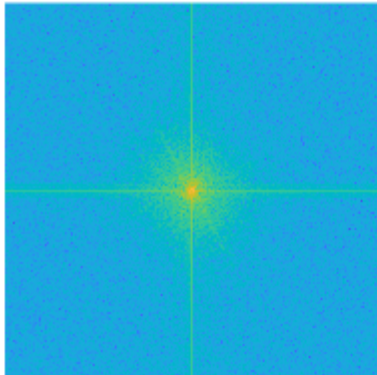
Power Spectrum of barbBig



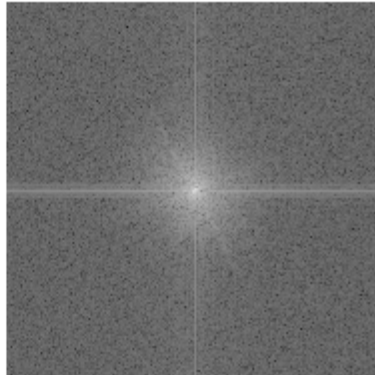
```
close all;
babyfft_1 = fftshift(abs(fft2(babyBig)).^2);
babyspectrum = log(babyfft_1 + 1);
figure, subplot(1,2,1),
imshow(babyspectrum / max(max(babyspectrum))),
colormap("default"),
title('Power Spectrum of babyBig w/ color');

subplot(1,2,2),
imshow(babyspectrum / max(max(babyspectrum))),
title('Power Spectrum of babyBig');
```

Power Spectrum of babyBig w/ color



Power Spectrum of babyBig



### **Part(a)**

As can be seen from the above Power Spectrum the DC coefficient is located right at the center. Note that it would initially be in the corner but the `fftshift` brings it to the center. First `fft` transforms the signal to frequency domain, then the shift is basically rearranges the fourier transform by shifting the DC to center. Before the `fftshift`, the DC coefficient is located in the (1,1) position, and the low frequencies are out in the four corner areas. The `fftshift` swaps the quadrants, making the corner of each into the center such that the quadrants are symmetric at the center. The way we can check this is through the matlab documentation on how the `fftshift` function shifts the DC coefficient to be at the center of the 2D space, such that the spectrum looks symmetric.

### **Part(b)**

By just doing the visual comparison, we can say that `barbBig` has a higher frequency content because of the vertical and horizontal lines that we see in the image and power spectrum. Looking at the `babyBig` and its power spectra, there are some high frequency components, however not as high as `barbBig`. We just see the white circle in the middle which is a low frequency component. `Barbara` will have more of the aliasing problem from downsampling because of the high frequency components in the image.