EE 391
Signal Processing

Matlab Assignment 2

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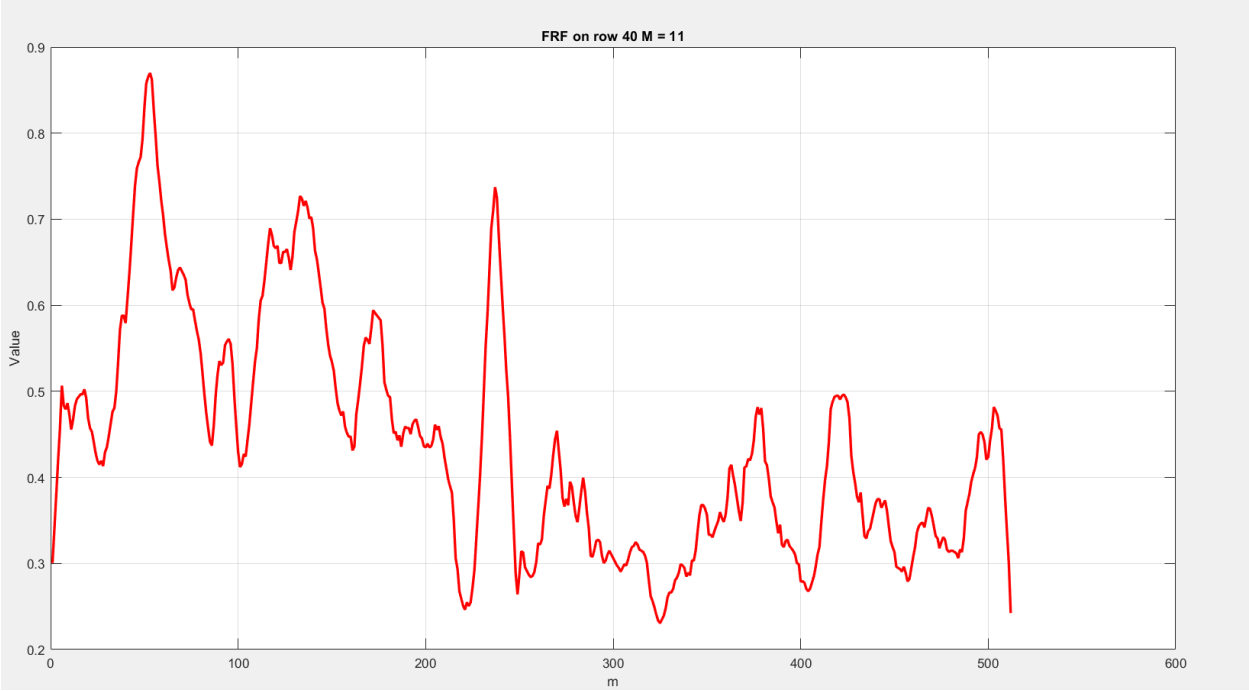
Part 1

Part i

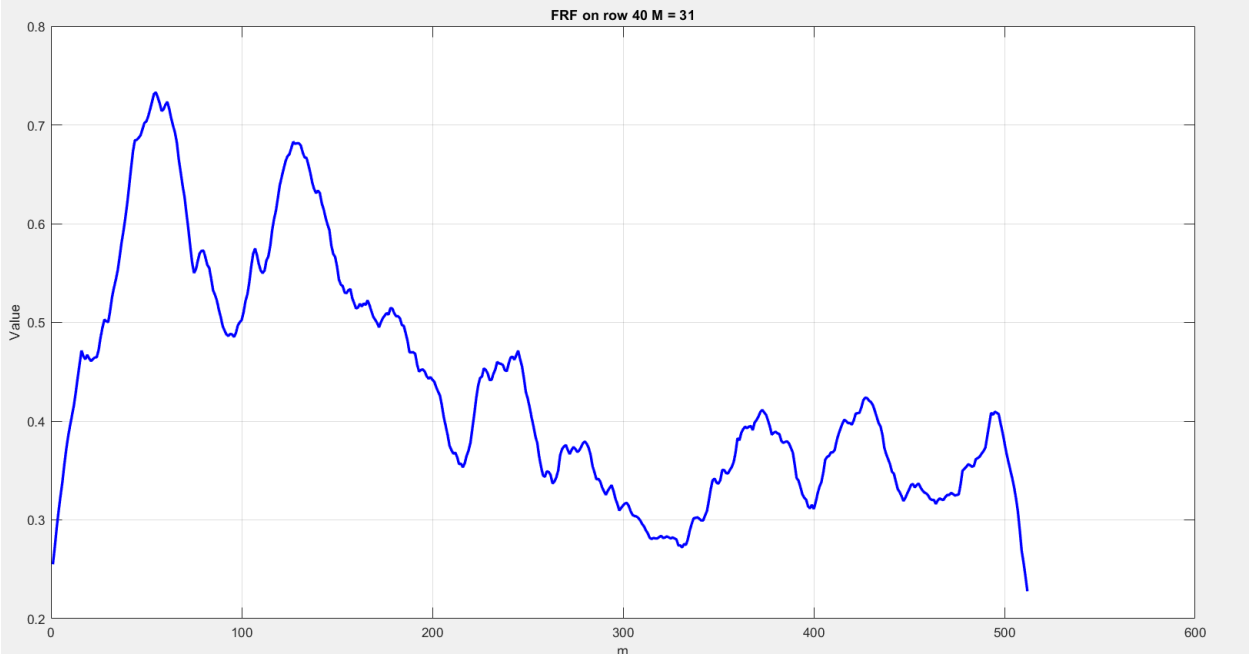
The explanation is at the bottom of the 4 images of this part i. Filters and filtered images are shown right below here.

Original Image

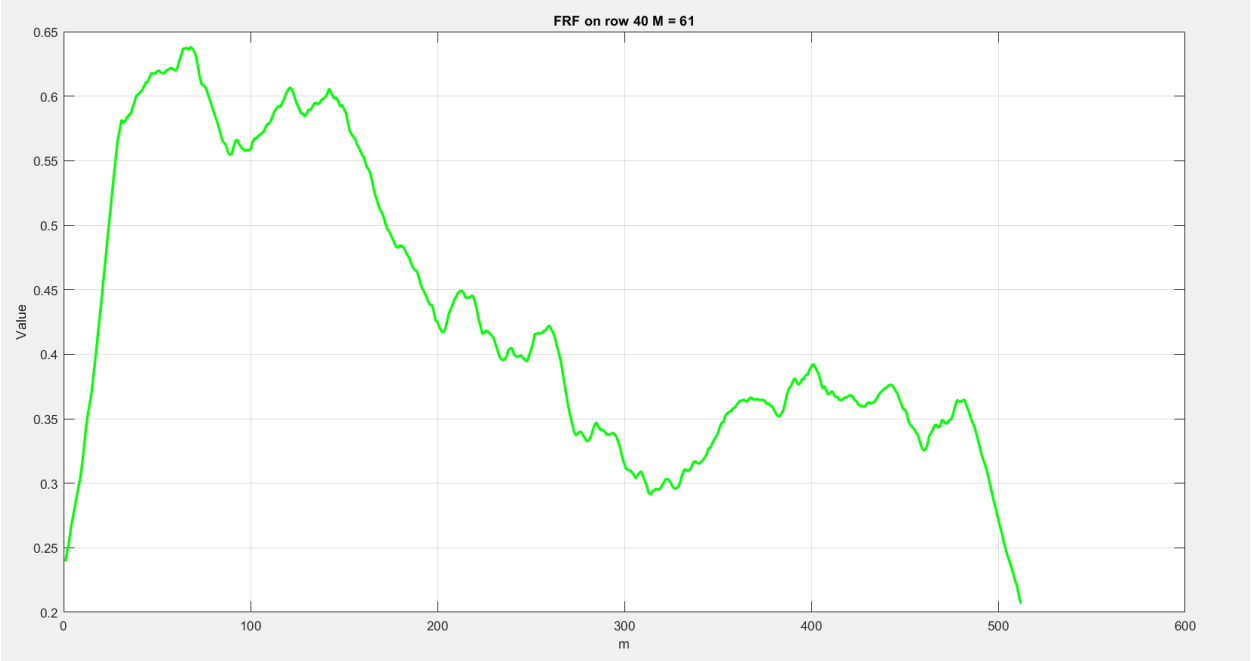
M = 11 Image and Filter


FRF on row 40 M = 11
Value
m
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
100
200
300
400
500
600

M = 31 and Filter


FRF on row 40 M = 31
Value
m
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
100
200
300
400
500
600

M = 61 and Filter



The images get more blurry as we increase the M value of the M-Point averaging filter. The reason for this is, we get so many more values to average one index and all of those single indexes carry the information of all the neighboring values of themselves (horizontally). The neighbors' numbers increase as we increase the M value, resulting in an even more blurred image. We can call this filter a blur effect.

Part ii

I actually described the effects of changing M in this formula. As we increase M, the horizontally neighboring indexes increase, and we get to add more information to the averaging calculation of each index in the new array. A smaller M will result in less blur, while a higher M will result in a really blurry almost unrecognizable image.

Part iii

Horizontally speaking, we can say that the effect is drawing over each row of the image traversing all columns, and instead of drawing a solid line, it blurs in a horizontal line. When looking at the filtered images, it seems as if we have drawn horizontal lines on the images.

For the vertical aspect, I do not think we can tell much, since this filter acts as a 1D array to each row. The information used to average each index is calculated by horizontal neighbors, so no vertical values affect each other.

Part iv

Part v

The corners of the image get slightly darker as we increase the M value. This is because the averaging formula assumes the indexes that are not existing to be 0, pitch black. As the M value goes higher, the 0 indexes will increase a lot, resulting in bigger darker spots as we get closer to the corners.

Part vi

Part vii

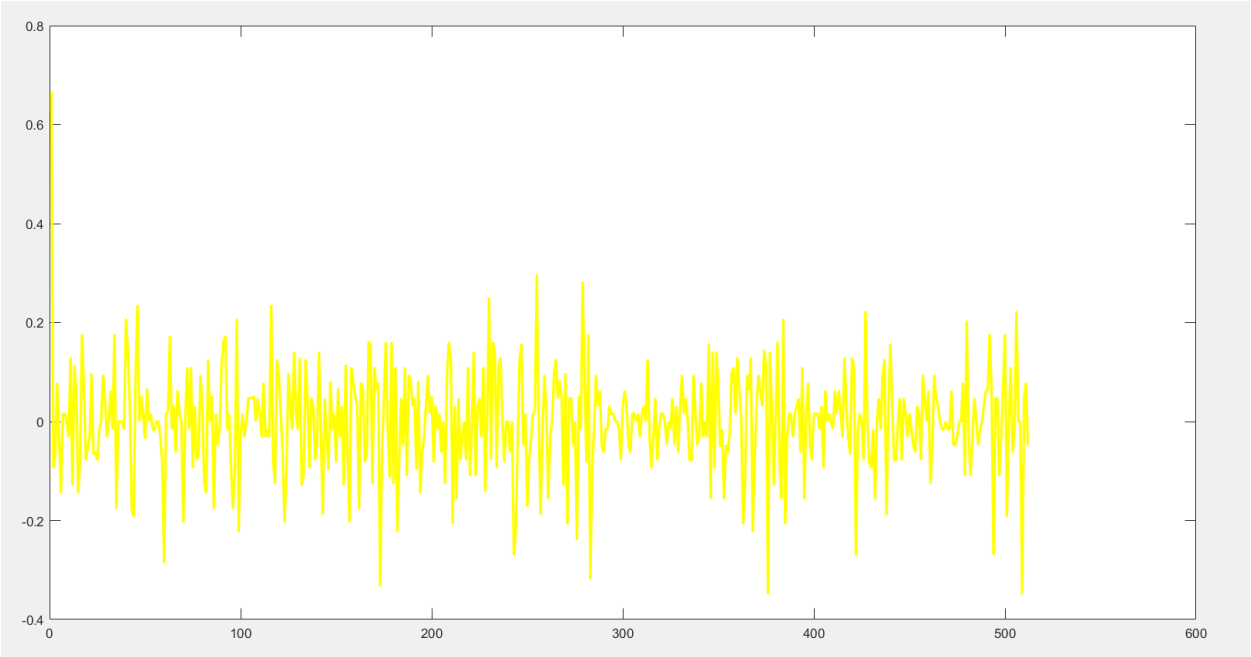
Part viii

Part 2

Part i

Original Image

Difference Filtered Image



The visual effect created by this filter is as seen in the figure above. Since we take the difference between each m index next to each other (m - (m-1)), the resulting image is almost black and white. And we can say that, upon observing this image, white pixels next to darker pixels do not change much, that is why we can still distinguish some parts of the bridge or the brightest parts of the trees. However, most of the image goes black.

Part ii

I would theoretically expect this filter to result in a dark image. Since we subtract one value from another there is no other reasonable expectation. However, I expected a slightly more clear image, instead of what we got, a really dark image with slight bright spots. But I can safely say, the resulting image is still very distinguishable and I can understand what the picture is.

Part iii

Part iv

CODE

```
%% Program runs by itself with each part waiting for the previous one
%% for z seconds.
z = 3;


A = imread('bridge.bmp');
A = double(A);

%%image(A);
[m,n] = size(A);

J = mat2gray(A, [0, 255]);


%% Part 1 --------------------------------
%% Part i FOR M = 11
M = 11;
Mavg = zeros(512);

for i = 1:n

    for j = 1:m
        sum = 0;
        for k = 1:(M-1)/2


            if j-k <= 0
                current1 = 0;
            else
                current1 = J(i,j-k);
            end

            if j+k > 512
                current2 = 0;
            else
                current2 = J(i,j+k);
            end

            sum = sum + current1 + current2;
```

```
        end
        sum = sum + J(i,j);
        avg = sum / M;
        Mavg(i,j) = (avg);


    end

end


% plot the graph
figure('units','normalized','outerposition',[0 0 1 1]) % fullscreen
plot(Mavg(40,:),'r', 'LineWidth',2); % red line is x1 or A
hold on % this makes program to keep the existing plot to stay
% and draw the new plot on top of it

% several settings
grid on;
xlabel('m');
ylabel('Value');
title('FRF on row 40 M = 11');

pause(z);

imshow(Mavg);
grid off;
xlabel('');
ylabel('');
title('M = 11 Image');

pause(z);

%% Part i FOR M = 31
M = 31;


for i = 1:n

    for j = 1:m
        sum = 0;
        for k = 1:(M-1)/2
```

```
            if j-k <= 0
               current1 = 0;
            else
               current1 = J(i,j-k);
            end

            if j+k > 512
               current2 = 0;
            else
               current2 = J(i,j+k);
            end

            sum = sum + current1 + current2;


         end
         sum = sum + J(i,j);
         avg = sum / M;
         Mavg(i,j) = (avg);


      end

end


% plot the graph
figure('Units','normalized','Position',[0 0 1 1])
plot(Mavg(40,:),'b', 'LineWidth',2); % red line is x1 or A
hold on


% several settings
grid on;
xlabel('m');
ylabel('Value');
title('FRF on row 40 M = 31');

pause(z);

imshow(Mavg);
grid off;
xlabel('');
ylabel('');
```

```
title('M = 31 Image');

pause(z);

%% Part i FOR M = 61
M = 61;


for i = 1:n

   for j = 1:m
      sum = 0;
      for k = 1:(M-1)/2


         if j-k <= 0
            current1 = 0;
         else
            current1 = J(i,j-k);
         end

         if j+k > 512
            current2 = 0;
         else
            current2 = J(i,j+k);
         end

         sum = sum + current1 + current2;


      end
      sum = sum + J(i,j);
      avg = sum / M;
      Mavg(i,j) = (avg);


   end

end


% plot the graph
plot(Mavg(40,:),'g', 'LineWidth',2); % red line is x1 or A
hold on
```

```
% several settings
grid on;
xlabel('m');
ylabel('Value');
title('FRF on row 40 M = 61');

pause(z);

imshow(Mavg);
grid off;
xlabel('');
ylabel('');
title('M = 61 Image');

pause(z);

%% Part 2 -------------------------------
%% Part i
subJ = zeros(512);
for i = 1:n
   for j = 1:m
      sub1 = J(i,j);

      if j-1<1
         sub = sub1;
      else
         sub2 = J(i,j-1);
         sub = sub1 - sub2;
      end


      subJ(i,j) = sub;


   end
end

% plot the graph
plot(subJ(40,:),'y', 'LineWidth',2); % red line is x1 or A
hold on

pause(z);
```

```
imshow(subJ);
grid off;
xlabel('');
ylabel('');
title('Difference Filter Image');
```