FOREWORD

Dear Customer, Greetings for the Festival of Lights!!

Consulting Competence

Niche domain, dry subject, less operators and poor coverage of subject in the engineering curriculum - these are the most common terms associated with Noise & Vibration subject as a whole. Even so, for about 25 years now, the subject, its application and finally the users have grown substantially, both by number and quality. The off-shoot of this growth is that what was once a proprietary activity of the institutions and government operated R&D and service laboratories, have now come into open for the private entrepreneurs to work on, but with pit falls.

- Many agents / distributers of Noise & Vibration instrumentation have taken up consulting as a part of pre-sales activity. As their main focus is on selling a particular product or feature, the customer is given a FREE SIP of the feature of the instrument as so called consulting. In reality; these are either a pre-defined set of measurements or a typical PROVEN DEMO that will work everywhere.
- Then there are these FREELANCE consultants, who normally hang around with one (or sometimes half!) low cost / low featured instrument promising the gullible customer about all the possibilities of measurement and analysis with their black box. With practically no overheads to maintain, these jacks are cheap fly by night operators.
- Also are some professors and institutional big-wigs who offer their (rest time) consulting knowledge via media, through some of the external private operators, as they are too theoretical and hence almost can't solve any real life situations and they have the best escape route once the matter gets tougher.

It is prudent to look into the missing link in each of the case; recently we were in discussion about a published article of MODAL ANAYSIS being carried-out on a road machinery, when we brought up the issue of authenticity of the methodology being used in the exercise, the publisher slipped under the umbrage of "customer confidentiality", only to be realized later that it was simply an excuse for the technically inferior way of handling the task.

A report on ORDER TRACKING was sent over to us for second opinion by a well known automotive OEM. Upon review, it was found that the instrument used did not even had a Tachometer input !!, Plots, graphs and other information relating to order spectrum were put up credibly on the report knowing that customer has no way to check it or prove it wrong, our attempts to discuss the matter with the consultants went unanswered.

There was a requirement of building a semi-anechoic chamber for a two wheeler company near Delhi, the so called specialist whom we took with us proved to be simply a middleman as he gathered some pre-determined information at customer site and later passed it on to a top notch professor of a top ranking institution in Bangalore. It took nearly 70 days for this specialist to give us any valid reply, later we discovered that the professor was out of the country all along...

So, in a nutshell, I understand that consulting in such niche domain requires strong institutional background, good temper of science and application knowledge to arrive at solutions quickly and effectively. It is seen that some CONSULTANTS offer condition monitoring (bearing vibration analysis) services without even having exposed to any machine tool basics; they wouldn't even know how a ball bearing & a roller bearing look like. This unrelenting downgrading of technical offerings have seriously cast its shadow on the prospect of good and qualified consulting, so much so that at places, people have lost faith in consulting as fallout of hiring inferior service providers in the name of cost savings.

However, there is surely the brighter side to this; building people resource, instrumentation and knowledge base has its say in offering qualitative & consistent service; it takes a while to get over the bumps in the market but it is worth it.

Warm regards
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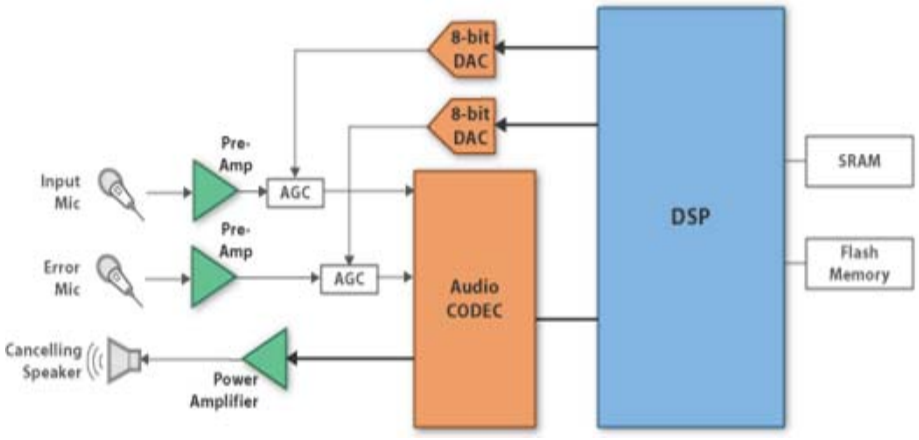
Noise reduction, by definition is mainly addressed by two distinct methods

- **Passive methods** – that involves covering the source of the noise with materials that absorb and dissipate noise energy, this is the most common practice in almost all the noise control application. Right from industrial mufflers to car door body stuffing; from Diesel Generator enclosure to Audio recording studio rooms, they all use the passive methods to achieve the noise reduction. The magnitude of noise reduction is achieved by the type of material used, the impending frequencies and finally the purpose for which the noise reduction is intended for.
- **Active methods –** even being improved & perfected till date, this method typically uses either the actually generated noise as the reference to work on cancellation or will use a pre-determined set/s of noise signatures to PREDICT the cancellation pattern. The first one is typically referred to as FEED BACK method and second one more as FEED FORWARD method. However, with substantial developments in Microprocessor and DSP technologies, both the above referred methods are being redefined and improved with newer techniques of addressing the cancellation issues. **Modern active noise control is achieved through the use of a computer, which analyzes the waveform of the background** *aural* **or** *non-aural* **noise, then generates a signal reversed waveform to cancel it out by interference. This waveform has identical or directly proportional amplitude to the waveform of the original noise, but its signal is inverted. This creates the destructive interference that reduces the amplitude of the perceived noise.**

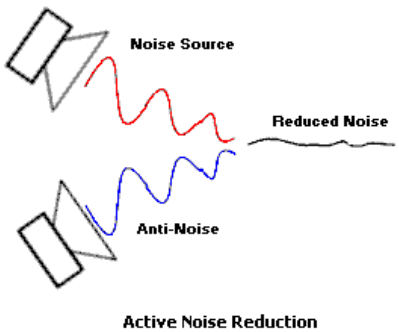
The advantages of active noise control methods compared to passive ones are that they are generally

- More effective at low frequencies
- Less bulky
- Able to block noise selectively

But the factor of higher cost is still a serious issue in respect of Active Noise control, probably this is one important reason as to why we do not see its application in everyday life as often we see the passive methods.



Block diagram of a typical Active Noise Control module (ANC)



Active Noise conceptualization

The constituents of ANC are generally as follows

- **DSP**
  performs system initialization and executes the adaptive signal processing algorithm
- **Memory**
  stores executing code and data/parameters
- **AGC**
  maximizes the ADC SNR and maintains the overall system dynamic range
- **Audio CODEC**
  the residual noise signals are converted o digital form by the ADC. The DAC generates the output anti-noise signals.
- **Power Conversion**
  converts the battery power to run various functional blocks.

Canceling complex waves

Electronically, it would be easy to detect a simple tone, adjust it 180° out of phase and add it to the original, thus canceling out the sound. Unfortunately, most sound is much more complex than a simple sine wave.

Spectrum of frequencies

A spoken word consists of a spectrum of frequencies of different amplitudes. This means that to cancel out each waveform, the electronics would need to filter each frequency separately, determine its frequency, create the same frequency and amplitude at 180° out of phase, and then add it to the original.

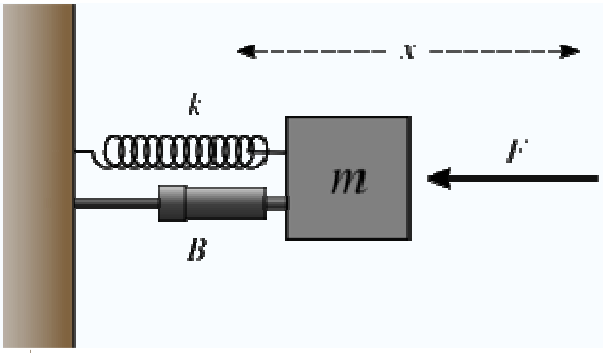
What is not correct

Since there are so many frequencies and fractions of frequencies in some sounds, it is impossible to cancel them all out with this method. Instead, the electronics selects a narrow band of frequencies and averages out the result. This is a fairly good job at noise cancellation, but it is not 100%.

In the next issue, we will discuss on the actual applications of ANC and about some of the products that have already implemented this methodology; we will also discuss on the merits and limitations of ANC specific to the type of product / application in which it is used in……

In physics and engineering, damping may be mathematically modeled as a force synchronous with the velocity of the object but opposite in direction to it. If such force is also proportional to the velocity, as for a simple mechanical viscous damper (dashpot), the force **F** may be related to the velocity **v** by

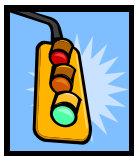
$$\mathbf{F} = -c\mathbf{v}$$



A mass attached to a spring and damper. The damping coefficient, usually *c*, is represented by *B* in this case. The *F* in the diagram denotes an external force

Where "c" is the viscous damping coefficient, given in units of Newton-seconds per meter.

This relationship is perfectly analogous to electrical resistance. The other comparison is of force as an approximation to the friction caused by drag.



Some facts about dB's !!

- Auditory nerves can be permanently damaged from prolonged exposure at 90 dB
- 120 dB can cause pain and ringing in the ear
- Sharp pain and extensive destruction of the auditory nerves occurs at 140 dB
- At 150 - 160 dB massive destruction of the auditory nerves and persistent ringing in the ears will occur immediately

Inputs used in the article are obtained from various sources and are duly acknowledged