Filtering RUBE Data of SDOF M,C,K Model - OPTIONAL PROJECT

Purpose

The intent of this project is to use the data collected from RUBE and to filter some of the high frequency effects seen in the data. Using the LVDT and the 100 mV/g accelerometer data from the Project #2 data set collected, design and apply a 1st order RC filter to minimize some of the high frequency data superimposed on the primary frequency data of concern. A Simulink model is to be developed for the RC circuit low pass filter. The filtered data is to be rescaled to normalize the attenuation effects of the filter for the primary frequency of concern. Compared the original data from the 100 mV/g accelerometer to the 1 V/g accelerometer and to the double differentiated LVDT data; determine the peak acceleration for the primary frequency of interest.

Model for Evaluation

The model used for evaluation is the single degree of freedom lumped mass model defined by second order differential equation with constant coefficients. The measurements of displacement and acceleration to be used are those acquired from Project #2 from RUBE. The LVDT and the 100 mV/g accelerometer data is to be used for the analysis described. The model and RC circuit low pass filter conceptualization is shown in Figure 1. The commands for importing Excel data into MATLAB and then into Simulink are contained on the following page.

![Diagram of single degree of freedom model](image)

Figure 1 – Single Degree of Freedom Model

Post Analysis and Report– (INDIVIDUAL Report)

A short ONE PAGE memo describing the analyses performed is to be provided. A description of the filter characteristics used should be provided. The comparison of the original accelerometer signal and the rescaled, normalized filtered signal should be provided and compared to the double differentiation of the LVDT data; the peak acceleration for all three measurements must be compared. Details of the model and analysis should be provided in an appendices as appropriate. The one page of the memo must be typed and should point to attached plots or models in appendix; the appendices may contain a combination of handwritten and computer generated results. BE CLEAR AND CONCISE. NOTE: this is not a report – just a well organized memo with results.
IMPORTING DATA FROM EXCEL INTO MATLAB AND SIMULINK

Project #2 data is assumed to be previously acquired and available in Excel. Procedural steps to read this data into Simulink are defined below; MATLAB commands MUST be run BEFORE Simulink. This is shown for the LVDT and accelerometer AS AN EXAMPLE only.

1- The data should be contained in the first two columns of Excel as shown in Figure 1 (left). A Simulink model must be developed to “Import” the data from the LVDT and accelerometer and is conceptually shown in Figure 1 (right).

2 – In MATLAB, the Excel file must be read using the XLSREAD command.
   \[ b = \\text{xlsread('expdata')}; \]
   \[ c = b(:,1); \% \text{takes first column of data and assigns it to variable named 'c'} \]
   \[ d = b(:,2); \% \text{takes second column of data and assigns it to variable named 'd'} \]

3 – The MATLAB data arrays must be set up as follows BEFORE reading into Simulink
   \% Sets up Inports 1 & 2 for Simulink model
   \% Inports must be in Simulink model
   \[ a.time = (0:.001:1.499)'; \% \text{assumes 1500 time steps of 0.001 sec of data} \]
   \[ a.signals(1).values = c; \% \text{assumes data 'c' is assigned to port '1'} \]
   \[ a.signals(1).dimensions = 1; \]
   \[ a.signals(2).values = d; \% \text{assumes data 'd' is assigned to port '2'} \]
   \[ a.signals(2).dimensions = 1; \]

4 – The Simulink model must contain TWO input ports; these can be obtained from the Sources -> Input Block contained in Simulink. Once manipulations are performed on the signals as desired, the output can be written back to the workspace or to a .MAT file.
One further note regarding MATLAB and importing the data acquired for this project. Depending on the version of MATLAB that is used there may be some slight differences. The commands above work for MATLAB 6.5 Version 13. In Version 7, the default parameters are not the same as in Version 6.5.

The MATLAB/Simulink Simulation Parameters may need to be specified.

The Solver parameters need to be specified as “fixed step” with delta t set to the sample time of your data. The start and stop times must correspond to your data set.

The Data Import/Export must be selected as “Load from Workspace” as shown.