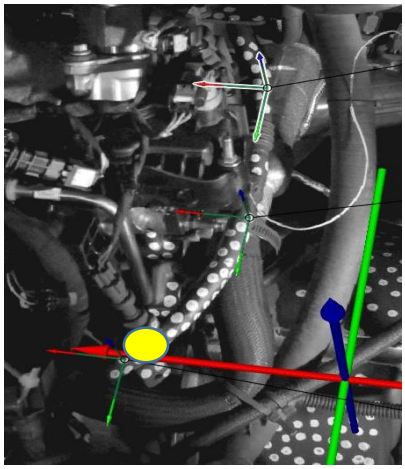
Vibration analysis using optical metrology

Problem overview

Identifying resonance modes of auxiliary piping systems in automotive applications is critical to ensure the system can withstand the harsh conditions of operation which can lead to fatigue failure during the lifetime of the parts in question. ARAMIS High-speed metrology techniques were employed to identify component resonances at various engine operation speeds.

Test setup



Notes

The application allowed for advanced detection of system resonance during an RPM sweep. Using ARAMIS, a constellation of points is tracked at 15kHz to highlight damaging frequencies of interest. As the system approaches its resonant frequency the amplitude of deflection increases exponentially. This phenomenon can be observed in Figure 1.

The ARAMIS system, including a pair of Photron AX-200 high-speed cameras (sampling at 15kHz) was used in RPM sweep resonance detection. The testing was performed on auxiliary compressor piping while conventional spray paint was utilized to construct a 6 DOF trackable point constellation. The yellow dot seen in the test setup shows acquisition point for FFT data below.

Direct velocity measurements were acquired allowing for Fast Fourier Transform analysis to highlight detrimental operating frequencies in the system. Each component in the systems constellation of points is tracked to 6 DOF showing displacements and rotations as well.

The acquired data allowed for a direct FEA comparison, while even elucidating frequencies of interest not predicted in the model.

Conclusion

ARAMIS high-speed vibrational analysis was shown to be highly effective at identifying resonant frequencies of operation in an automotive component model verification.

For more information on this ARAMIS application, please contact Trilion Quality Systems, world leader in custom optical metrology application development.

Keywords: *Vibrational Analysis, FFT, Resonance, ARAMIS, Optical Metrology, FEA validation, 6 DOF*

Figure 1

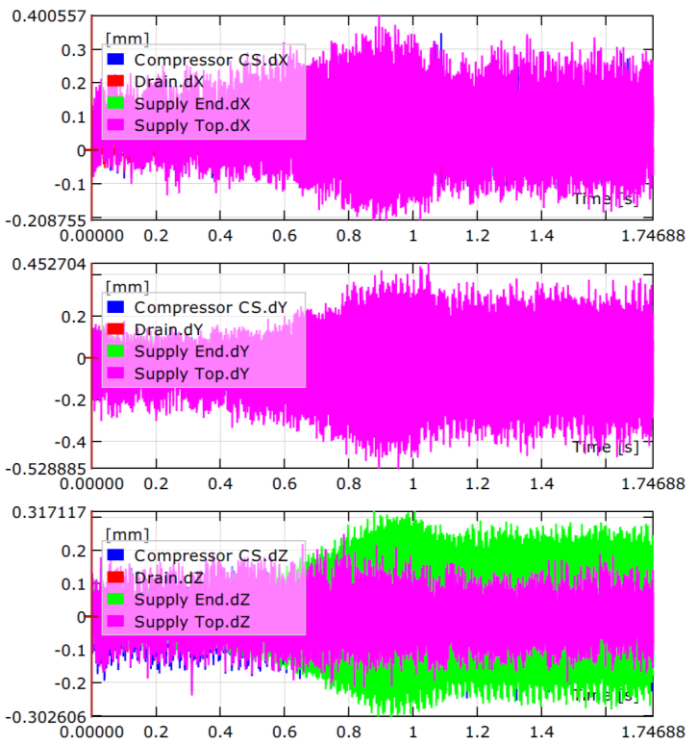


Figure 2