

EE630 PROJECT B
STRIPE SUPPRESSION
by LGH
Updated 11-1-2011

You will be graded on performing steps and answering questions (indicated by ?).

1. INPUT DATA

Given a bmp image HOLDPATFRED.bmp.

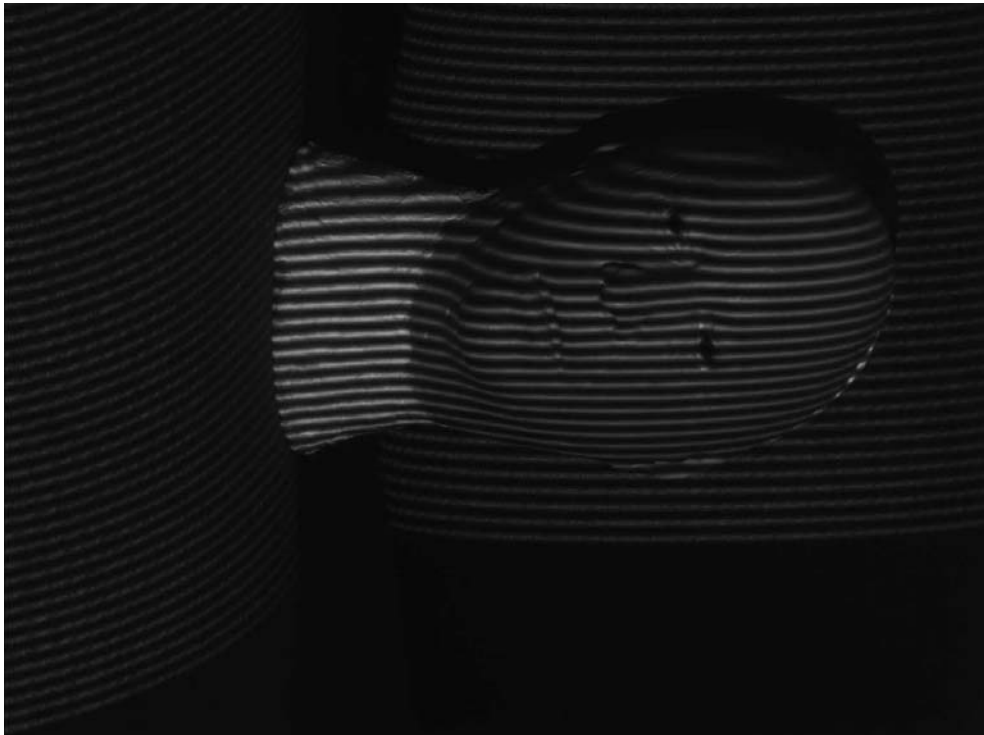


Figure 1: Mannequin Fred with triangular stripe patten projected at an angle from the camera's optical axis.

Step 1: The image can be brought into MATLAB with the following code:

```
A_bmp=double(imread('HOLDPATFRED.bmp')); % load HOLDPATFRED.jpg image
Ar=A_bmp(:,:,1);
Ag=A_bmp(:,:,2);
Ab=A_bmp(:,:,3);
```

The image is B&W so the Ar=Ag=Ab. To plot Ar use imagesc(Ar) followed by colormap gray.

Step 1.1: Plot image of input data file.

2. SELECT SIGNAL COLUMN

Step 2.1: Select and plot, the nx column to represent a signal. Indicate which nx you used. The size of the image is $[My\ Nx]=\text{size}(Ar)$; A 1-D vector would be My by 1. $sc=Ar(1:My, nx)$;

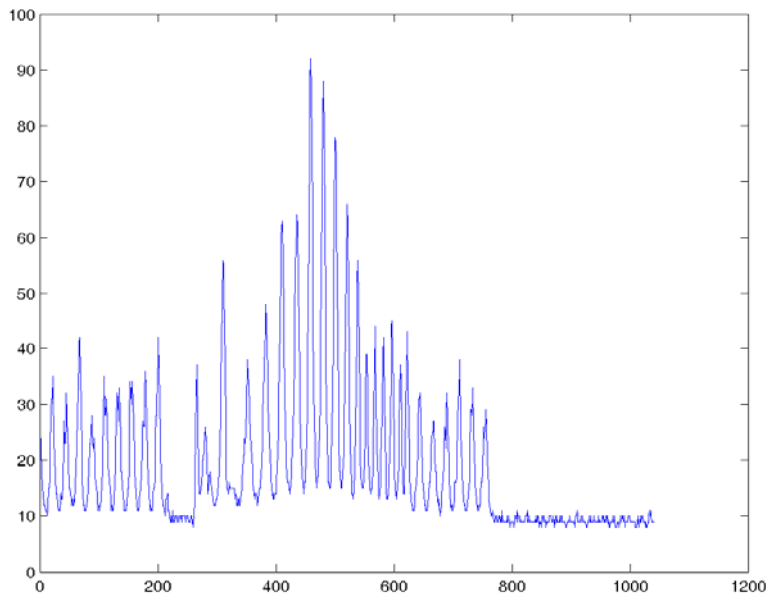


Figure 2: The middle column intensity of Fig. 1.

3. FIND THE SPECTRA OF THE COLUMN

Step 3.1: Take the DFT of Figure 2 and plot as in Figure 3, such that

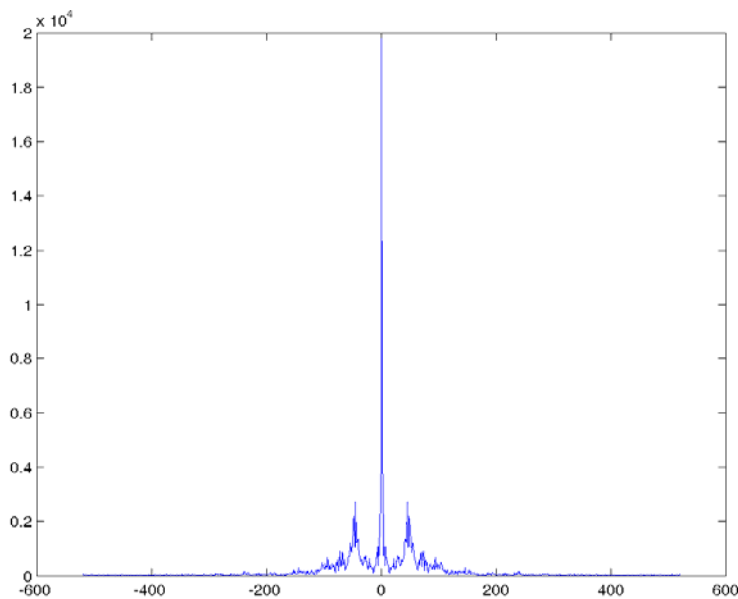


Figure 3: FFT of Figure 2, with “fftshift” to center the dc term.

Questions:

(3.1) Knowing the pixel height of the image in Fig 1, estimate the number of stripe cycles occurring across the image? Show how you find the cycle period and calculate the number of stripe cycles.

(3.2) Does this value correspond to the peak locations in Fig. 3?

(3.3) Which peaks?

4. STRIPE SUPPRESSION

We would like to suppress the striping from the image of Fred. To do this, we can use an ideal bandnotch filter. An “ideal” bandpass filter is two rectangle functions symmetric about dc in the frequency domain. To create a bandnotch filter, we determine the bandpass filter and then invert its values. To create the bandpass we use a discrete-time cosine function and the downloadable `irect`. The discrete cosine can be synthesized as

```
t=k-1;
kc=??;
c=cos(2*pi*kc*t/My);
c=c';
```

Combining this with the rectangle function

```
H=irect(1,41,1,My);
H=H';
h=ifft(H); % time domain DT Sinc
```

such that the bandpass filter is

```
Hb=fft(c.*h);
```

To convert to a bandnotch filter we invert its values. Let `hmax=max(real(Hb))`. Then the band notch is `Hnb= -Hb+hmax`;

Step 4.1: generate the bandnotch filter and manually optimize the center frequency. Plot results as in Figs. 4 and 5.

The plot of the filter superimposed on the spectra is

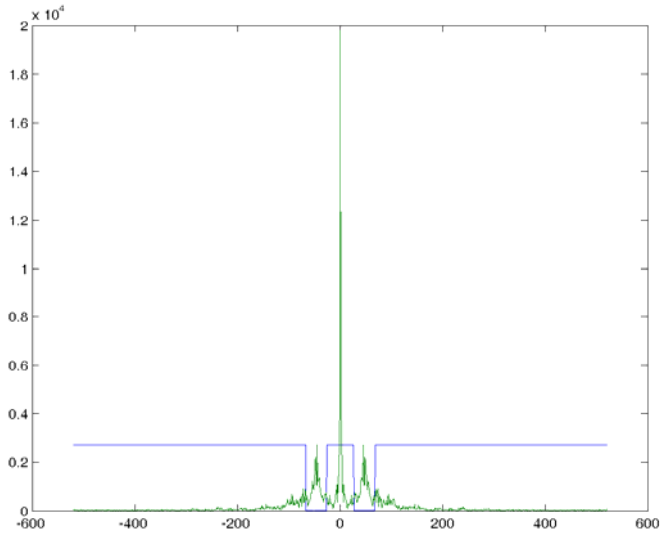


Figure 4: Bandnotch filter superimposed on the signal spectra.

Applying the bandnotch filter to the column signal and superimposing the results yields Fig. 5.

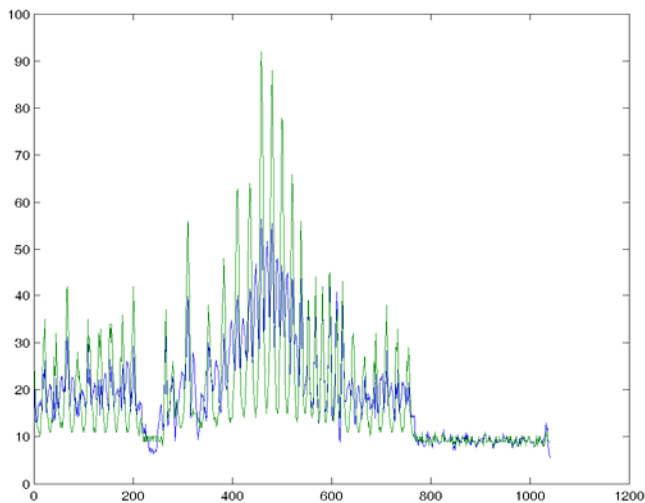


Figure 5: Blue signal is filtering result and green is original.

Step 4.2: Generate and plot the 2-D fft of the image as described for Fig. 6.

To really evaluate the effectiveness of this approach and to gain an understanding of the effects of the Bandpass filter width, we look at the 2-D FFT of the full image. To be able to see this more clearly, we should either use a log scale or suppress the dc term. For this example we will suppress dc by using a 2-D irect function and then “notting” it as to notch out the dc term.

```
Fr=fft2 (Ar) ;
H2d=irect (11, 11, My, Nx) ;
H2d=1-H2d;
Sr=Fr .*H2d;
```

The plot of the magnitude squared of S_r is

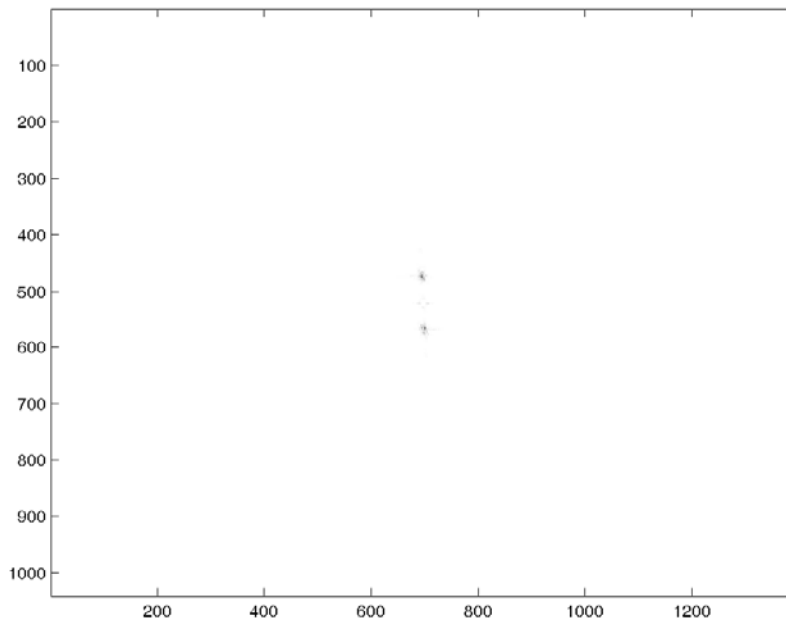


Figure 6: 2-D FFT based PSD of input image (negative for display).

To filter out the regions of interest in Fig. 6, we need a spatial bandpass filter. This can be constructed with a cosine wave in one direction multiplied by a 2-D DT Sinc function. A 2-d image with a 1-D cosine function in it can be synthesized in matlab by

```
c=cos(2*pi*kc*t/My);  
c=c';  
uv=ones(1,Nx);  
cimage=c*uv;
```

Step 4.3: Generate and plot the sine wave image as in Fig. 7.

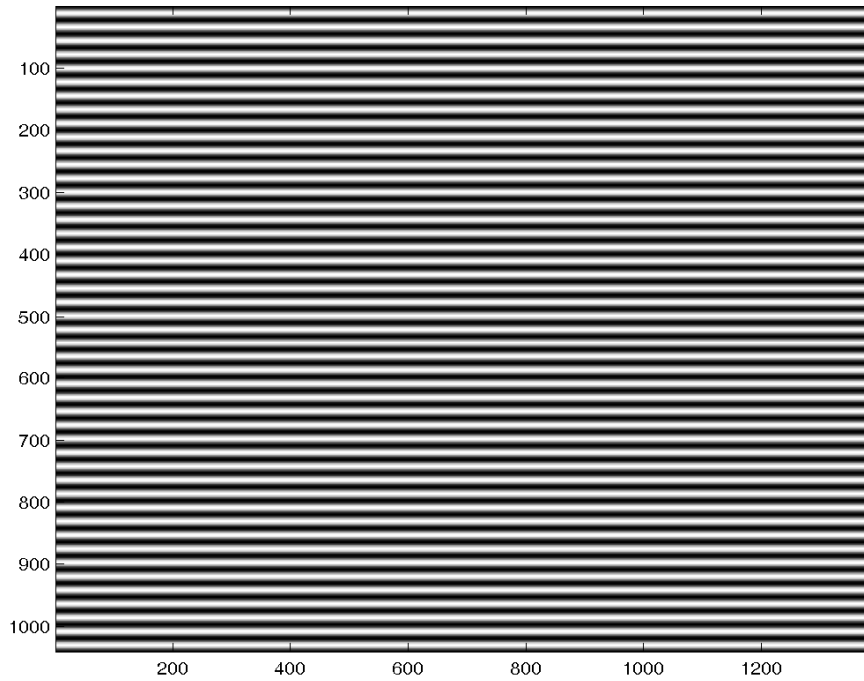


Figure 7: Sine wave patterned image.

Step 4.4: Generate a symmetric pulse using `irect`. Then inverse 2-D DFT the pulse, multiply by the 2-D sinewave image and 2-D DFT to create a 2-D filter in the frequency domain. Multiply this filter spectra times the spectra of the input and inverse 2-D DFT the resulting image as shown in Fig 8.

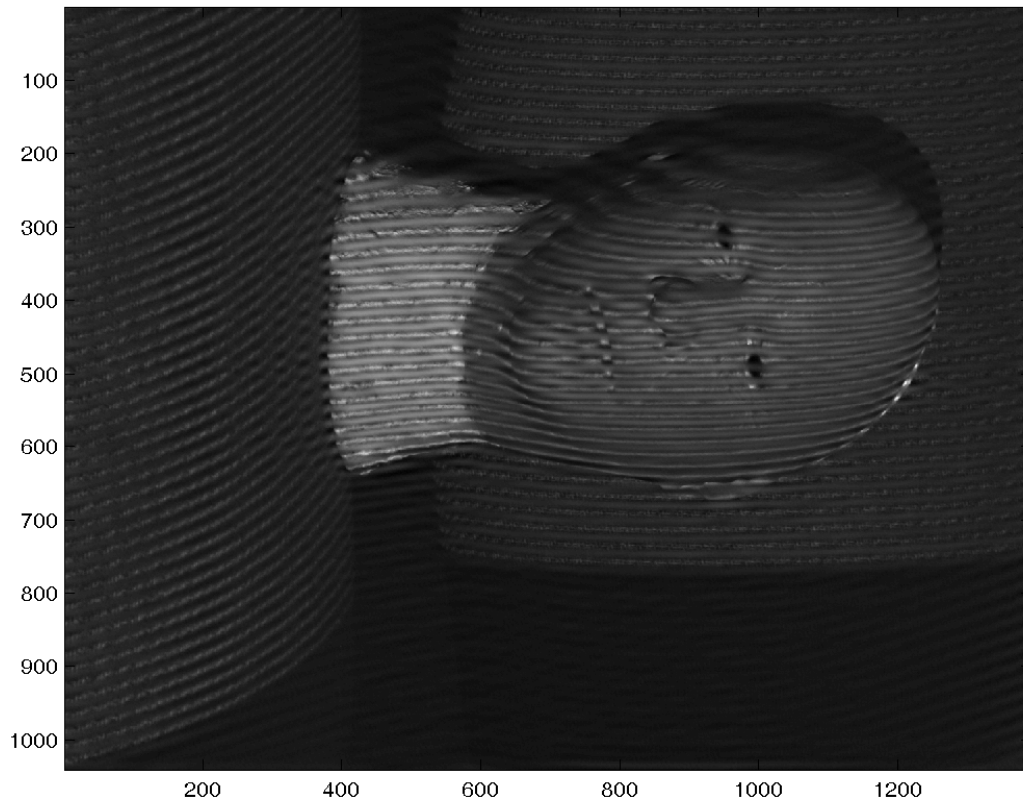


Figure 8: Filter selected stripes of input object.

Step 4.5: Optimize the bandwidth and center frequency of the 2-D bandpass filter as to optimize the suppression of the stripes in Fig. 8. Show your results compared with the results given in Fig. 8.