TRILION - APPLICATION NOTE
Machine Health Investigations

Problem Overview

Rotating Equipment health studies have long been performed utilizing accelerometers, which inherently have a poor low frequency response, influencing measurements, at the same time, being attached to the equipment. Conversely, optical, non-contact, metrology methods outperform traditional measurement technologies in the low frequency regime boasting micrometer precision and therefore ultra-accurate low frequency detection.

Figure 1 Shaft Analysis of Pump Startup

Notes

Accelerometers inherently prove inadequate for measuring low frequency vibrations on rotating equipment. Although they are ideal for the high frequency regime, most of the damaging frequencies will be seen at lower frequencies where the energy is highest.

A comparison study was performed on the same pump to study the feasibility of using optical metrology as a means of conducting machine health investigations. Digital image correlation techniques were applied using Photron AX-200 high frame rate cameras to capture a start-up of a barrel style pump.

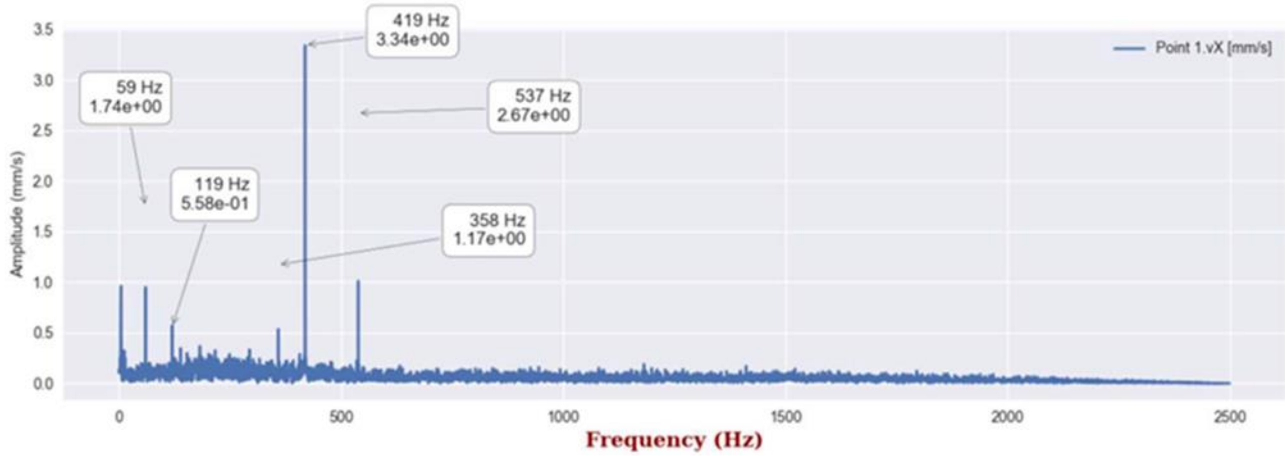
The system can measure displacements and velocities with micrometer level precision allowing for a strong response across the entire spectrum. The velocities were then used to compute the corresponding Fast Fourier Transforms (FFT) for direct comparison. Once the FFTs were computed, the optical mirrored data collected by traditional accelerometers, showing the same peaks across the entire spectrum while showing low frequency vibrations not seen by the accelerometers. The optical data also gave ultra-precise displacement measurements which allowed for trajectory mapping of discrete points showing the gross movement of the system. Optical methods, such as the ARAMIS tool, utilize massless target dots which do not introduce sources of error (stiffness change) resulting from weight of the instrument.

Conclusion

ARAMIS proved highly effective at precisely identifying frequencies of interest during both startup and steady state operation of a large barrel style pump. The corresponding FFTs from both ARAMIS (Fig.2) and a traditional accelerometer (Fig.3) mirrored each other proving ARAMIS to be a suitable tool for machine health investigations.

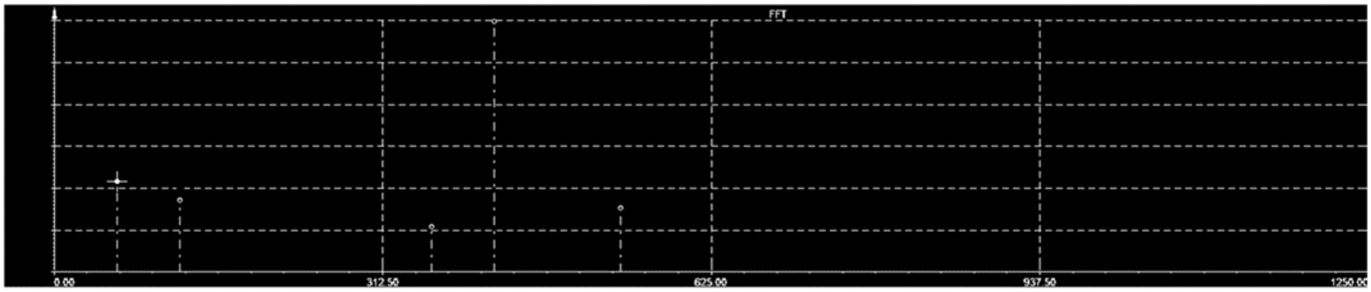
Keywords: Machine Health Monitoring, Digital Image Correlation, FFT, Vibration Studies

Figure 2 – FFT data collected using ARAMIS and the FAST module



Peak Number	Frequency (Hz)	Amplitude (in/s)
1	59	.06
2	119	0.24
3	418	.13
4	358	0.022
5	538	.039

Figure 3 – FFT data collected using a Dewetron data acquisition system



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