NVSAGE

The Newsletter of Noise and Vibration

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"Science is made up of mistakes, but they are mistakes which is useful to make, because they lead little by little to the truth."
– Jules Verne

Foreword

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

The 1st quarter of 2023 FY is ending soon and NV Dynamics is closing it with a bang!! We were at our busiest yet with multiple tasks that had varied technical contents, depth and overall revenues.

In the previous edition of NVSAGE, I had shared the news of our progress in acoustic domain; the first of this activity happened with the assessment of a large commercial space adjacent to Mumbai Airport Terminal 2. The client engaged our team to assess the road traffic and aircraft induced noise affecting the inner space of the proposed hotel project. The results shared with client are included into the project scope to accomplish the results.

GE is long associated with NV Dynamics for specialised testing and validation on many of their products and processes. One such requirement was to analyse the dynamic stability of payloads on the transport carriers on which GE's crucial components are transported. This special task was a combination of site / road tests combined with some numerical calculations to arrive at critical values of vehicle speed, turning radius, gradient constants and so on. These results will be included into GE's SoP for future operations.

Our IoT based activities are expanding rapidly; recently, a critical data centre managed by ITC was installed with NV Dynamics proprietary IoT system to monitor vibrations for a period of 9 months on real time basis. With this, our IoT services have moved into next level of deployment to very crucial applications.

Time & Frequency Domains

Aravind Reddy, Engineer - Technical Services

In the previous edition, we discussed about the window functions, its types and applications based on the window types. We also discussed about window correction factor and the reason for its use.

Moving forward, in the current edition let's find out what are filters, its application and types of filters.

Filters

A filter is a system that performs mathematical operations on a sampled, discrete-time signal to reduce or enhance certain aspects of that signal. They are used to alter the frequency content of a time signal by either reducing or amplifying certain frequencies.

As shown in **Fig 1,** the measured time data contains some unnecessary content that may be irrelevant. Therefore, to correct this into relevant and informative data, a filter is applied.

- **Applications of filters**

  Filters are used in different ways, from signal cleanup to signal analysis.

  - Anti-Aliasing Filter – It is used to remove signal content that cannot be properly digitized before Analog-to-Digital conversion.
  - Noise Removal – Filters could be used to remove unwanted high frequency noise from a signal, for example, a hiss in a musical recording.
  - Drift Removal – Drift or large offsets can be removed from a signal via a high pass filter or AC coupling.
  - A-weighting filter reduces the high and low frequencies of a microphone signal to reflect how the human ear perceives sound.

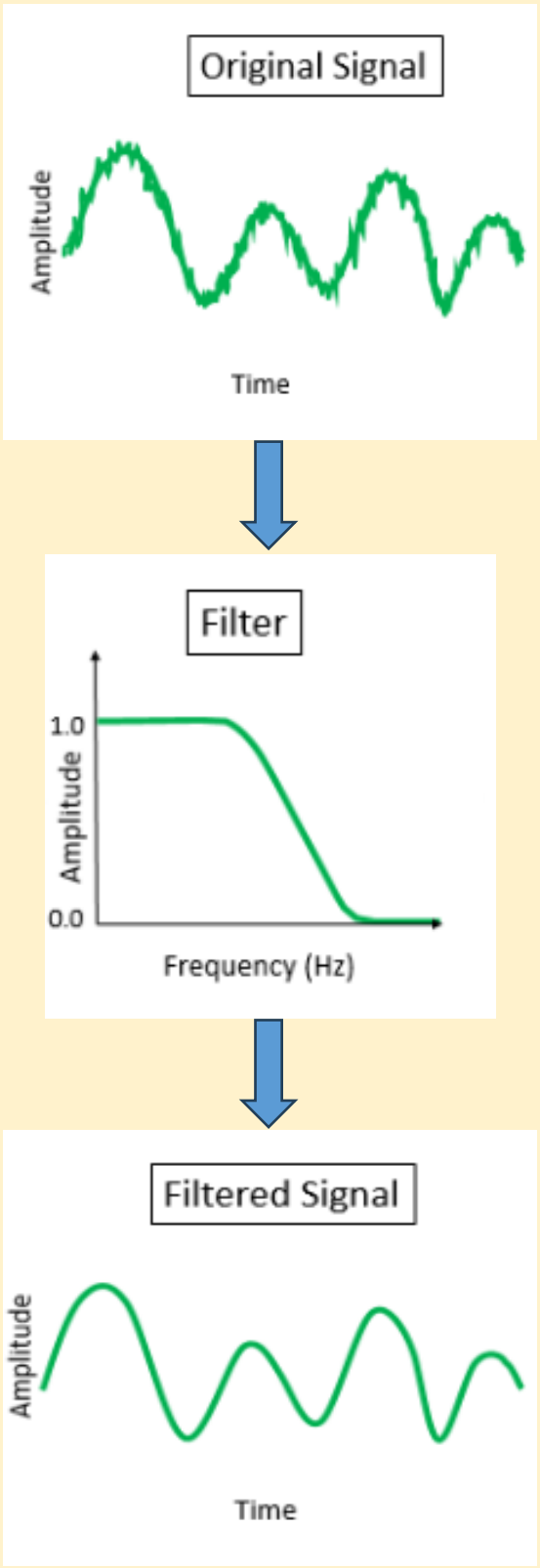


Fig 1

- Human Body Vibration – A filter (defined by ISO 2631) can be used to evaluate human body health and comfort based on an accelerometer vibration signal.

Filter Types

- **High Pass** – It is used to remove low frequency offsets from a signal. (Refer **Fig 2)**
- **Low Pass** - It attenuates, or gets rid of, frequencies above a specified frequency.
- **Band Pass** – This filter is used to allow only a band limited portion of the frequency content to be passed through the filter.
- **Band Stop** – It is used to remove frequency content over a specified range.

Filter Classes

FIR filters and **IIR filters** are the two classes of digital filters used in signal processing. They have different characteristics and are suitable for different applications.

FIR (Finite Impulse Response) and IIR (Infinite Impulse Response). Both have their own advantages however, IIR filters are well suited for applications that require no phase information and FIR filters are better suited for applications that require a linear phase response. There are again different FIR and IIR filter methods:

FIR:

1. Chebyshev
2. Hamming
3. Kaiser
4. Hanning
5. Rectangular

IIR:

1. Butterworth
2. Inverse Chebyshev
3. Chebyshev
4. Cauer,
5. Bessel

A filter method can be selected to best suit a particular application.

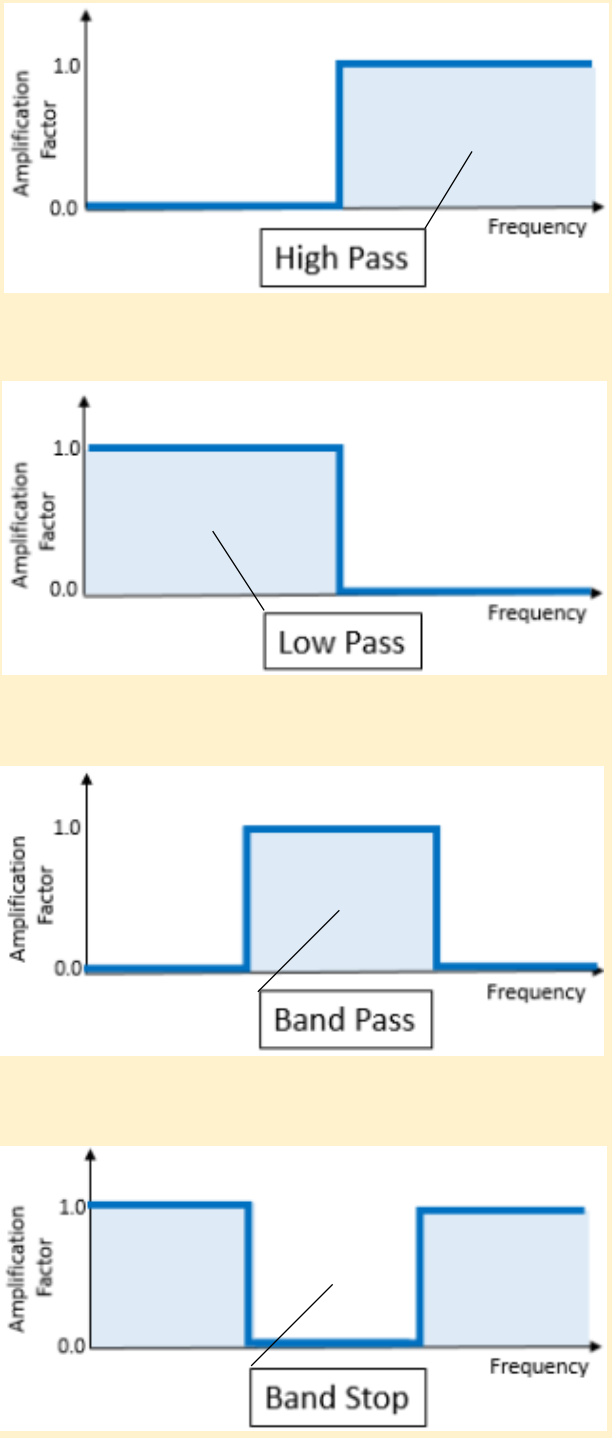


Fig 2

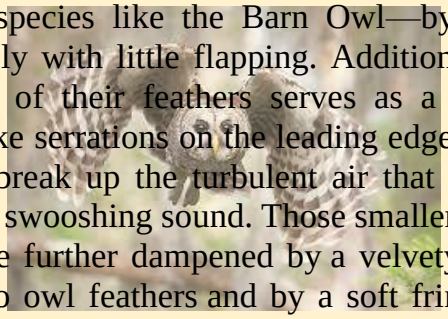
Great minds & their contribution to the world of science

Shreeram Shankar Abhyankar (22 July 1930 – 2 November 2012) was an Indian American mathematician known for his contributions to algebraic geometry. His latest research was in the area of computational and algorithmic algebraic geometry. Abhyankar was born in a Chitpavan Brahmin family in Ujjain, Madhya Pradesh, India. He earned his B.Sc. from Royal Institute of Science of University of Mumbai in 1951, his M.A. and Ph.D. at Harvard University in 1952 and 1955 respectively. His thesis, written under the direction of Oscar Zariski, was titled Local uniformization on algebraic surfaces over modular ground fields. Before going to Purdue, he was an associate professor of mathematics at Cornell University and Johns Hopkins University. Abhyankar was appointed the Marshall Distinguished Professor of Mathematics at Purdue in 1967. His research topics include algebraic geometry, commutative algebra, valuation theory, computer aided design and robotics.

He popularized the Jacobian conjecture, at the time of his death, held the Marshall Distinguished Professor of Mathematics Chair at Purdue University, and was also a professor of computer science and industrial engineering. He is known for Abhyankar's conjecture of finite group theory. Abhyankar died of a heart condition on 2 November 2012 at his residence near Purdue University.

Physics to Know

The silent flight of owls



They have large wings relative to their body mass, which let them fly unusually slowly as 2 mph for a large species like the Barn Owl—by gliding noiselessly with little flapping. Additionally, the structure of their feathers serves as a silencer. Comb-like serrations on the leading edge of wing feathers break up the turbulent air that typically creates a swooshing sound. Those smaller streams of air are further dampened by a velvety texture unique to owl feathers and by a soft fringe on a wing's trailing edge. These structures together streamline the air flow and absorb the sound produced.