NVSAGE

The Newsletter of Noise and Vibration

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Failure is an option here. If things are not failing, you are not innovating enough.

– Elon Musk

Foreword

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

To the time this newsletter finds your attention, the 22-23 FY would have ended, for NV Dynamics it was a good year closing with Q4 orders at their peak and with prospective queries for the new year.

Along with the ongoing projects of Bhilai steel plant for specialised vibration testing and analysis, we received orders from TATA chemicals and TATA steel for vibration investigation and RCA.

M/s Cropnosys, a Bangalore based speciality fertiliser company assigned us the task of evaluating their large HVAC noise performance and to come up with plans for its mitigation; this turn-key assignment was carried-out to accomplish the committed deliverables.

Many Metro Rail related queries are in their advanced stage and we are confidant of bagging good number of assignments for the new FY.

With the tasks in the pipe and more prospects on the horizon, we added 2 more engineers to our services team, this will enable our service deliverables more effective and efficient.

Extending our service profile to shipping industry, NV Dynamics is now certified by the acclaimed Bureau Veritas; this will allow us to work on both flag and non-flag vessels in any part of the world. In addition to the on-board noise and vibration assessments, we are also certified to conduct under water acoustic measurements.

To supplement this new service area, we are adding resources of hydrophones and new generation all featured type 1, model AM 100 sound level meter from Bedrock.

Overall, we are geared up for a busy year ahead with assignments of varied technical contents and deliverables.

Time & Frequency Domains

Aravind Reddy, Engineer - Technical Services

In the previous edition, discussion was done on spectral leakage and the reasons for its occurrence i.e., frequency resolution and frame size, also discussion was done on how a basic window function works.

Moving forward, in the current edition, types of window functions and correction factors will be discussed.

Window functions

Window functions are mathematical functions that are applied to a signal before performing operations such as Fourier transform or signal filtering to reduce the spectral leakage.

There are different types of window functions based on its own characteristics and advantages:

a. Hanning window

Hanning window has a smooth, bell-shaped curve that tapers off to zero at the edges of the window (**Fig 1**). They are often used with random or non-periodic data as they have moderate impact on the frequency resolution and amplitude accuracy of the resulting frequency spectrum.

b. Rectangular window

Also known as 'Uniform window' (**Fig 2**), this window works best when applied to a periodic signal; there is no frequency or amplitude distortion due to this window. When this window is applied to a non-periodic signal, there is a significant distortion in both amplitude levels and frequency.

c. Exponential window

Exponential windows are used mainly for the accelerometer response of the Impact testing (**Fig 3**). If the response dies down within the measurement time frame, no window function is required. Whereas if the response does not decay to zero within the

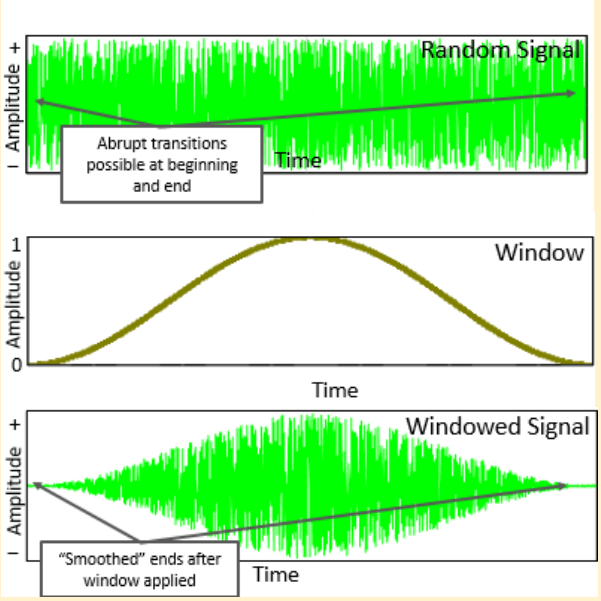

Fig 1

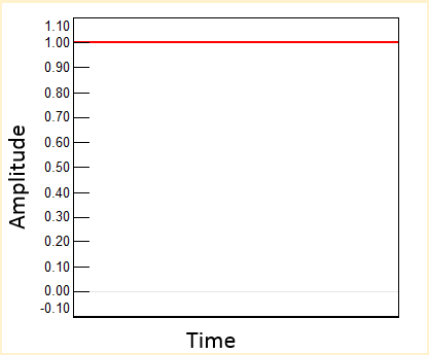

Fig 2

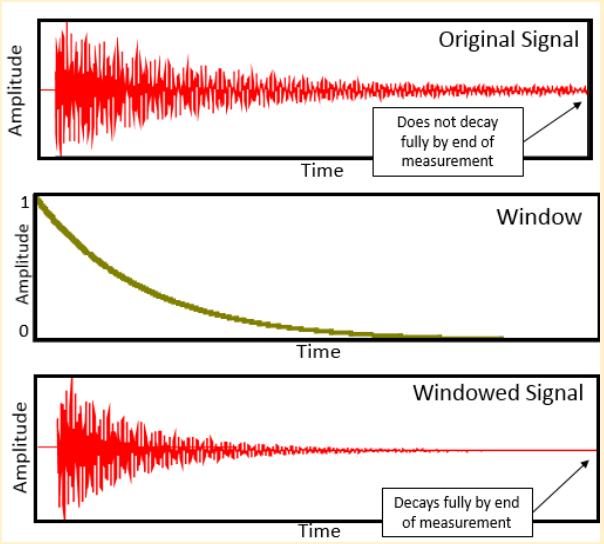

Fig 3

measurement time frame, the response is multiplied by an exponential window to assure that it does decay to zero.

d. Force window

Force window is used, during impact testing, on the measured input force signal that is received from the force transducer (**Fig 4**). It is used to improve the signal-to-noise ratio of the measured input by eliminating noise on the signal followed by the duration of impact.

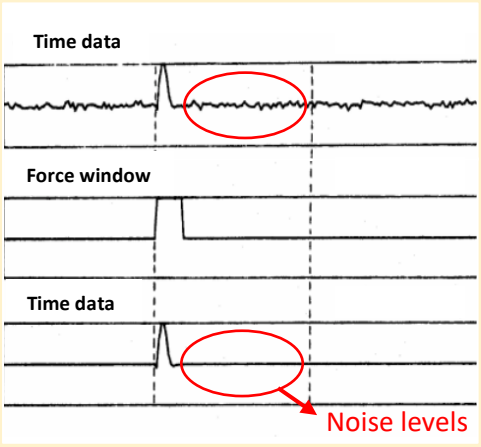

Fig 4

Window correction factors

While a window helps reduce leakage, the window itself distorts the data, it reduces the amplitude level of the signal and energy of the signal is also reduced. To compensate these effects window correction factors are used for both amplitude and energy levels.

a. Amplitude correction factor

Consider the example of a sine wave signal and a Hanning window (**Fig 5**). When the windowed signal is transformed to the frequency domain, then the amplitude of the resulting spectrum will be only about half of that of the equivalent unwindowed signal. Thus, in order to correct for the effect of the Hanning window on the amplitude of the frequency spectrum, it has to be multiplied by an amplitude correction factor of 2 (calculated).

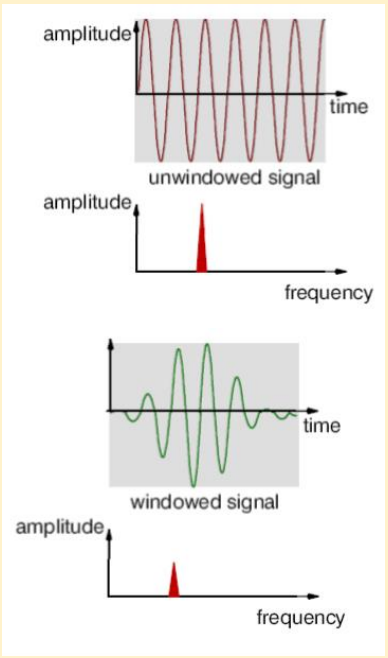

Fig 5

b. Energy correction factor

In case of broadband signals (**Fig 6**), it is the energy of the signal which is usually important to maintain. An energy correction factor will be applied to restore the energy level of the windowed signal to that of the original signal. In the case of a Hanning window, the energy in the windowed signal is 61% of that of the original signal. The windowed data needs to be multiplied by 1.63 (calculated) to correct the energy level.

Similarly, every window function has its own correction factors to compensate for the distortion of data.

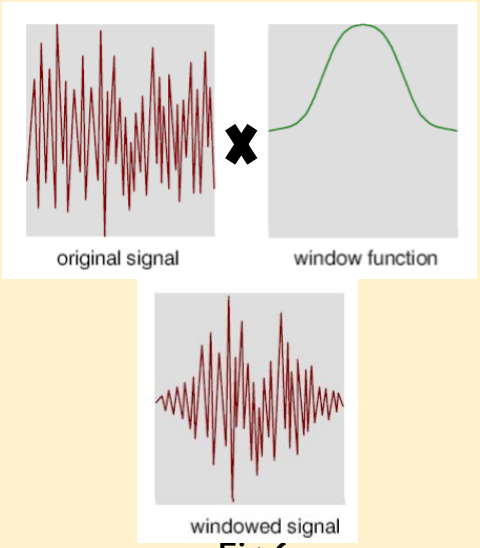

Fig 6

Great Minds & their contribution to the world of science

Homi Jehangir Bhabha, FRS (30 October 1909 – 24 January 1966) was an Indian nuclear physicist, founding director, and professor of physics at the Tata Institute of Fundamental Research (TIFR). Colloquially known as "Father of Indian nuclear program Bhabha was also the founding director of the Atomic Energy Establishment, Trombay (AEET) which is now named the Bhabha Atomic Research Centre in his honor. TIFR and AEET were the cornerstone of the Indian development of nuclear weapons which Bhabha also supervised as director. Bhabha gained international prominence after deriving a correct expression for the probability of scattering positrons by electrons, a process now known as Bhabha scattering. His major contribution included his work on Compton scattering, R-process, and the advancement of nuclear physics. He was awarded Padma Bhushan by the Government of India in 1954. He later served as the member of the Indian Cabinet's Scientific Advisory Committee

and provided the pivotal role to Vikram Sarabhai to set up the Indian National Committee for Space Research. In January 1966, Bhabha died in a plane crash near Mont Blanc, while heading to Vienna, Austria to attend a meeting of the International Atomic Energy Agency's Scientific Advisory Committee.

Physics to Know

Singing Ringing Tree, Burnley

The Singing Ringing Tree in Burnley, in Lancashire, England, is 3-meter tall and comprises of galvanized steel pipes of differing lengths and with holes punctured into the underside. When the wind blows, the sculpture produces an eerie sound in several octaves. Completed in 2006, the Singing Ringing Tree is part of the series of four sculptures within the Panopticons arts and regeneration project created by the East Lancashire Environmental Arts Network (ELEAN).