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Wireless Active Vibration Control for Structural Vibrations using Embedded Controller

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Abstract -*The paper presents the outcomes on active vibration control of a 1mm beam on which the PZT patches are bonded. The beam is energized and the actuator activates to frame a hostile to vibration signal. The concealment of the vibrations is attained. A vibration signal is obtained when the exciter is energized and the counter vibration signal is produced utilizing Least Means Square (LMS) feed forward adaptive control. The experimental outcomes are observed remotely utilizing a RF module coordinated on the controller using Code Composer studio v7.*

***Key Words*: Active Vibration Control, PZT patches, Least Means Square (LMS), Code Composer Studio v7.**

1.INTRODUCTION

Active vibration control has been presented and utilized as one of the powerful methodologies to smother undesirable vibrations in various systems. Effective performance of vibration control technique is unforeseen to precise outline and appropriates the elements choice of the control unit. Integrated controllers are known as a standout amongst the best techniques for vibration control. Active control depends on superimposing vibration sources on essential sources to acquire a least remaining sign. Active vibration control is the dynamic use of force in an equivalent and inverse mold to the other force by outside vibration. With this application, a mechanical process can be kept up on a stage basically without vibration. A feed-forward AVC is considered for a controller using controlling algorithms such as Least Means Square (LMS).

1.1 LMS ALGORITHM

As the LMS calculation does not utilize the correct estimations of the desires, the weights could never achieve the ideal weights in the supreme sense, yet a meeting is conceivable in mean. That is, despite the fact that the weights may change by little sums, it changes about the ideal weights. Be that as it may, if the fluctuation, with which the weights change, is expansive, merging in mean would delude. This issue may happen, if the estimation of step-measure isn't picked appropriately [1]. On the off chance that is been expansive, the sum with which the weights change depends vigorously on the inclination gauge, thus the weights may change by a substantial esteem so angle which was negative at the principal moment may now wind up positive. Also, at the second moment, the weight may alter in the contrary course by a substantial sum as a result of the negative angle and would subsequently continue swaying with a vast difference about the ideal weights. Then again, if mu is been too little, time to unite to the ideal weights will be too huge. The LMS algorithm basically performs few steps:

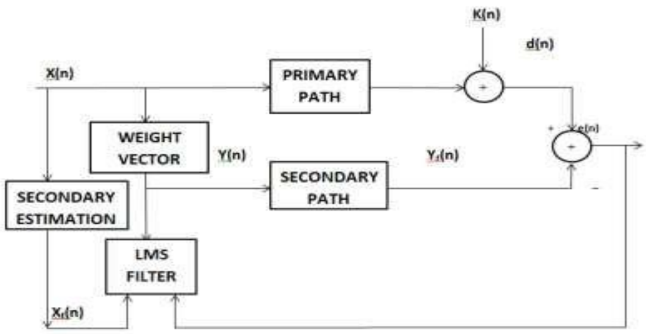

Fig -1: Block diagram of LMS Algorithm.

1.The input signal x(n) is known.

2.The filter weights are to be updated and calculated using the equation [2].

w(n+1)=w(n)+M(n)u(n)e(n).

3.The resultant LMS output y(b) is calculated.

In the above figure we have considered a secondary path. LMS algorithm needs a linear filter only and using a primary path is more easier to implement [3].

The convergence speed of LMS algorithm depends on the step size parameter. The LMS algorithm is implemented in the easier way. But it is observed that implementing the LMS algorithm results in slower convergence rate.

1.2 EQUIPMENT SETUP

The exploratory equipment comprises of a Dynamic shaker, cantilever shaft, accelerometer, Signal conditioner, Stellaris (LM4F120XL) microcontroller, RF module and PZT fix. The dynamic shaker is utilized as vibrating gadget. Cantilever shaft is gadget under test on which dynamic vibration control is performed. Accelerometer is a gadget which is utilized as sensor to detect vibrations. Signal conditioner is utilized to intensify input flag which is taken from accelerometer. The setup consists of a specimen, beam.The root part is fixed and the tip part of the beam is left free to vibrate. The beam of 1mm thickness which is free to vibrate. The dynamic shaker type 4809 is used as an exciter, a function generator (type 3022) is used to excite the dynamic shaker [4]. An accelerometer placed on the tip end of the beam is used to measure the vibrations from the beam.

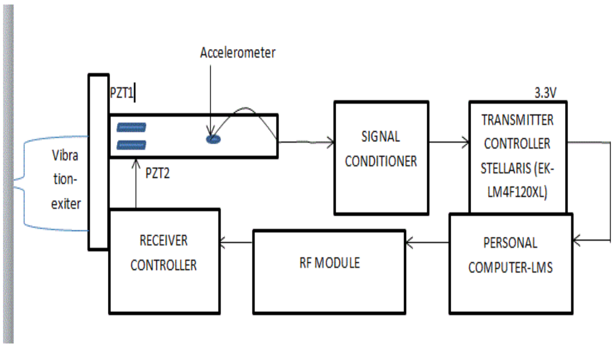

Fig -2: Experimental setup of the active vibration control.

The accelerometer is directly connected to the signal conditioner which filters,amplifies the signal.They are also used to isolate the unwanted noise produced.The output from signal conditioner is fed to the controller which is the transmitter.

2. CODE COMPOSER STUDIO

Code Composer Studio has bolster the Embedded Processors and Microcontroller. It is used to make and investigate introduced applications. The IDE gives each interface from first to last progress of the stream. CCS speeds the change strategy for continuous applications. TI was wearing down the IDE and it is an open-source Eclipse16 [5].

The complete setup is implemented in code composer studio. The AD converter which is internally built in the controller. The analog signal is fed to the controller is converted to a digital form. The AD converter produces a noise value for a noisy signal. Using LMS algorithm the counter noise value of the noisy signal is obtained. This is viewed wirelessly. The wireless setup is introduced with a RF module. The RF module has transmitter and a receiver.

Table -1: Parametric calculation

PARAMETERS	LMS ALGORITHM
Steady State Error	0.8
Convergence rate	0.4

Table- 1: Parametric calculation of Active Vibration Control. Steady state error is the state when the versatile channel focalizes and the channel coefficients never again have noteworthy changes [6]. Since signs may incorporate error or on the grounds that adaptive channels are not ideal, the error signal yields of adaptive filter are not really zero when the adaptive filter unites. Hence the steady state error is known.

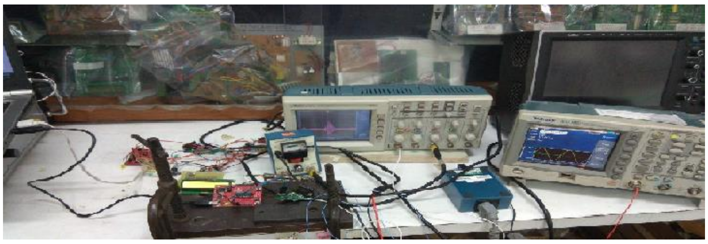

Fig- 3: Experimental setup of the active vibration control.

The power supply given to the RF module ranges from 5V.The experimental setup is integrated on the embedded systems.

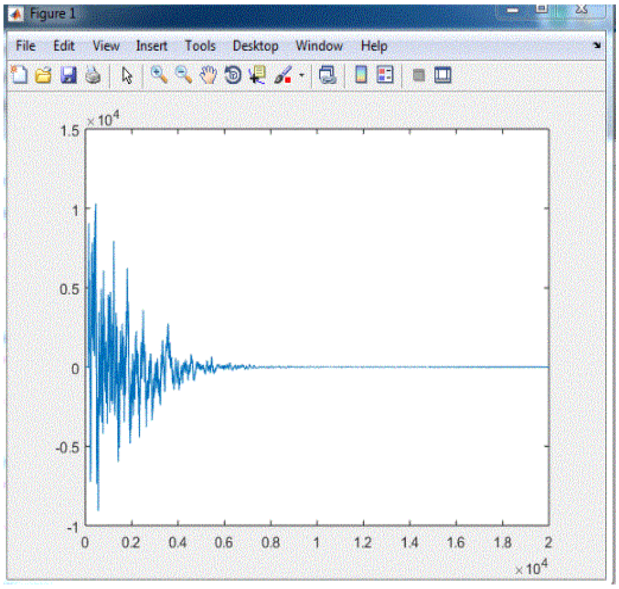

Fig - 4: Generation of the error signal.

The error signal is generated where the steady state error and convergence rate is calculated.

3. CONCLUSIONS

A wireless model link for active vibration control integrated on embedded systems using RF as the module is successfully implemented.The transmitter and receiver module are carefully chosen.The entire system is carried out in the code composer studio v7 environment.Various parameters are observed and the graph is plotted.

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REFERENCES

1. https://en.wikipedia.org/wiki/Least_mean_ _filter.

2. http://www.cs.tut.fi/~tabus/course/AdvSP/21006Lect5.pdf.

3. Reshma Rajkumar,Siva Subba Rao, Dr.S.Raja,Aravindu.B,Mahommed Toufiq A Hindustani,"Comparison of FxLMS and NFxLMS Algorithms in MATLAB Using Active Vibration Control".

4. Mahommed Toufiq A Hindustani, Siva Subba Rao P, Dr. S. Raja, Maheshan C M, "Performance analysis and comparison of FXLMS and NFXLMS algorithms for active vibration control".

5. http://www.ti.com/tool/CCSTUDIO.

6. http://www.ni.com/example/31220/en/.