NVSAGE

The Newsletter of Noise and Vibration

NV DYNAMICS www.nvdynamics.com

services@nvdynamics.com | +91 7760381818

July 2022
Volume 082

IN THIS ISSUE

Everything is theoretically impossible, until it is done."
– Robert A. Heinlein

Foreword

By Krishna Balamurali, Principal Engineer- krishna@nvdynamics.com

A leading Japanese passenger car manufacturer in India had a specific problem definition; the new line of gasoline engines being manufactured required subjective assessment of engine mechanical noise as an End of the Line process.

Being a market leader in the semi-premium segment of vehicles that this customer is into, identifying and assessing the engine mechanical noise/s consistently and credibly in an engine assembly area was a challenge of sorts. The installed setup of few qualified microphones and a connected amplifier further terminated to a generic loudspeaker unit was a minimum arrangement for this purpose.

What is even more important was that how far the personnel who are involved in this activity have a FEEL for the types of noise that originates from the engine, do they really have some of the basic concepts and understanding of Noise and its subjective and objective definitions, so on.

This brought the decision to run the involved team through a 2-day refresher course on fundamentals of Noise to cover all the much-needed aspects of this subject. The program was carefully devised to minimise mathematics and formulae but to emphasise on how to understand Noise as a physical quantity and what all are the factors that are likely to influence the noise perception factor.

Real life hands-on sessions were conducted to measure and record Noise from Engines in the End of the line testing unit. The recorded data were run through a series of Sound Quality and Jury assessment tools to evaluate varied human response to noise data. The data compilation on the subjective evaluation of noise were then compared with the derived objective sound matrix terms.

At the end of this intensive 2-day program, a good clarity on the fundamentals of Noise and its evaluation were realised as a takeaway; some improvements to the installed setup for noise measurements are proposed and NV Dynamics would like to complete this process as a value addition to the program.

Time & Frequency Domains

Guru Kiran, Engineer - Technical Services

The previous edition had the discussion on Elements of Digital Signal Processing wherein the basic elements of DSP is understood. Also, Time and Frequency domains were put to perspective.

Continuing with the course, the present edition will focus more on the Time data, Frequency data and Time-Frequency conversion.

Time data is the basic raw data that is collected and stored, which can be in the form of acceleration, velocity, pressure…etc. **(Fig 1)**. At this stage one cannot analyze the data without deriving it to a more informative domain which can be in the frequency domain, octaves…etc. For this edition, Frequency domain is discussed.

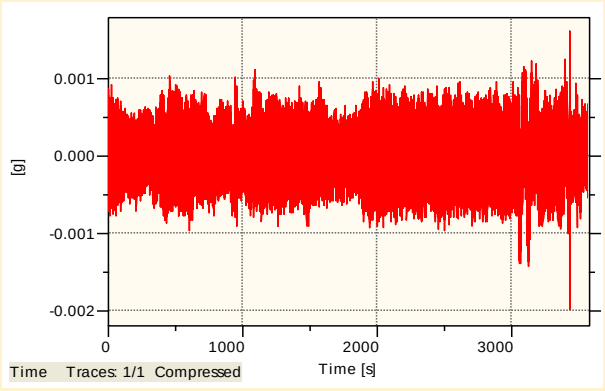


Fig 1

Time Domain

Fig 1 shows the stored data which is viewed in the "Time Domain", hence the name "Time Data". The time data that we see is a graph of Amplitude Vs Time which contains a lot of information wherein it tells the change in amplitude (acceleration) with respect to time.

The time data could seem very complex but basically it is just a very simple overlapping of thousands of sine wave signals having different frequencies.

To put it in simple words, refer to **Fig 2.** On the LHS, the signal resembles the time data in **Fig 1** where the signal is very random with different amplitudes. On the RHS, the signals are separated one-by-one for each frequency for a better understanding. In the same way, one can understand that the time data consists of various number of sine waves. **(Refer Fig 3)**

A better clarity on this subject will be given in the later part of this newsletter.

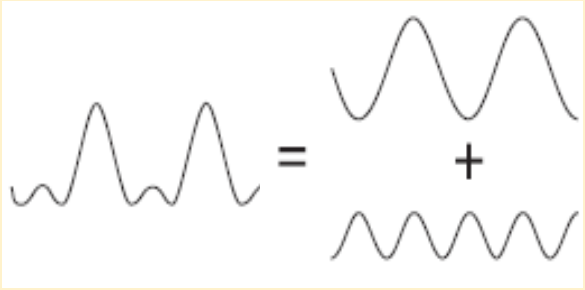


Fig 2

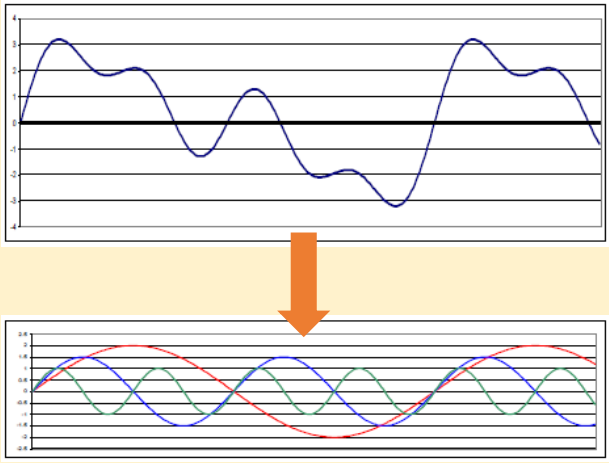


Fig 3

Frequency Domain

As explained earlier, the stored data viewed in the Time Domain is called the Time Data, similarly the data viewed in the Frequency Domain is called the Frequency Data except that the data viewed is not the basic raw data, it is the data after applying an operation called the Fast Fourier Transform or FFT which would segregate the time data to view the amplitude levels of individual frequencies.

For better understanding, refer **Fig 4** which represents the 3-dimentional graph where the purple window indicates the time data (Amplitude vs Time), containing various overlapping sine waves, and the blue window indicates the frequency data (Amplitude vs Frequency), indicating the amplitudes of individual frequencies.

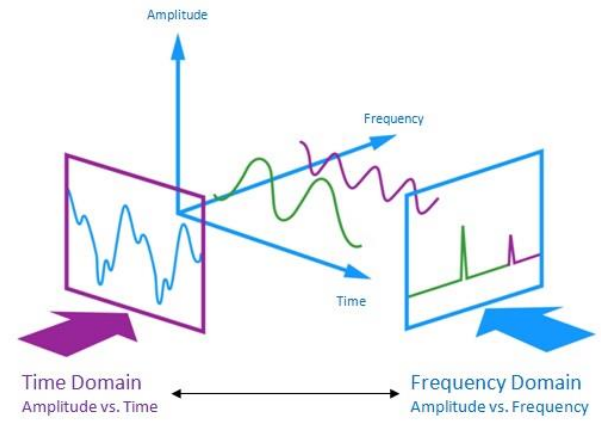


Fig 4

Why Frequency Domain?

The frequency domain would give a lot of information on an object's Natural Frequency, Modal characteristics, response to a force, sensitivity to lower or higher frequencies…etc. **Fig 5** shows the sensitivity of a machine to lower frequencies. Let's take one condition to understand how frequency could help understand the above said nature of an object.

- Natural Frequency

  First, there should be an understanding of what it actually means. Natural Frequency of a body is the free vibration or oscillation of the body once the external force acting on it is removed.

  If the same body operates at this frequency or closer to this frequency at a certain amplitude, then the body vibrates at an increased amplitude that affects the lifespan of the same body. This phenomenon of an object vibrating at higher amplitudes is known as resonance.

  Hence, when such information of a machine is known, then one can avoid the operation of such machines reaching closer to its natural frequency.

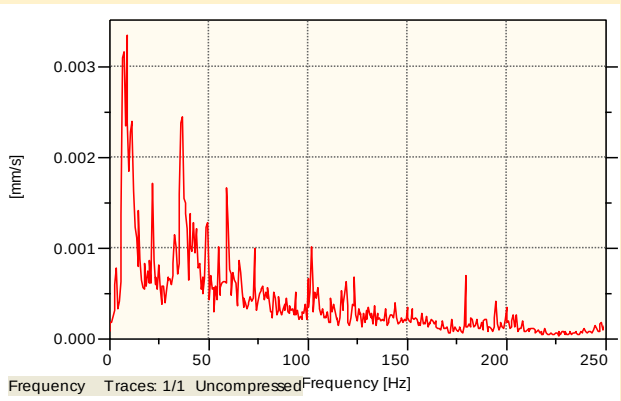
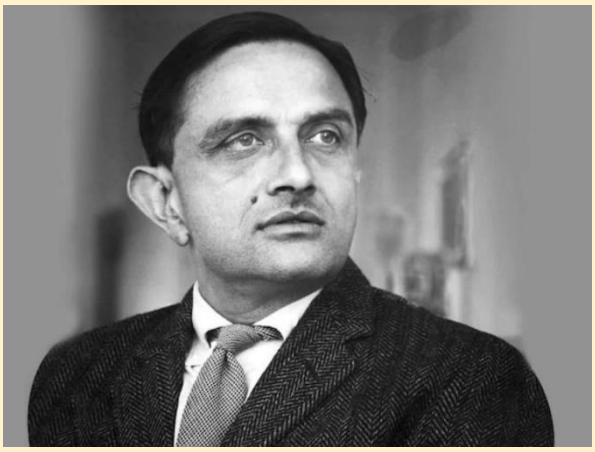


Fig 5

Great Minds & their contribution to the world of Science

Vikram Ambalal Sarabhai (12 August 1919 – 30 December 1971) was an Indian physicist and astronomer who initiated space research and helped develop nuclear power in India. He was honored with Padma Bhushan in 1966 and the Padma Vibhushan in 1972. He is internationally regarded as the Father of the Indian Space Program. Known as the cradle of space sciences in India, the Physical Research Laboratory (PRL) was founded in 1947. He set up Operations Research Group (ORG), the first market research organization in the country and helped setup many more like the Nehru Foundation for Development in Ahmedabad, the Indian Institute of Management Ahmedabad (IIMA), the Ahmedabad Textile Industry's Research Association (ATIRA) and the CEPT. His interests varied from science to sports to statistics. Sarabhai started a project for the fabrication and launch of an Indian satellite. As a result, the first Indian satellite, Aryabhata, was put in orbit in 1975 from a Russian cosmodrome. He founded the Indian Space Research Organization and became its chairman in 1963.



Physics to Know

Horror movies

Everyone experiences chills or shivers when they watch horror movies. This is because the scene uses super-low-frequency sounds that are right at the limit of what humans can hear. The human ear is best at registering sounds above the frequency of 20 hertz. Anything below that is called infrasound. Horror movies like "Paranormal Activity" use sounds right around that 20-hertz threshold, called sub-bass sounds. People subjected to infrasound and sub-bass sounds reported feelings of discomfort or chills.