

# RANDOM VIBRATION ANALYSIS OF A CANTILEVER BEAM USING LABVIEW

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**Abstract :** A horizontal cantilever beam designed with inexpensive materials mostly with some acrylic and steel fabrication. To plot the displacement, velocity, acceleration graphs with respect to time, an accelerometer is used. The experimentation has been carried out on a steel beam. This method is quite efficient to represent the dynamic behavior of the cantilever beam under disturbance created by certain external force. This process is carried out for different scenarios. The beam was arranged as a cantilever for theoretical, numerical and experimental setup. But to achieve precision of data and accuracy of system, the data acquisition and the control of an actuator which is capable of vibrating the cantilever beam continuously is done through National Instruments DAQ system and LabVIEW software.

**IndexTerms – Cantilever beam, LabVIEW, Trending , Position.**

## I. INTRODUCTION

A horizontal cantilever beam is designed with inexpensive materials mostly with some acrylic and steel fabrication. Cantilever beam will be outlined as a beam that is held on just one finish, Which means one end is fastened and therefore the alternative finish is free on the far side the support. The load is transferred to the support by the beam wherever it manages the shear stress and moment of force. When the associated object is rotated or twisted by a force, this tendency of a force is said to be moment of force. Stress applied collaterally to the face of any matter is called as Shear stress. In alternative words, the beam carries a load on its non-supported end as a result of the support on its encircled or fastened finish.

Additionally to forestall the breaking down due to the the shear stress, the load would be created on the beam. Cantilever construction allows for overhanging structures while not external bracing/support pillars. Cantilever beams will also be created with slabs or trusses. Here we tend to use a stainless-steel mensuration scale because the cantilever beam whose one finish fastened to a structure made by acrylic material and therefore the alternative finish left free that is liberal to move vertically. The accelerometer is used to find the displacement velocity and acceleration graphs with respect to time. The test carried out on a steel beam. It is very effective way for representing the dynamic behavior of cantilever beam while it is disturbed by some external force and different scenarios where tested, the beam set up as a cantilever with theoretical, numerical and experimental. But to achieve the precision of data and accuracy of system the data acquisition and the control of an actuator which is capable of vibrating the cantilever beam continuously is done through National Instruments DAQ system and LabVIEW software.

## II. RESEARCH AND METHODOLOGY

### 2.1 CONSTRUCTING A CANTILEVER BEAM

Here we tend to use a stainless-steel mensuration scale because the cantilever beam whose one finish fastened to a structure made by acrylic material and therefore the alternative finish left free that is liberal to move vertically.

### 2.2 VIBRATION EXCITATION OF CANTILEVER BEAM

A non-contact actuator is developed which is capable of vibrating the cantilever beam continuously in steady state. The actuator is made up of an 12V electromagnet. One such actuators is installed in the system. The actuator is placed below the free end of the cantilever beam and a magnet is place above the cantilever beam adding one mass in the free end . As there is no contact between the actuator and the beam, electromagnetic force is developed when current passes through the coils of electromagnet, which attracts the magnet placed on the top of the free end . Magnet along with the beam is pulled down by the electromagnet and off a sudden when the electromagnet is switched off it releases the magnet along with beam thus creating the vibration of the cantilever beam.

### 2.3 CALIBRATION OF THE ACCELEROMETER

The cantilever is then connected to an accelerometer at the end which is free and then is connected to National Instruments data acquisition. The data collected is analyzed using LabVIEW software. The acceleration, velocity and displacement at the free end of the beam is measured using the accelerometer.

## 2.4 FILTERING THE SIGNAL

Filter express VI tool available in LabVIEW is used to remove the unwanted frequencies present in the signal. A butterworth lowpass filter is used here to get the filtered data.

## 2.5 REMOVING OFFSETS AND TRENDS

To ensure there is no external noise, scaling problem, outliers or any other corruptions, there are numerous of preprocessing techniques. The preprocessing techniques implemented here are for removing offsets and trends. In LabVIEW software, there is SI Remove Trend VI which removes offsets and trends from the obtained raw data.

# III. RESULTS AND DISCUSSION

## 3.1 INPUT SIGNAL

Input accounts for the voltage applied to the electromagnet that creates the magnetic field which acts on the free end of the cantilever beam. The cantilever beam is given a vertical deflection by a magnetic excitation realized by a magnet placed on the free end of the cantilever which is subjected to a time variant magnetic field gradient.

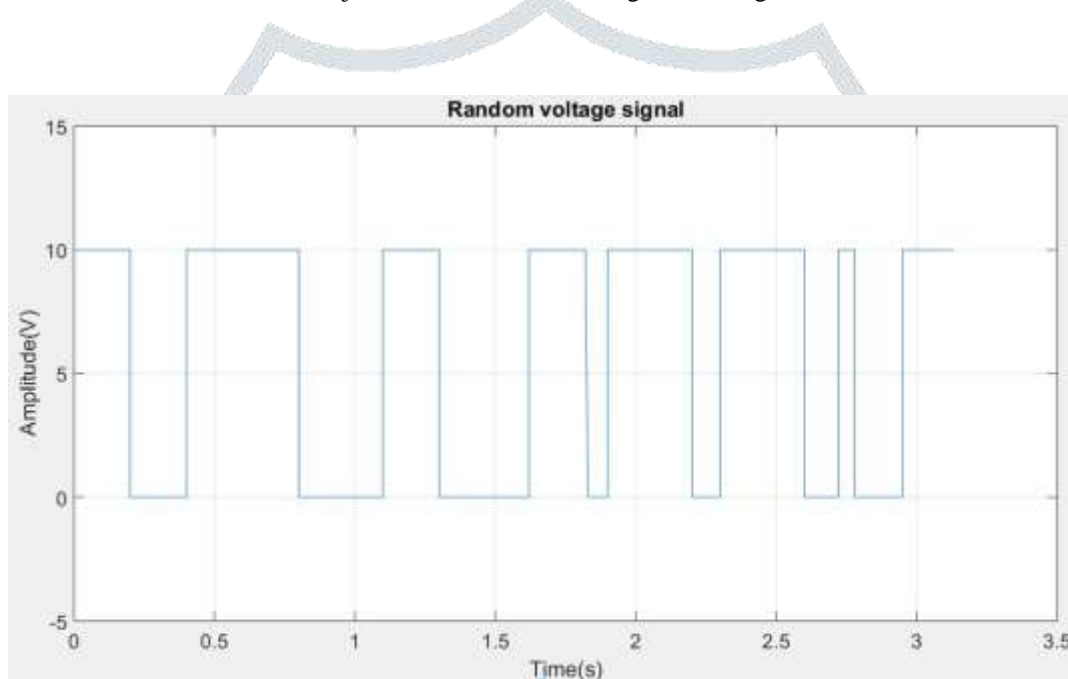


Figure 3.1: Amplitude vs Time graph for voltage

## 3.2 ACCELERATION, VELOCITY AND POSITION DATA

A accelerometer is connected at the free end of the cantilever beam, CompactDAQ module NI 9234 which is a analog input module is used to collect the data from the accelerometer when its given the vertical deflection. Data from the accelerometer (acceleration) is collected by the LabVIEW software through this module and is plotted.

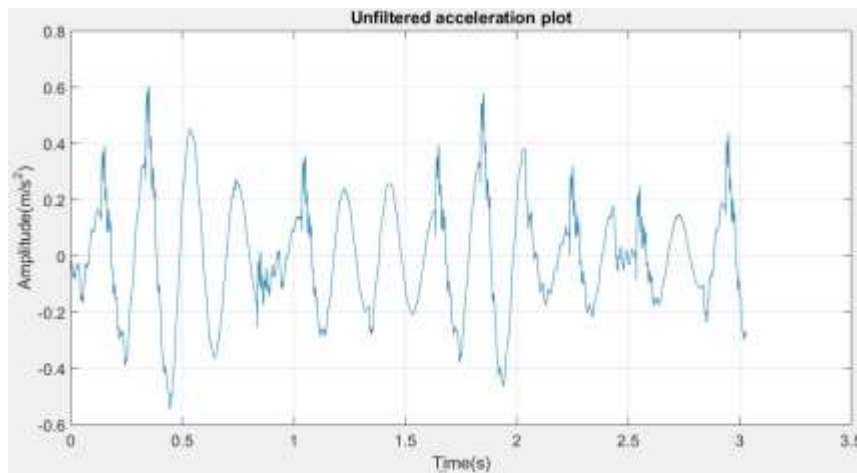


Figure 3.2: Amplitude vs Time graph for acceleration of unfiltered response signal

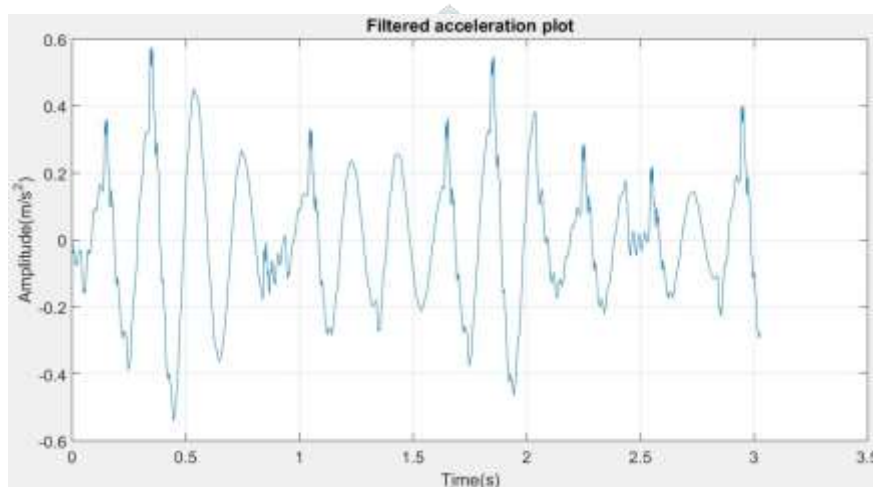


Figure 3.3: Amplitude vs Time graph for acceleration of filtered response signal

In LabVIEW we can take accelerometer measurements and represent that signal in acceleration, velocity, or displacement. The conversion from acceleration to velocity/ displacement requires numerical integration. Acceleration data is integrated to get the velocity using the mathematical tool available in LabVIEW

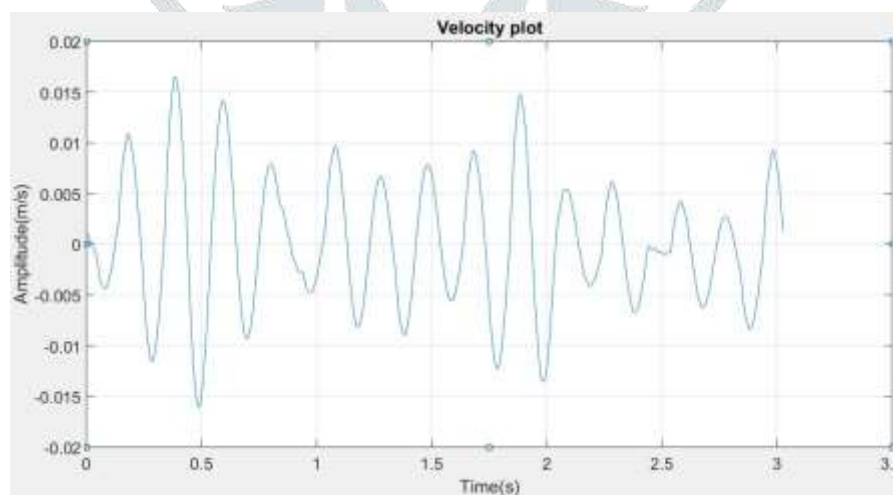


Figure 3.4: Amplitude vs Time graph for velocity of filtered response signal

The velocity data collected is again integrated to get the position of the cantilever beam.

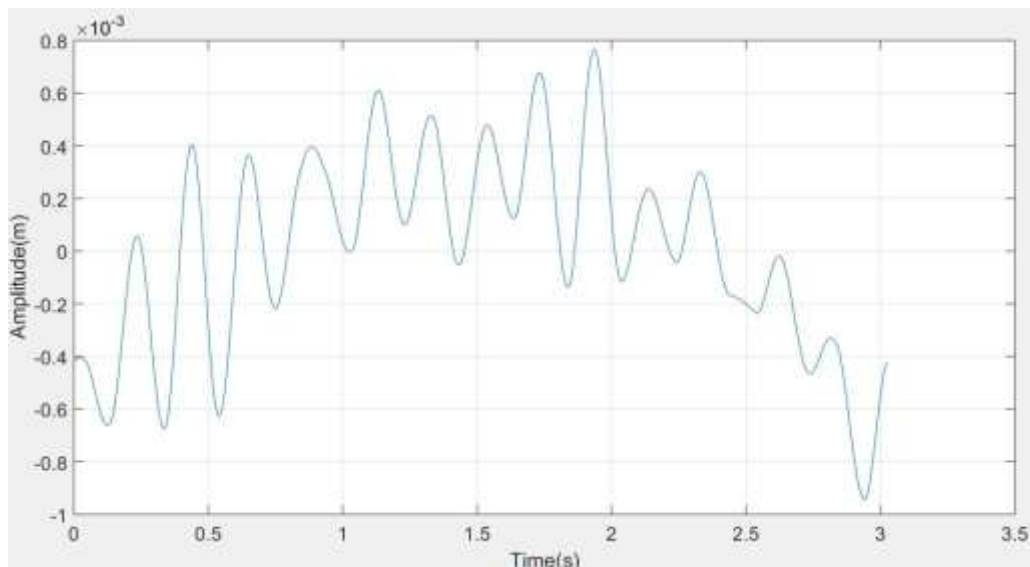


Figure 3.5: Amplitude vs Time graph for position of unfiltered response signal

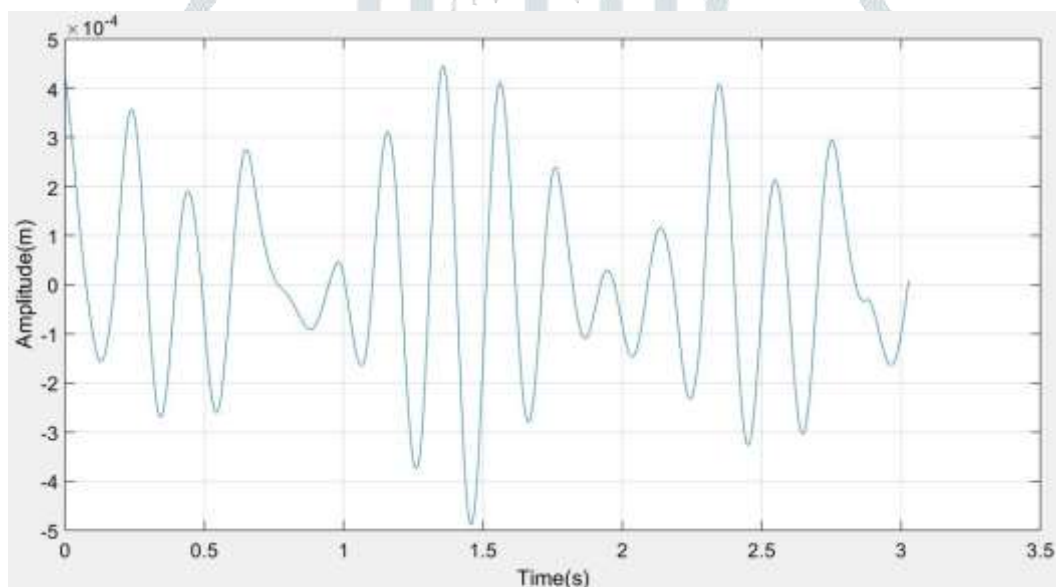


Figure 3.6: Amplitude vs Time graph for position of filtered response signal

#### IV. CONCLUSION

The objective of this work was to study the random vibration of the cantilever beam and plot the corresponding acceleration plot of the vibration at the free end of the cantilever beam and the input signal that is given to vibrate the beam using LabVIEW. The acceleration data acquired is integrated to get the velocity and is again integrated to get the position data of the cantilever beam. In order to remove the noises/disturbances in the signal that occur due to the integration of the data and also to remove the unwanted frequencies a Butterworth lowpass filter VI in LabVIEW is used. The offsets and trends occurring in the signals are also removed by coding in LabVIEW.

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