IMPACT OF ADAPTIVE NOISE EMPLOYED IN ACTUATORS UNDER THE PURVIEW OF MECHATRONIC SYSTEM WITH MATLAB PLATFORM INCLUDING PERVASIVE COMPUTING

[1] Dr. J.Sebastian Nixon, [2] Dr.G. Kalivarathan , [3] Dr. M. Venkatesan
1 - Professor, Department of Information Technology, Wolaita Sodo University, Ethiopia
*2, 3, - Associate Professor, Mechanical Engineering, College of Engineering, Wolaita Sodo University, Ethiopia.

Abstract: Basically, the power amplification and energy conservation stage are considered as most influensity factors in terms of actuators in mechatronic systems. In this context, a modest attempt has been made to capture the impact of adaptive noise employed in actuators under the purview of in mechatronic system along with MATLAB platform including pervasive computing as a critical study towards sustainable investigation. Generally, the non-linearity factors are directly proportional to the noise-cancellation aspects under fluctuations if any. In the case sound communication systems, noise reduction by using adaptive digital filter in considered as a famous technique for representing required sound signal through preventing sound from the actuating signal corrupted by noise. In this paper, the performance of adaptive noise canceller is discussed for mechatronic actuator system with de-normalized least square method blended with pervasive computing.

Index Terms **– Mechatronics, pervasive computing, actuators, noise control, Signal conditioning, adaptive digital filter, MATLAB, information technology**

I. INTRODUCTION

In general, the fundamental importance of measurement systems within mechatronc products and processes and their influence on designing the system plays vital role. Similarly , drives and actuators play a primary rolein mechatronic system and their design and development within the integrative nature of a mechatronic approach, is normally considered as critical success factor for designing signal conditioning process.

As sensors and transducers produce input to mechatronic systems, drives and actuators provide the output of the system, influencing the system itself and environment.

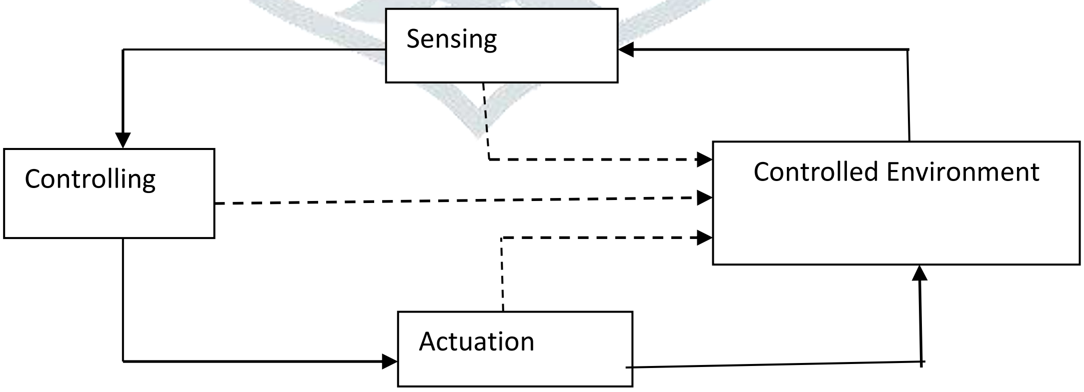


Figure 1. Interaction between controller and environment through sensing and actuator.

Typically, actuators are considered as only energy conversion devices. For instance, an electrical motor converts electrical power into rotary motion with huge noise. Similarly, a hydraulic motor will convert hydraulic power which is seen in the form of hydraulic fluid flow and pressure into rotary motion. However, it is more common to take an inclusive view of actuators and the actuation system has to be considered. However, the basic two components of an actuation system include the power amplification and modulation stage as well as the energy conversion stage.

II. RESEARCH METHODOLOGY

2.1 POWER AMPLIFICATION AND MODULATION STAGE

This stage concerned with converting the control signal with low power into an appropriate signal that delivers the required input power to the energy conservation unit. In electrical drives, such as element will consists of a power electronic circuit, providing the appropriate high power switching to the electrical drive. On the other hand, for a fluid power system such as a hydraulically powered drive, this stage will include appropriate valves (and hydraulic fluid supply), in order to convert the control signal to an appropriate hydraulic fluid flow and pressure to the hydraulic actuator.

2.2 THE ENERGY CONVERSION STAGE

This stage represents the physical actuator, ie. The components that converts energy and produces work, acting on the controlled process or environment accordingly. In the case of an electrical drive, for example, one can be looking at an electrical motor, whereas for a hydraulic drive system, a hydraulic cylinder can be a typical example.

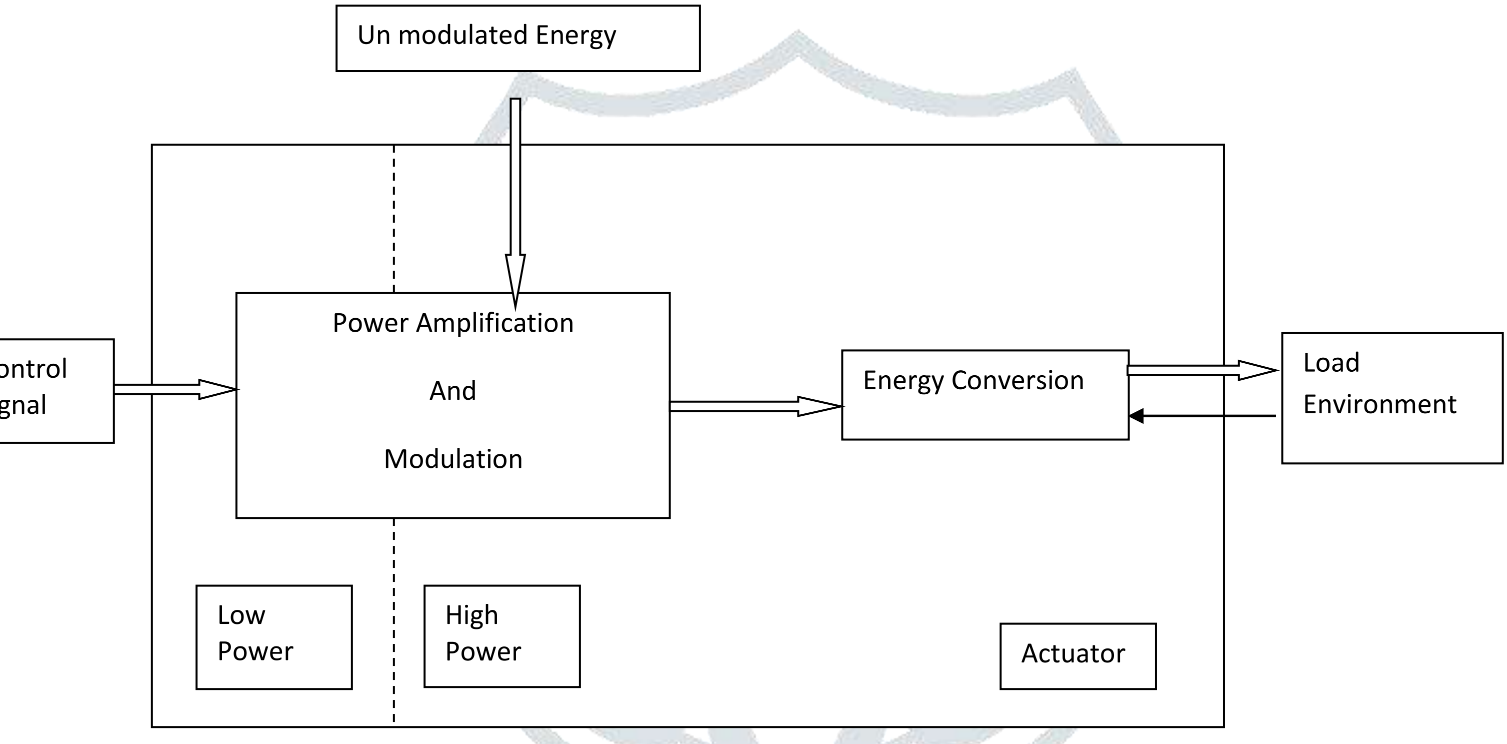
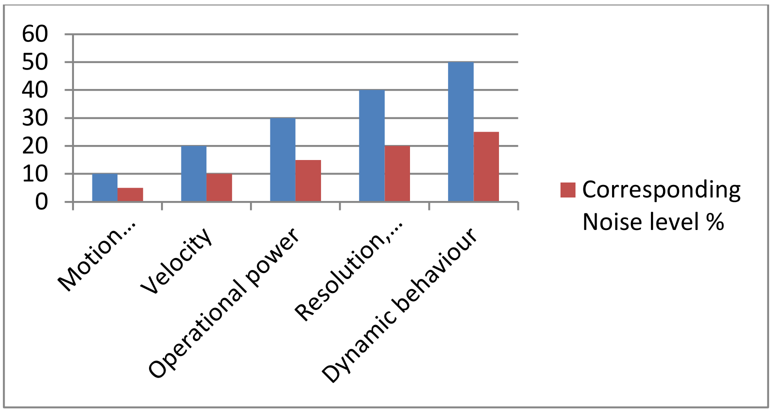


Figure 2. Functional Diagram of Actuation Ststem

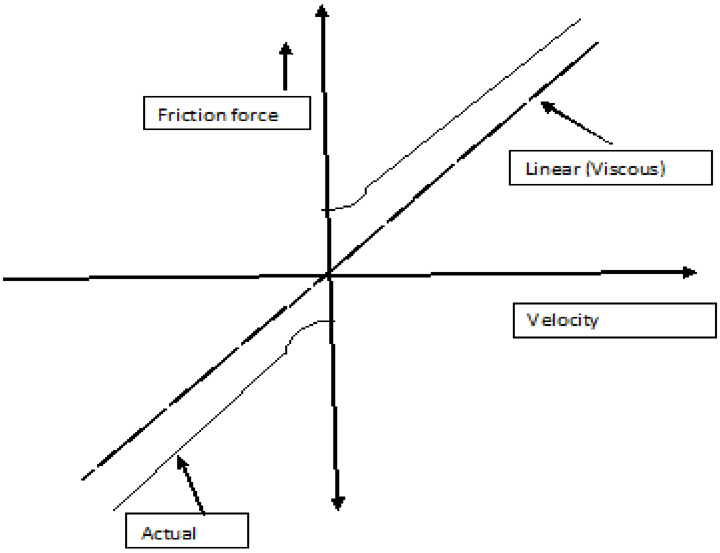
Element of an actuation system is shown in the figure 2 which represents the typical Electro- hydraulic and electrical actuation systems depicting these two components of an actuation system. In a number of instances, the outpour of energy conversion unit may not be appropriate for a specific application and some form of motion conversion may be required. For example, electrical motors are frequently connected to gear boxes to provide a reduction in rotational speed whilst increasing the output torque.

2.3 PERFORMANCE CHARACTERISTICS OF ACTUATORS

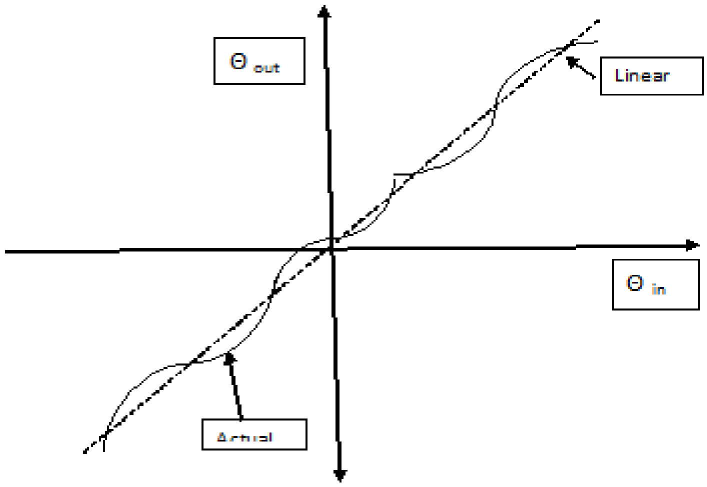


2.4 NON-LINEARITIES

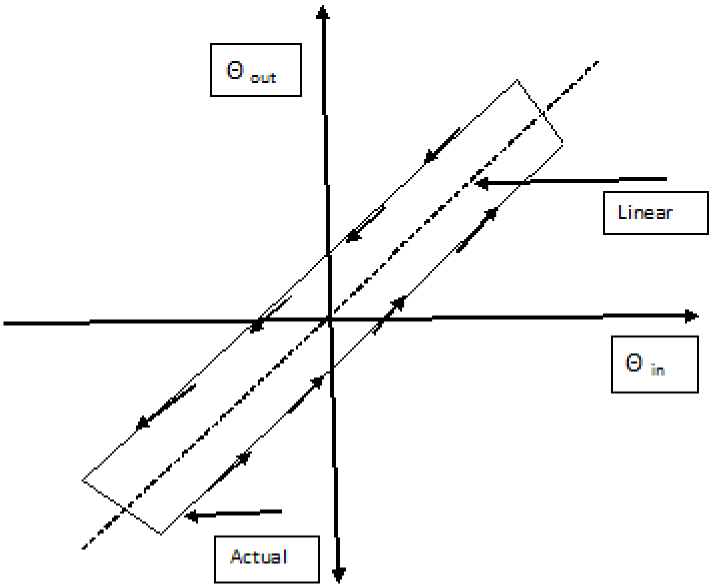
Case (i) Static and Columb Friction



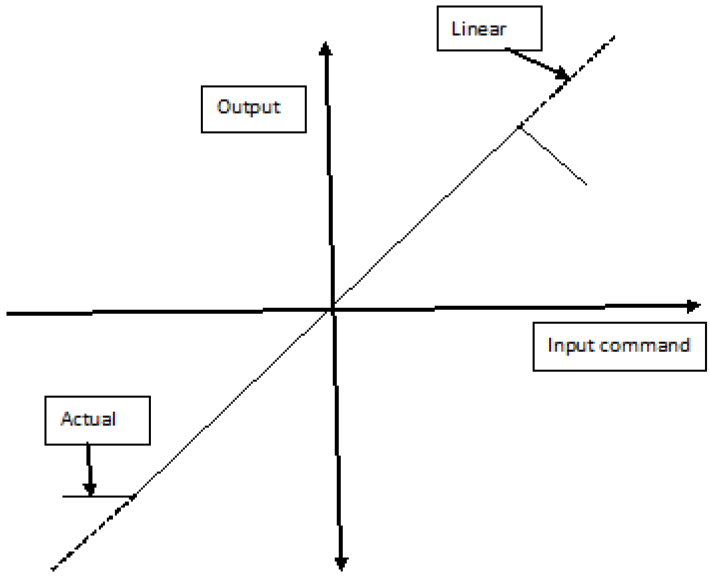
Case (ii) Eccentricity



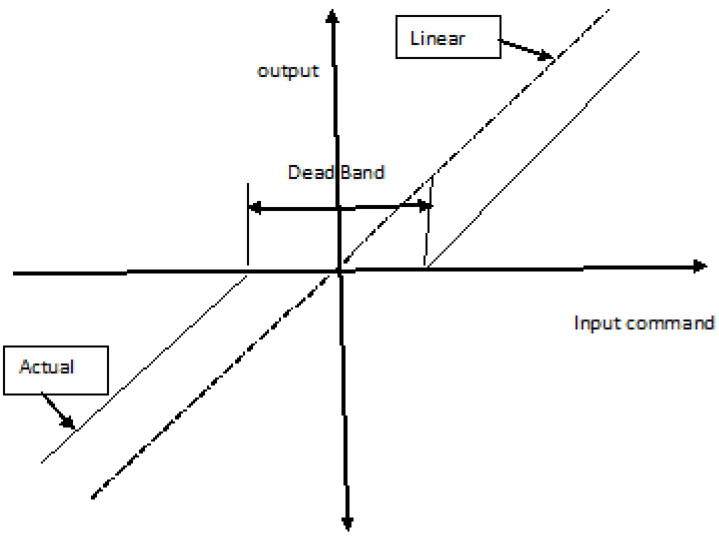
Case (iii) Backlash



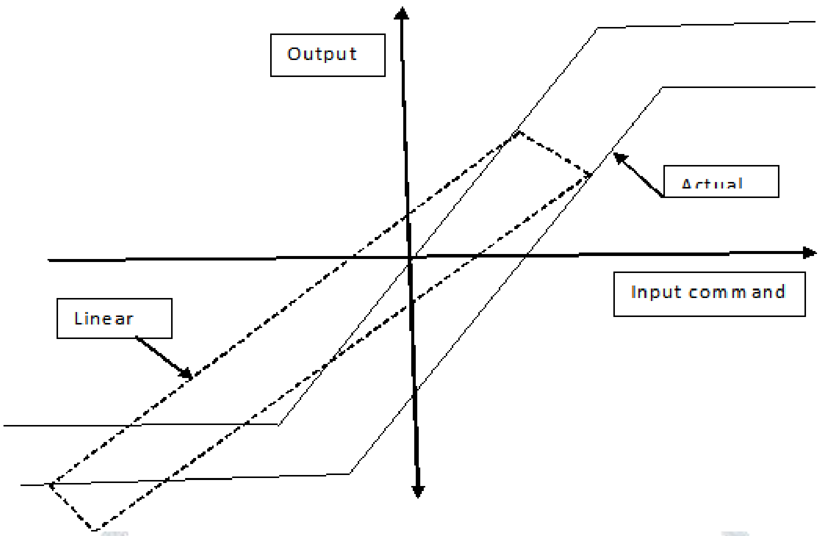
Case (iv) Saturation



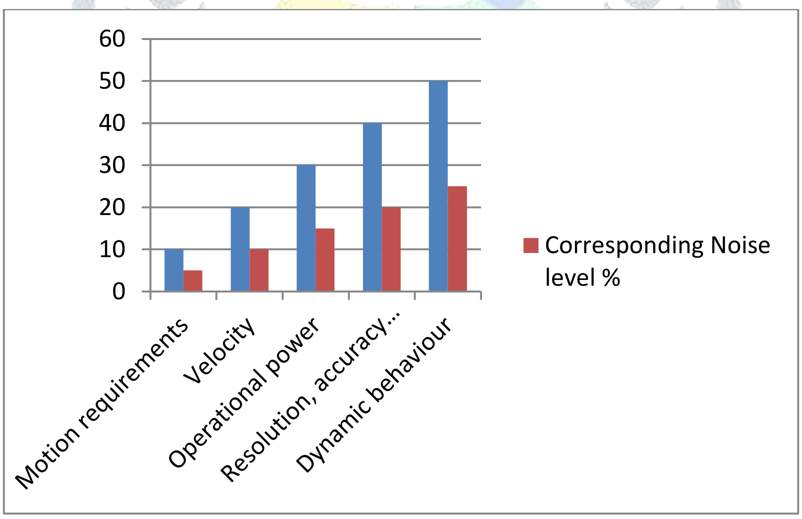
Case (v) Dead band



case (vi) Critical positioning through lesser noise



2.5 OTHER SELECTION PARAMETERS OF INTERESTS:

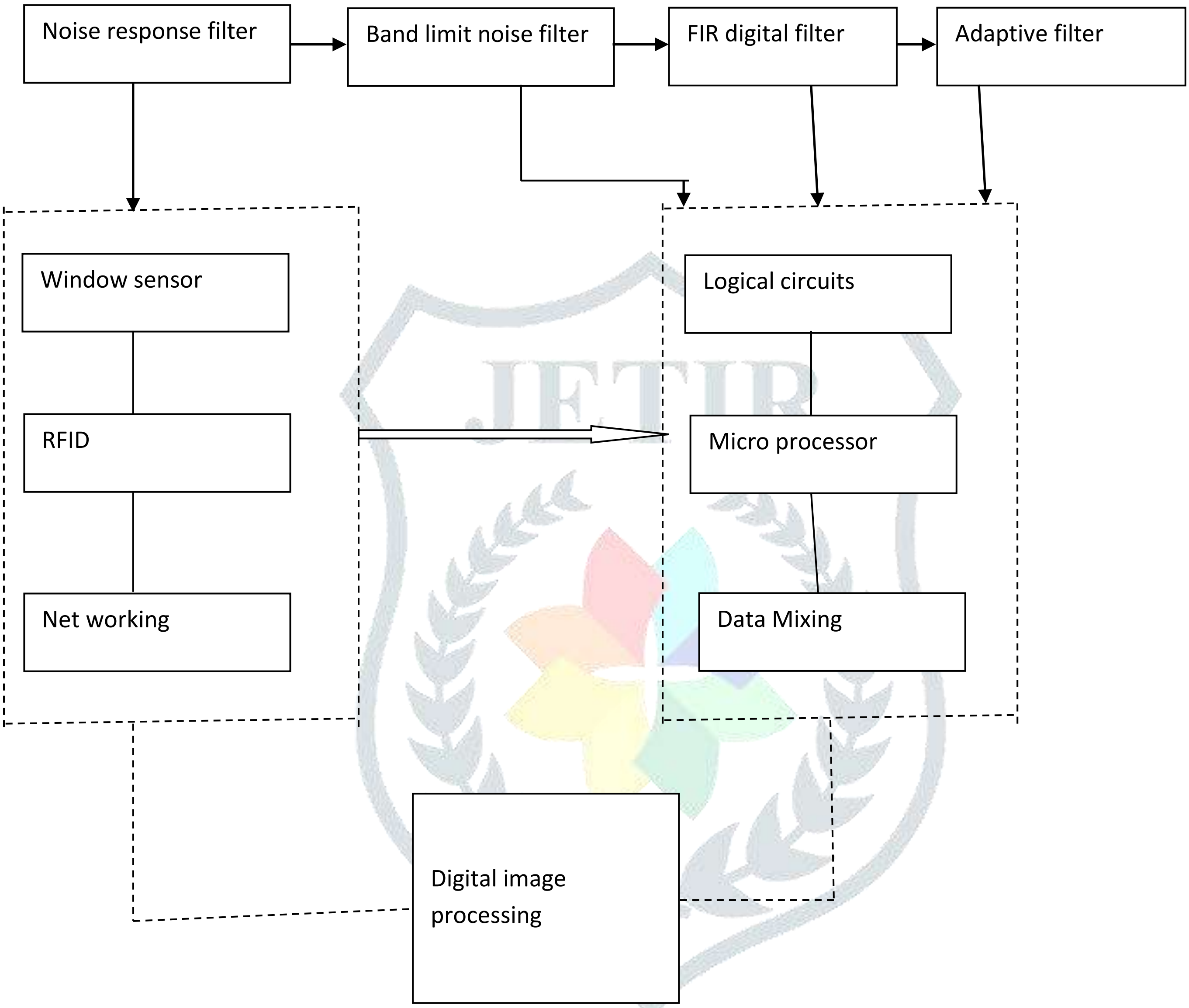


2.6 ADAPTIVE NOISE CANCELLER:

Adaptive noise canceller / canceller is used to prevent the background noise from useful signals, where a signal of interest becomes submerged in noise. One of the basic element of an adaptive noise cancelling system is adaptive filter. A digital filter having self-adjusting characteristic is known as adaptive filter. An adaptive filter gets adjusted automatically to the changes occurred in its input. The co-efficient of the adaptive filters are non fixed, rather these can be hanged to optimize some of the measure of filter performance.

In many applications, a frequently seen problem is the corruption of desired signal by noise or other unwanted signals. Conventional linear filters, in which the filter coefficients are fixed, generally can be utilized to extract the signal of interest in some situations. When the frequency bands occupied by the noise and signal are fixed and not spectrally overlapped with each other. However, many situation exists , when there is a spectrally overlapped situations between the desired signal and unwanted signal on the frequency band occupied by the noise is not known or changes with time. The filter coefficients cannot be defined in advance in such situation and it must be available, ie the filter characteristics need to be adjusted or charged correctly , according to the charges in its input signal characteristics in order to optimize its performance.

III MODEL OF ADAPTIVE NOISE CONTROLLER



The desired output of the adaptive noise controller is expressed as,

[Useful signal + Band-Limited noise- output of the filter]

$$\text{FIR Filter output} = \sum_{i=0}^{N-1} A_i \overline{X}_{k-i}$$

Where $A_i \rightarrow$ [Ai, A_1, A_2,…. A_{N-1}] are adjustable filter coefficients $\overline{X}_k$ - Input of the filter.

3.1 ADAPTIVE ALGORITHM

For implementing adaptive filter theory, many adaptive algorithms have been proposed with it own uniqueness for adjusting the noise control environment. In this context, a de-normalized least mean square algorithm for for studying the adaptive noise controlling systems and its performance is implemented.

3.2 DENORMALIZED LEAST MEAN SQUARE

It is a special implementation of least mean square algorithm which considered the variations in the signal level at the input of the filter and it chooses a normalized step-size parameter that yields in a stable adaptive algorithm having rapid convergence rate. The step-size parameter μ' is de-normalized to μ_o , and tap weights are updated accordingly to the following expression.

$$W'(n+1) = \left[\frac{W(n') + \mu' e\ (n')\, x(n')}{X'T\ (n')\, x(n') + \Phi'} \right]$$

Where φ' -> constant used to avoid the numerical instability of algorithm that may arise.

(x') (n) -> Filter Input Vector

e'(n') -> Estimated error signal

w'(n') -> Filter trap weight vector

μ' -> Step size

3.3 EFFECTS OF NUMBER OF CO-EFFICIENTS

Number of samples : 22,000

Noise power : 16.8252

Step size : 0.15

Frequency range of noise : 1200 – 2000 Hz.

Number of filter co-efficients	Noise Reduction Ratio (in db)
3	28.1342
4	29.3256
5	30.2361
6	31.2323
7	30.6742
50	27.6251
64	27.4326
70	25.2674

IV RESULT AND CONCLUSION

A viable attempt has been made to capture the impact of adaptive noise employed in actuators under the cluster of mechatronic system with MATLAB Platform comprising of pervasive computing and it is noticed that a complete noise reduction is possible with adaptive algorithm blended with pervasive computing simulation, so that all the non-linearities in the mechatronics actuators can be minimized with lesser noise.

REFERENCES:

[1]. C. Durai. R.B, Digital Signal Processing, Lami Publication, New Delhi.

[2]. Shin. H.C.Sayed , A.H and Sony H.J. (2004), " Mean Square Performance of Adaptive Filters using Averaging Theory", IEEE Conference Vol. 1 Pp 229-234.

[3]. Bolton – Text Book Mechatronics.

[4]. Proakie , J.G. and Manlakis, D.G. (1992), Digital Signal Processing Principle, Algorithms , and Applications, Newyork Macmillan.

[5]. Khanna V.K. (2009) , Digital Signal Processing , S. Chand company Ltd, New Delhi.