**Exercise 13**

You have been provided with two .csv files which include, amongst others, the Time, Distance and Speed signals for two laps (Lap1 and Lap2) of two racing cars.

Using the aforementioned data, find the time difference between the two laps or in other words the time that takes car A to cover distance Z minus (-) the time that takes car B to cover the same distance.

In order to complete this task follow the steps described below:

**Step 1:** From the .csv files provided, check whether the maximum value of distance of Lap 1 is different compared to the maximum value of distance of the other Lap. In case they are not equal then, the longer one should be reduced so as both maximum values of Distance to become equal. The other columns i.e. Time, Speed etc. should be shortened by the same amount of points as well.

**Step 2:** In order to find the time difference between the two laps it is required to interpolate the Time signal. Specifically, the length (number of samples) of the Time vector should become equal to the maximum (last) value of the Distance vector e.g. if the distance that the racing car covers is 5,000 meters then, the time signal should consist of the same number of points i.e. 5,000 time samples.

Definition of Interpolation: Interpolation increases the original sampling rate for a sequence to a higher rate.

**Step 3:** Repeat Step 2 for the Speed vector

(i) Plot in the same Figure (Figure 1) the interpolated Speed (in Miles per Hour) vs. Distance (Meters) for Lap1 and Lap2. Use different colors for each lap.

The Figure should contain: Title, x-axis labeling and y-axis labeling; the units of measurement should also be included.

Please note that the size of the Distance vector should become equal to the size of the interpolated Speed vector.

(ii) Plot the time difference signal (Figure 2) utilizing the interpolated time signals and find the cumulative time difference between the two laps.

(iii) State the relation between Figure 1 and Figure 2. Make a list of your observations.

(iv) a. Describe and explain briefly the process which has been followed in order to find the time difference between the two laps.

b. State the reason(s) that the non-interpolated time vector of Lap1 was not subtracted directly from the non-interpolated time vector of Lap2 or vice-versa in order to find the time difference.

c. State in which case you should decimate (decrease sampling rate) instead of interpolate the time signal.