Control of Piezoelectric Sensed and Actuated Beam using Labview

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Abstract— In our project to the beam setup, the frequency is given to the beam and as result vibration is formed. Then that is viewed on DSO. On the case of providing in frequency to the beam .The vibration is produced only at the point of resonant frequency .This is done on both the DSO and LabVIEW to have a clarification to our project .In future it is used to control the vibrations.

Key words: Actuated Beam, Piezoelectric, DSO

I. Introduction

In the beam four piezoelectric sensor was connected in series and to that input is given to one sensor from the function Generator and the output is taken from the another sensor at the end and given to the beam .

As the connection done with the DSO ,similarly the input is given and the output is taken from the beam and it was given as the input to the DAQ and certain initialization have been done with DAQ assistant data and the output waveform is taken from the waveform chart.

II. Block diagram

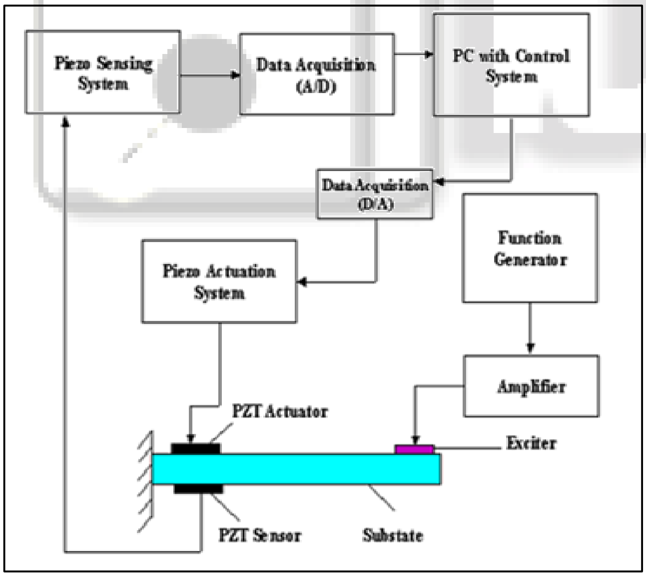

Fig: 1: Block Diagram Of Vibration Control

III. Hardware components

A. Piezoelectric Sensor:

Piezoelectric sensors measure the electrical potential caused by applying mechanical force to a piezoelectric material. Piezoelectric sensors are used in a variety of pressure-sensing applications. A few examples

- Alumini ceramics
- Single crystals
- Ultrasonic transducers

A piezoelectric sensor works on the principle of conversion of energy in mechanical and electrical energy forms. When a polarized crystals is put under pressure, some mechanical deformation takes place in the polarized crystal, which leads in the generation of the electric charge. The generated electric charge or the mechanical deformation can then be measured using a piezoelectric sensor.

B. Digital Oscilloscope:

A digital storage oscilloscope (often abbreviated DSO) is an oscilloscope which stores and analyses the signal digitally rather than using analog techniques. It is now the most common type of oscilloscope in use because of the advanced trigger, storage, display and measurement features it which typically provides. The input analogue signal is sampled and then converted in to a digital record of the amplitude of the signal at each sample time. The sampling frequency should be not less than the nyquist rate to avoid aliasing. This digital values are then turned back in to on analogue signal for display on a cathode ray tube(CRT),or transformed as needed for the various possible types of output.

C. Function Generator:

A function generator is usually a piece of electronic equipment or software used to generate different types of electrical waveforms over a wide range of frequencies. Some of the most common waveforms produced by the function generator are the sine, square, triangular and sawtooth shapes. This waveforms can be either repetitive or single- shot (which requires an internal or external trigger source). Integrated circuits used to generate waveforms also be described as function generator. Although function generator covers both audio and RF frequencies, they are usually not suitable for application that need low distortion or stable frequency signals.

D. Cantilever Beam:

Cantilever is a beam supported on only one end. The beam transfers the load to the support where it has managed the moment of force and shear stress. Moment of force is the tendency of a force to twist or rotate an abject. Shear stress is defined as stress which is applied parallel to the face of the material.

In other words, the beam bears a specific weight ot it open end as a result of the support on it is enclosed end, in addition to not breaking down as a result of the shear stress the weight would generate on the beam's structure cantilever construction allows for overhanging structures without external bracing/support pillars. Cantilever construction is famous in many kinds of architectural design and in other kinds of engineering, where professional use terms like end load, intermediate load and end moment to find out how much a cantilever will hold.

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Parameter	Value
Length (L)	0.35 m
Width (b)	0.025 m
Thickness (h)	0.003 m
Modulus (E)	$7.1*10^{10}$ N/m2
Density (ρ)	2700 kg/m^3
Mass Density (M)	0.06075 kg/m
Modal Mass (m)	0.015377 kg

Table 1: Properties of the smart beam

IV. Measurement of Resonance Frequency:

In the project regarding our view on the control operation we need to first look after the resonance frequency. Thus only for finding our requirements we have made two type of connections using DSO and LabVIEW

Resonant frequency is that frequency of the beam at which the beam vibrates continuously .Only for the find out of this frequency we have such an arrangement.

A. *Resonance frequency in DSO:*

As the sensors connected in series to the beam, to that one sensor is connected to the function generator, and the other sensor is connected to the Digital Storage Oscilloscope.

Here in this the input is given to the beam by using the Function Generator at the maximum voltage of 20V and frequency is varied continuously till the beam get vibrates and changes getting obtained on the DSO normal sine waveform.

Fig. 2: Initial waveform in DSO

In the above figure was our project setup connecting DSO .Actually while providing frequency to the beam with the help of function generator for the normal frequencies as the beam does not vibrates ,the waveform will be normal as shown in the figure only at the resonance frequency the beam will vibrate.

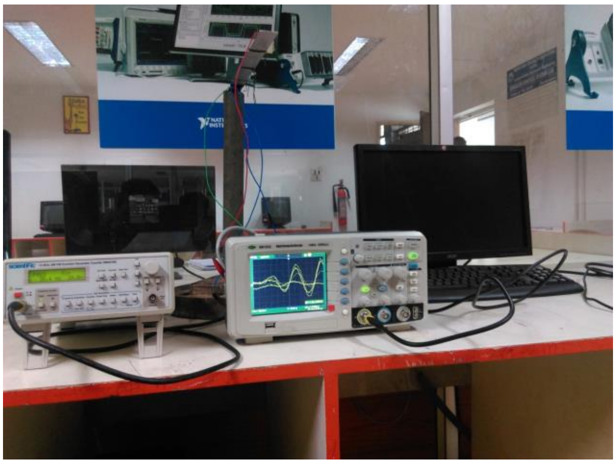

Fig. 3: Final waveform in DSO

In the above figure, on the display of the DSO we get the waveform slight variation from the normal sine waveform i.e the waveform will attain a peak. This was the resonance frequency we have got and that is 38.6 Hz.

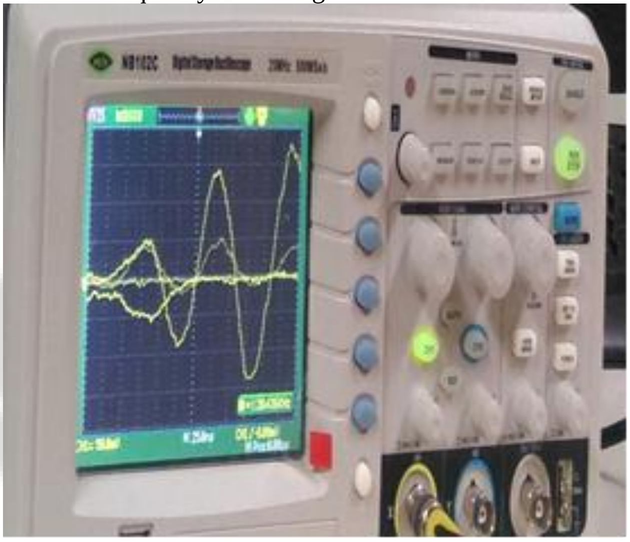

Fig. 4: Close view of final waveform

B. *Resonant frequency in LabVIEW:*

In the beam, the piezoelectric sensors are connected in the series. In that series connection four piezoelectric sensors has been placed and the another sensor has been placed separately. Here the sensor is used to give the input from the functional generator. In which these series connection to take output. The sensors are connected to the labVIEW by using data acquisition(DAQ).

Fig. 5: Initial waveform in LabVIEW

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The above LabVIEW program DAQ assistant, tone measurements waveform chart, write to measurement file, dial are used. Input from the piezoelectric sensor is given throw DAQ assistant. That is connected to tone measurement and waveform chart.

Tone measurement is used to calculate the amplitude and frequency of detected single tone in volts and hertz respectively by using numeric to display the amplitude and frequency values waveform chart is used for shown frequency wave. Then the tone measurement is connected to the write to measurement file. It is used to display the full path to the file to which you want to write data. It can be placed inside on the case structure.

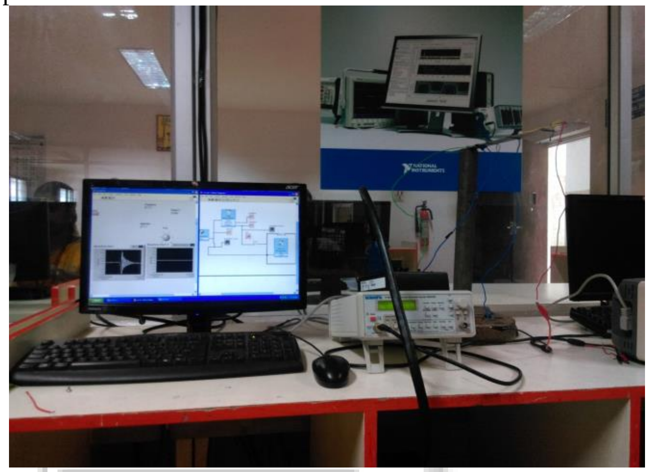

Fig. 6: Final waveform in LabVIEW

For continuous measurement while lop around the DAQ assistant. So the whole program can be surrounding by while loop. Then we can double click the DAQ assistant to edit and installing the DAQ.

V. LABVIEW SIMULATION PART

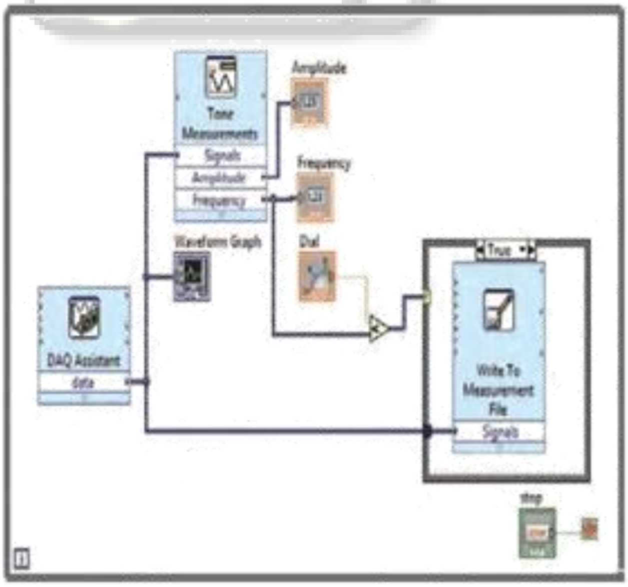

Fig. 7: LabVIEW program

We tune the frequency in function generator, based on the frequency the beam's vibration will be change. The output voltage in the cantilever beam will be given to the DAQ. The graph will be displayed in the PC with LabVIEW.

VI. CONCLUSION

Thus we have determined the resonance frequency for the beam for controlling. The resonance frequency is the major factor. Since of only if we find at what frequency it will vibrate, we can able to control. Upto now we have done it, in future or in our next project we will look out of the control aspect.

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