NVSAGE

The Newsletter of Noise and Vibration

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October 2023
Volume 087

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"Sound is the vocabulary of NATURE"
– Pierre Schaeffer

Foreword

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

Continuing our resource enhancement for acoustic activities, we have now acquired the full package of acoustic simulation software CadnaA. This addition further enhances and upgrades our already existing capabilities in Noise and Acoustic domain.

In the month of July, we completed extensive Noise & Vibrations assessments, mitigation and consulting task for PITCMRL, the metro rail implementing company for Line 3 in Pune city. This 23 km, all via-duct alignment, had multiple challenges to account for and to come up with feasible solution plans.

Gujarat Metro has placed LoA on NV Dynamics to take up complete monitoring and assessment of environmental noise and vibrations due to metro line construction activities. This task will be completed over a period of 12 months conducting multiple site tests, modelling, and recommending mitigation plans through the course of the project.

We are in the final stage of receiving work order from DMRC for a multi-facet Noise and Vibration testing and engineering services, this is a prestigious assignment for NV Dynamics as the task is won against stringent technical requirements and deliverables.

TATA steel assigned us the investigation of vibration problems of their heavy EOT cranes; a full-size multi test-based site task is completed and all the findings have been shared with the client. This is a unique type of task involving special tests and tools for understanding the dynamic response of the crane in its operation.

Time & Frequency Domains

Guru Kiran, Engineer - Technical Services

In the previous edition, we discussed about filters, their types and classes. We also discussed about the different applications of filters. Moving forward, in the current edition fixed sampling and adaptive sampling are discussed.

Sampling Frequency

In Vol. 083, sampling frequency was briefly discussed. To elaborate on that, sampling rate (sometimes called sampling frequency or F_s) is the number of data points acquired per second. A sampling rate of 2000 samples/second means that 2000 discrete data points are acquired every second. This can be referred to as 2000 Hertz sample frequency. The sampling rate is important for determining the maximum amplitude and correct waveform of the signal as shown in **Fig 1.** In short, higher the sampling rate, better the data.

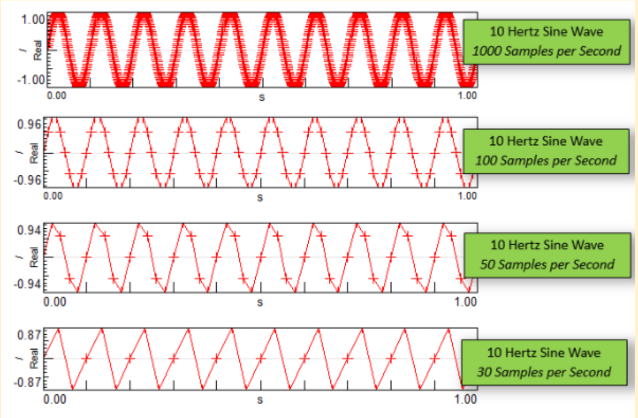


Fig 1

There are 2 types of sampling commonly used:

1. Fixed sampling
2. Adaptive sampling

Fixed Sampling

The concept of fixed sampling is that the user decides the frequency range to be considered for a particular measurement. The software / system will set the sampling frequency automatically as a function of Nyquist criteria.

It is understood by Nyquist rate that sampling rate is 2.56 times the desired frequency, meaning if the input signal has a desired frequency component of 1 kHz, then the sampler must sample at least 2.56 kHz, or the signal might alias.

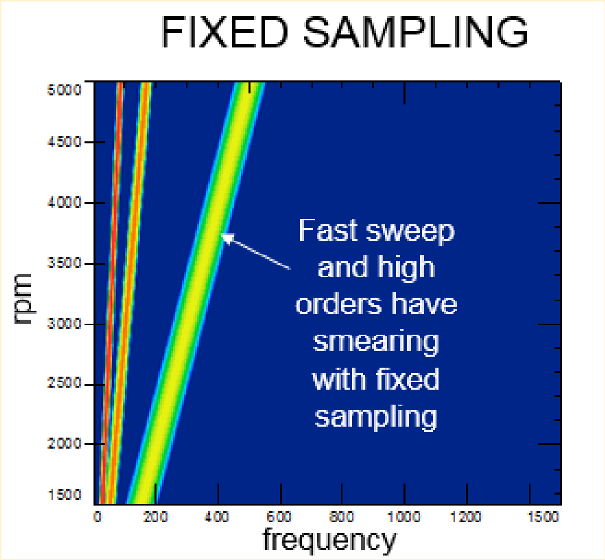


Fig 2

With the frequency range considered, the lowest frequency (Ex. 1Hz) will have the highest sampling points and the highest frequency will have the least sampling points.

For example, if 1000Hz is the highest frequency (bandwidth), with the sampling frequency complying to Nyquist (which becomes 2000Hz), 1000Hz will get 2 samples and 1Hz will get 2000 samples points.

Limitations

1. The number of samples per increasing frequency starts reducing, resulting in loss of frequency resolution, particularly with higher frequencies.
2. When the object under test runs at fast varying speeds or has events that changes rapidly, the data integrity is compromised resulting in leakage of signal. This can be seen as shown in **Fig 2**.

Adaptive/Synchronous Sampling

Unlike the fixed sampling method, this method does not use the user defined sampling frequency. It uses an external device, usually a tachometer, to track the rate of change in events taking place in the device under test. The data from this device, in the form of pulses per event, is fed to the data acquiring system to serve as reference to change the sampling frequency for every instance of event change. This helps because the adequate number of samples for the desired frequency is fulfilled.

This approach will substantially improve the quality of the frequencies with lowered leakage and better accuracy. Adaptive sampling is extremely useful for conducting tests of equipment with varying speed or varying events. The same can be seen in **Fig 3.**

Limitations

1. Sometimes information such as resonance is not visible.

Working

As shown in **Fig 4**, there is a clear difference in the block size of fixed and adaptive sampling for varying speed. In fixed sampling, irrespective of the machine speed, the block size for acquiring the signal is same for entire period which compromises capturing the higher frequencies; whereas in adaptive sampling, the bandwidth adapts instantaneously w.r.t time for entire period to sample data at a faster rate to compensate for higher frequency outputs.

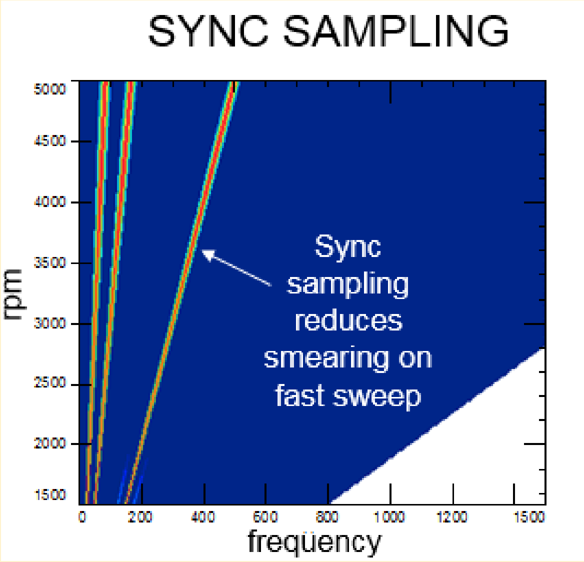


Fig 3

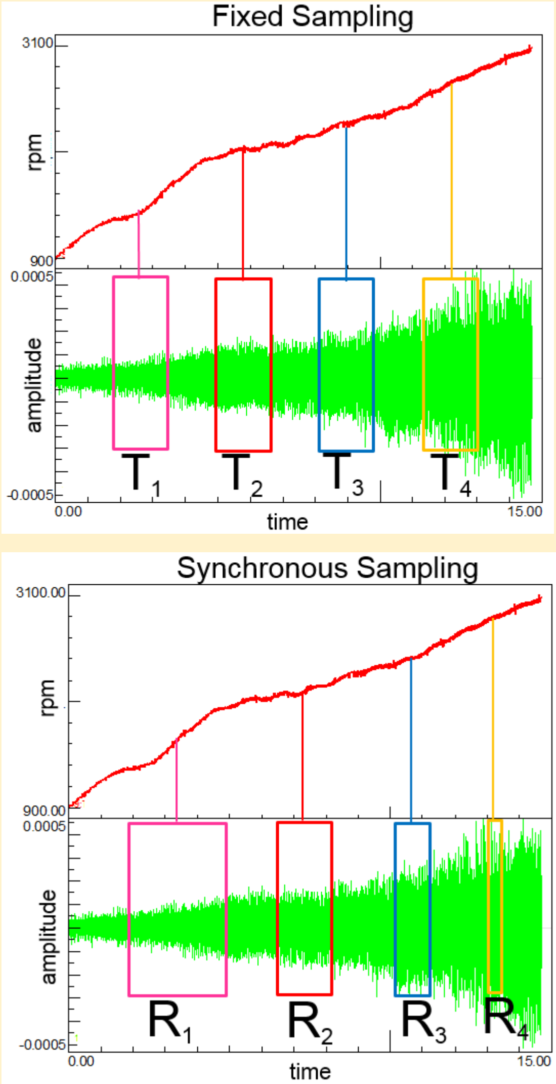


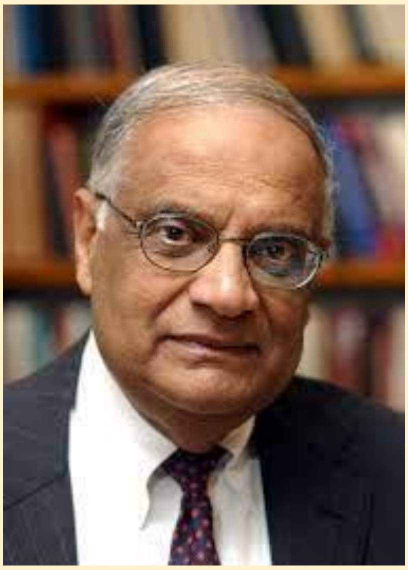
Fig 4

Great minds & their contribution to the world of science

Narendra Krishna Karmarkar (born 1956) is an Indian mathematician. He developed an algorithm called Karmarkar's algorithm. He invented one of the first provably polynomial time algorithms for linear programming, which is generally referred to as an interior point method. The algorithm is a cornerstone in the field of linear programming. He published his famous result in 1984 while he was working for Bell Laboratories in New Jersey.

Karmarkar's algorithm solves linear programming problems in polynomial time. These problems are represented by several linear constraints involving several variables. The previous method of solving these problems consisted of considering the problem as a high-dimensional solid with vertices, where the solution was approached by traversing from vertex to vertex.

Karmarkar's novel method approaches the solution by cutting through the above solid in its traversal. Consequently, complex optimization problems are solved much faster using the algorithm.



A practical example of this efficiency is the solution to a complex problem in communications network optimization, where the solution time was reduced from weeks to days. His algorithm thus enables faster business and policy decisions. The algorithm has stimulated the development of several interior-point methods, some of which are used in current implementations of linear-program solvers.

Physics to Know

Dolphins can see sound.

A dolphin's "clicks" travel long distances and bounce off from objects, allowing them to calculate the distance, shape, density, movement, and texture of an object. Dolphin sonar is the best within the animal kingdom and is also superior to bat and man-made sonar technology. They have the incredible ability to emit sounds with a frequency of 120 kHz. To put that in perspective, humans with excellent hearing can only hear sounds with frequencies ranging from 20 Hz to 20 kHz. However, dolphins generally receive optimal results only when the object is at a distance no greater than 656 feet from them.