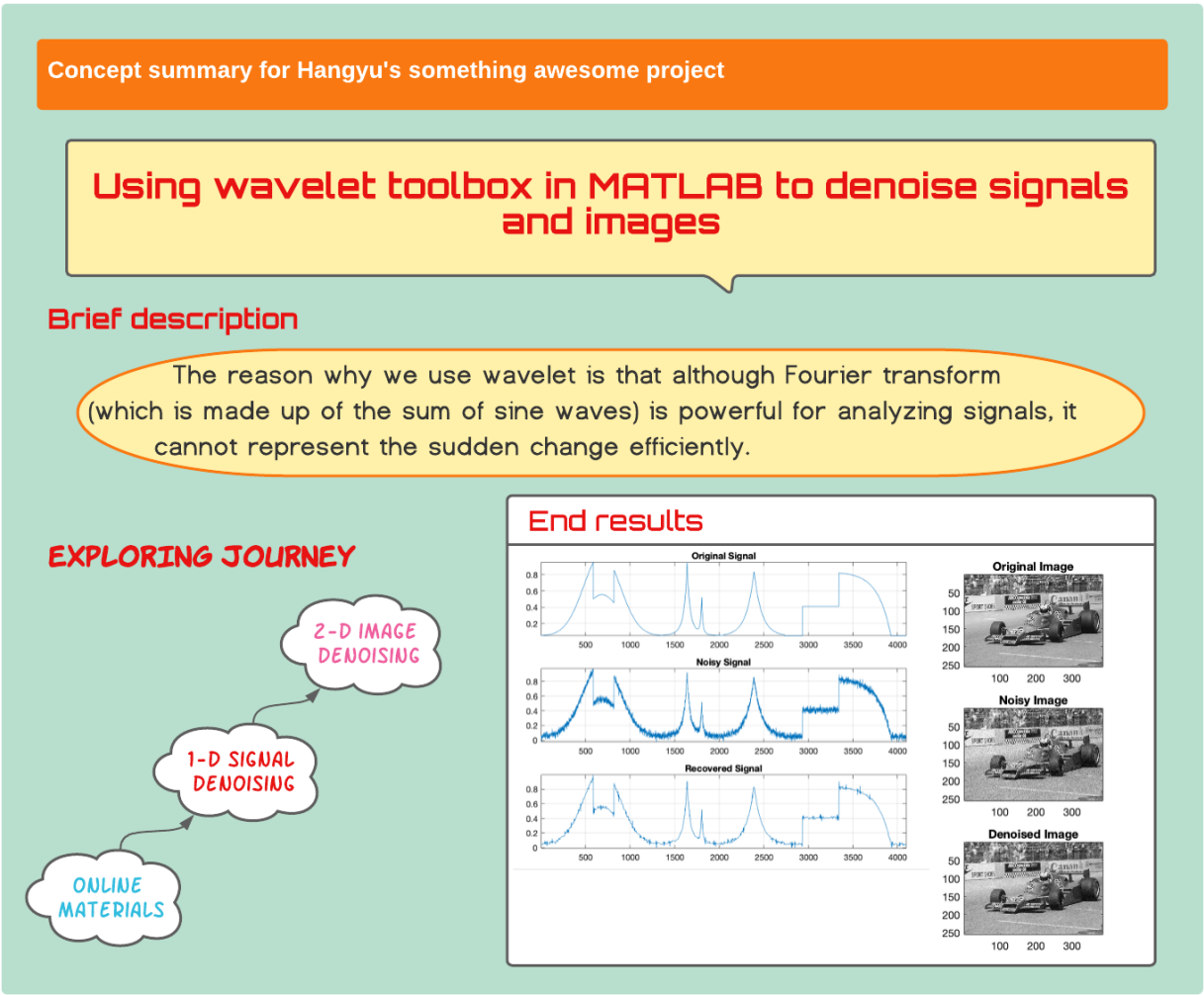
# Explore MATLAB Wavelet Denoising Journey

**Infographic at the start.**




## Proposal Submission

In this assignment, I will explore the basic knowledge of wavelet and implement wavelet denoising methods for 1-D signals and 2-D images. Firstly, as I have no background knowledge about wavelet, I will search for some materials online and put them as references in the report.
I will try my best to think and work as an engineer, so I will focus on demonstrating the skills of:

1. Planning: set up a formal schedule to learn and complete the whole project.
2. Debugging and testing on the code of MATLAB
3. Signal Modelling and Analysis: upload the code and show the final results as screenshots in the report.
4. Self-Reflection: I would make a reflection of myself after this project and write a reflection as part of the report.

Credit level:

1. Document how I implement my denoising methods for a 1-D signal and 2-D images with code in a MATLAB live-script file with explanations.
2. A report about wavelet and my personal understanding especially for signal denoising.
3. I would search for materials about wavelet analysis such as online courses and make them as references in the report.
4. Make a self-reflection in the report about how I was feeling before and after this project, where I met problems and where could be improved.

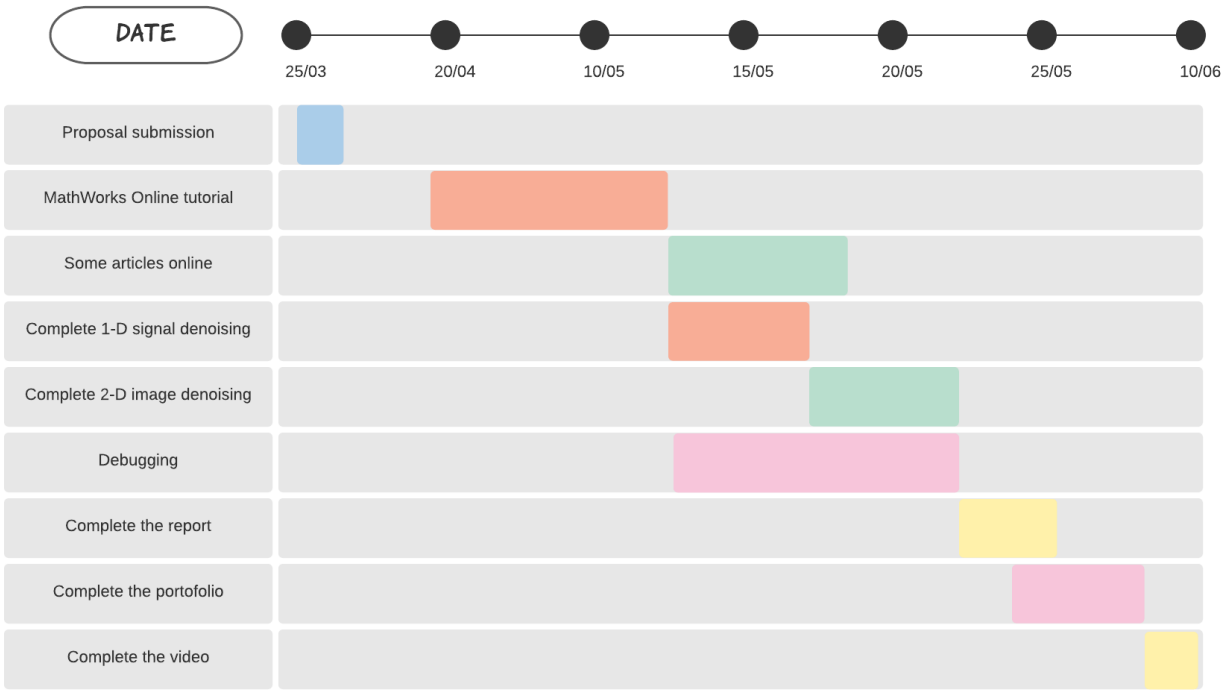
Additional factors:
Make a blog to record my progress for this project weekly.

## Skills Demonstration

Skills: Planning, Debugging, Modelling and Analyzing, Reflecting

### Planning

In order to think and work as an engineer, I made a Gantt chart at the beginning in order to plan and track the progress of my project.



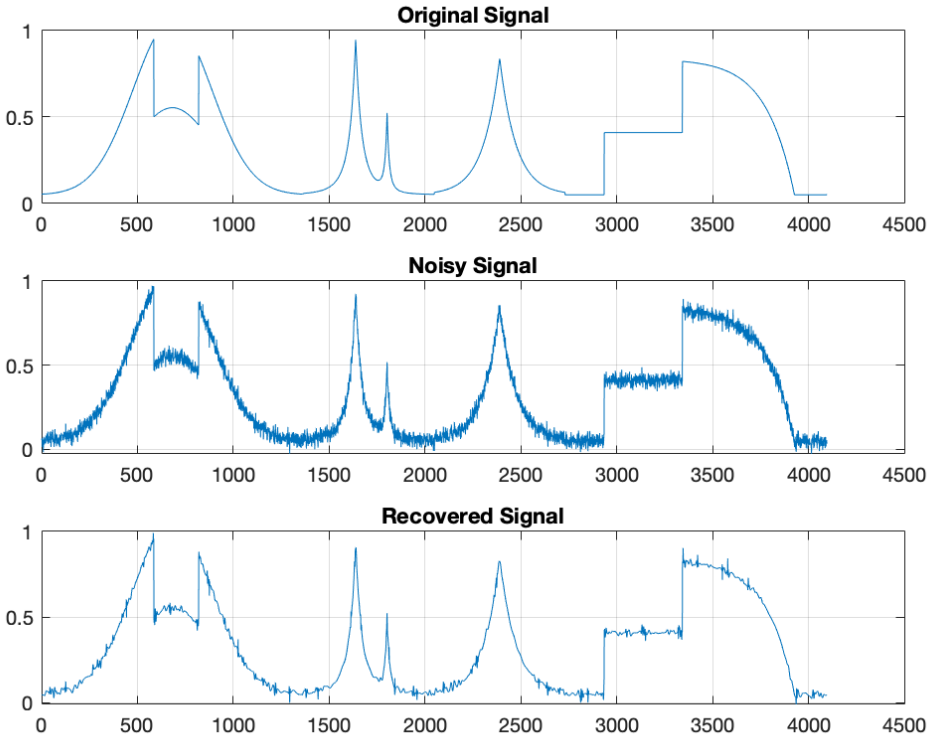

The link of the blog for recording the progress weekly is shown below:

### Modelling and Analyzing

In order to make the result looks more intuitive, I used subplot() function in MATLAB to combine the reconstructed signal with the original noisy signal. And for analyzing, I calculated the SNR value for each method and compare the value with each other. In this part, only parts of my code will be shown, the whole code is uploaded in the main.mlx file.

1. For 1-D signal using sigm6 wavelet denoising:

```
figure;
subplot(3,1,1);
plot(f0); grid on;
title('Original Signal');
subplot(3,1,2);
plot(f); grid on;
title('Noisy Signal');
subplot(3,1,3)
plot(fd); grid on;
title('Recovered Signal');
```




```
sprintf('Noisy Signal SNR:  %0.2f dB',-20*log10(norm(abs(f0-f))/norm(f0)))
```

```
ans = 'Noisy Signal SNR:  24.44 dB'
```

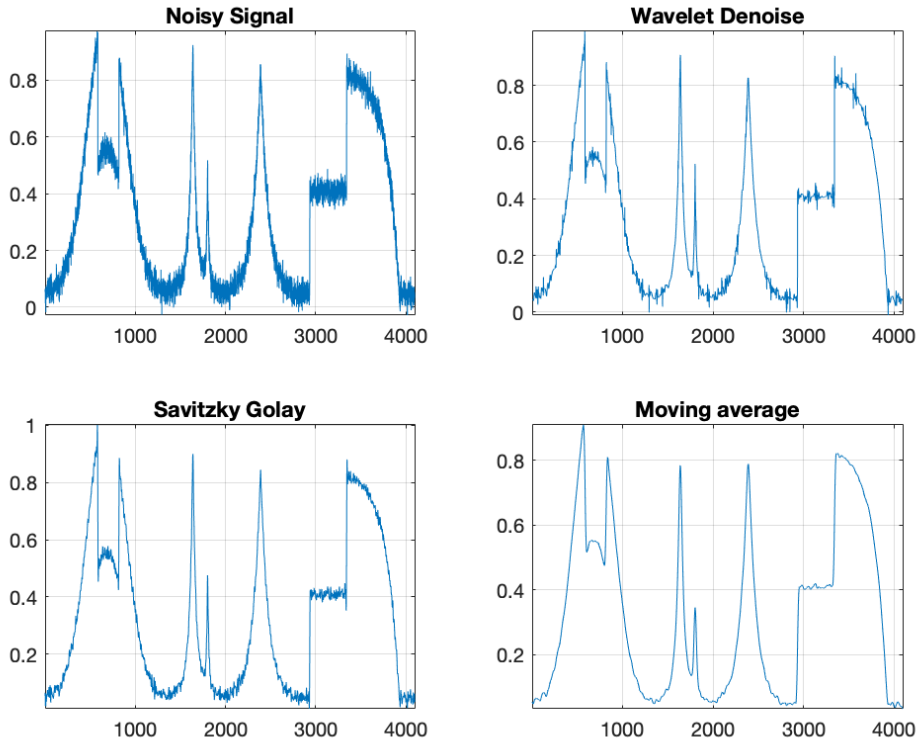
```
sprintf('Denoised Signal SNR:  %0.2f dB',-20*log10(norm(abs(f0-fd))/norm(f0)))
```

```
ans = 'Denoised Signal SNR:  30.73 dB'
```

2. For 1-D signal using other wavelet methods denoising:

```
figure;
subplot(2,2,1);
plot(f); axis tight; grid on;
title('Noisy Signal');

subplot(2,2,2)
plot(fd); axis tight; grid on;
title('Wavelet Denoise');

subplot(2,2,3)
sgolay = sgolayfilt(f,31,101);
plot(sgolay); axis tight; grid on;
```

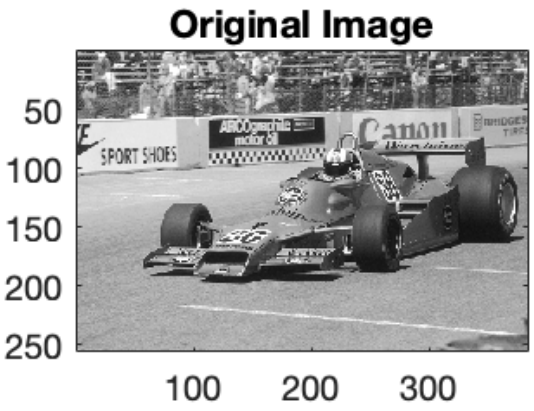
```
title('Savitzky Golay');

subplot(2,2,4)
movavg = 1/20*ones(20,1);
fmv = filtfilt(movavg,1,f);
plot(fmv); axis tight; grid on;
title('Moving average');
```

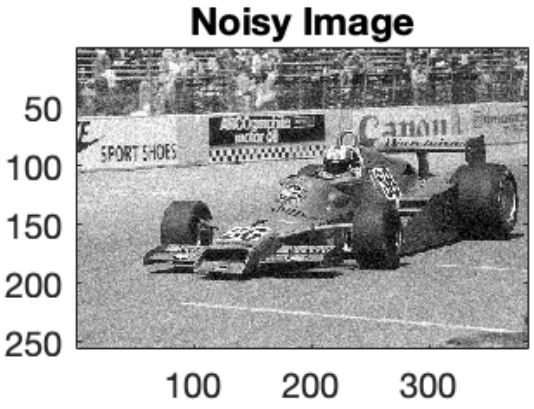


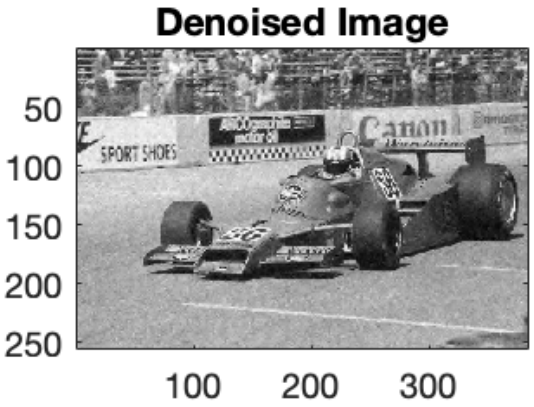

```
ans = 'Wavelet Denoising SNR:  30.73 dB'
ans = 'Savitzky Golay SNR:  29.01 dB'

ans = 'Moving Average SNR:  26.14 dB'
```

3. For 2-D image using ′coif2′ wavelet denoising:

```
figure;
subplot(3,1,1);
image(myImage)
colormap(gray(256)); axis('image'); title('Original Image')
hold on

subplot(3,1,2);
image(myImageN1); colormap(gray(256)); axis('image'); title('Noisy Image')
hold on

subplot(3,1,3);
image(X3)
colormap(gray(256)); axis('image'); title('Denoised Image')
```




```
sprintf('Noisy Signal SNR:  %0.2f dB',-20*log10(norm(abs(myImage-myImageN1))/norm(myImage)))
```

```
ans = 'Noisy Signal SNR:  20.35 dB'
```

```
sprintf('Recovered Signal SNR:  %0.2f dB',-20*log10(norm(abs(myImage-X3))/norm(myImage)))
```

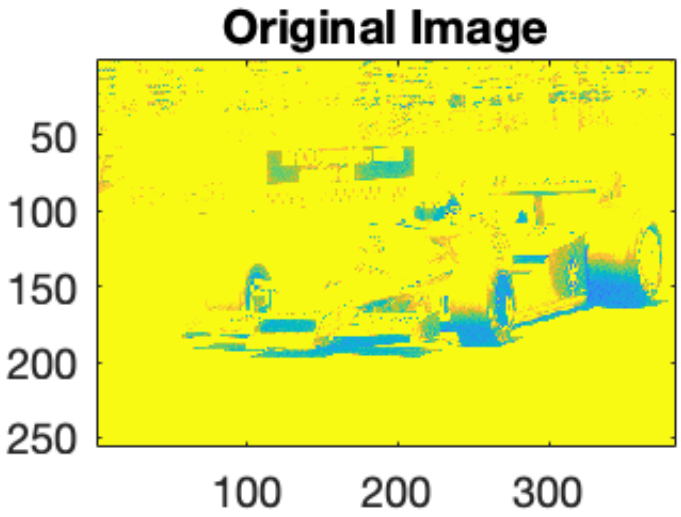
```
ans = 'Recovered Signal SNR:  23.21 dB'
```

4. For analysing the result for different denoising methods, we use the SNR value. If the SNR increased, it means the quality of the image increased. So the higher SNR, the better quality.

**Debugging**

1. The first bug I met in the project is when I used the wavedec() fucntion for signal decomposition. And I found it is because I did not install the wavelet toolbox in my laptop.

2. Also, when I used image() function in order to show the image I got, it gave me a image with color such as with exposure, which cannot seen the image clearly. So I used colormap(gray(256)) to change it as a gray image with maximum pixel value 256. Then it can be shown clearly.




**Reflecting**

Making a reflection is a good habit for us to improve ourselves in the future especially as an engineer. In this case, after I finished the project, I found that although I made a Gantt Chart at beginning which is aim to push me to make the project in time, I still did not follow that scheduler to finish my project step by step. I think it is because I did not think about the "risks" that I might meet. For example I have other units and other projects/exam to do, which would effect my progress. In this case, I will try to leave room for the scheduler in the next project.
And the whole reflection is written at the end of the report submitted.

## Accomplishments

Describe what you did and what you accomplished and provide examples. You should provide a copy of your credit level outcomes and indicate whether you achieved these outcomes.
Credit level:

1. Document how I implement my denoising methods for a 1-D signal and 2-D images with code in a MATLAB live-script file with explanations.
2. A report about wavelet and my personal understanding especially for signal denoising.
3. I would search for materials about wavelet analysis such as online courses and make them as references in the report.
4. Make a self-reflection in the report about how I was feeling before and after this project, where I met problems and where could be improved.

Additional factors:
Make a blog to record my progress for this project weekly.

I finished all the credit levels.
I have uploaded the code in main.mlx and the results I got after denoising for 1-D signals and 2-D images have been shown above.
And the report with my reflection has been uploaded together with the MATLAB code on Canvas.
The link for my blog and video presentation is in the next section.

## Video documentary

Provide a video documentary describing your Something Awesome project.

The link of the video is shown below.
`https://youtu.be/xdXZz-ZfOKQ`

## Upload your Deliverables

The link of the video is shown below.
https://youtu.be/xdXZz-ZfOKQ

The code (main.mlx) and the formal report (Report.pdf) are submitted together with the portfolio on Canvas.
There are 7 pages in the report (including one cover page and a reference page)

The link of my blog is shown below:
https://v3.pebblepad.com.au/spa/#/public/tj7z9wwgfMxq4Zn6bzrgHHbywc