**Exercise 12**

For this exercise you need to utilise the PowerPoint file entitled: ‘DAS\_Exercise\_12’ which has been included in this folder.

You have been provided with a .csv file (Lap1) which includes a lap of a racing car.

(i) Develop a figure consisting of two subplots. The upper subplot should present the actual Acceleration signal in (acquired from the Long-G sensor) vs. time (in sec) whereas the lower subplot should present the Numerical Differentiation of the Speed sensor signal i.e. estimated Acceleration, in **without the utilisation of the MA filter,** vs. time (in sec). Compare the two subplots and comment.

(ii) Repeat the same process as in (ii) however, **select different values for the span size of the MA filter** and compare visually the estimated acceleration with the actual acceleration. You can incorporate a number of selected plots in order to support your observations. State briefly your observations.

(iii) Compare the ‘estimated’ acceleration and the ‘actual’ acceleration **utilising the RMSE** for different span sizes of the MA filter. Specifically, conduct a series of experiments with different span sizes and calculate the corresponding RMSE. Plot the results on a graph. Which values of span size are of particular interest and why? State your observations.

*Extra Questions*

(iv) Follow the directions of Slide 23 of the ‘DAS\_Exercise\_12’ PowerPoint file and use the .csv file provided to develop the following figures:

*Numerical Differentiation*

1. Develop a figure consisting of two subplots. The upper subplot should present the actual Speed signal acquired from the Wheelspeed sensor () vs. Time (*sec*), whereas the lower subplot should present the Numerical Differentiation of the Distance sensor signal i.e., the estimated Wheelspeed signal (*m/sec*) vs. time (*sec*). Compare the two subplots and comment.

Hint: For this question you may need to utilise a Low Pass Filter (LPF).

2. Develop a figure consisting of two subplots. The upper subplot should present the actual Acceleration signal acquired from the Long-G sensor ( ) vs. Time (*sec*), whereas the lower subplot should present the Numerical Differentiation of the Wheelspeed sensor signal i.e., the estimated Acceleration signal ( vs. time (*sec*). Compare the two subplots and comment.

Hint: For this question you may need to utilise a Low Pass Filter (LPF).

*Numerical Integration*

3. Develop a figure consisting of two subplots. The upper subplot should present the actual Wheelspeed signal acquired from the Wheelspeed sensor ( vs. Time (*sec*), whereas the lower subplot should present the Numerical Integration of the Long-G sensor signal i.e., the estimated Wheelspeed signal () vs. time (*sec*). Compare the two subplots and comment.

Hint: For this question you may need to utilise a Low Pass Filter (LPF).

4. Develop a figure consisting of two subplots. The upper subplot should present the actual Distance signal acquired from the .csv file provided ( vs. Time (*sec*), whereas the lower subplot should present the Numerical Integration of the Wheelspeed sensor signal i.e., the estimated Distance signal ( vs. Time (*sec*). Compare the two subplots and comment.