Case Study: Performance Comparison of UEB Ultrasound Sensors

Introduction

This case study examines the superior performance of CTC's UEB Series ultrasound sensors in detecting bearing faults and stress waves compared to competitor sensors and standard 100 mV/g accelerometers.

The trials were conducted by certified Category IV Vibration Analysts from leading companies in the vibration analysis industry, using CTC hardware along with industry-standard software. The goal was to evaluate the accuracy, sensitivity, and high-frequency detection abilities of CTC UEB Series ultrasound sensors under real-world conditions.

TRIAL 1 - Outer Race Bearing Fault Detection

Conducted by Tony Dimatteo, Category IV Analyst - 4X Diagnostics

Objective

Compare the results of IMI accelerometer and CTC UEB ultrasound sensor in detecting an outer race bearing fault.

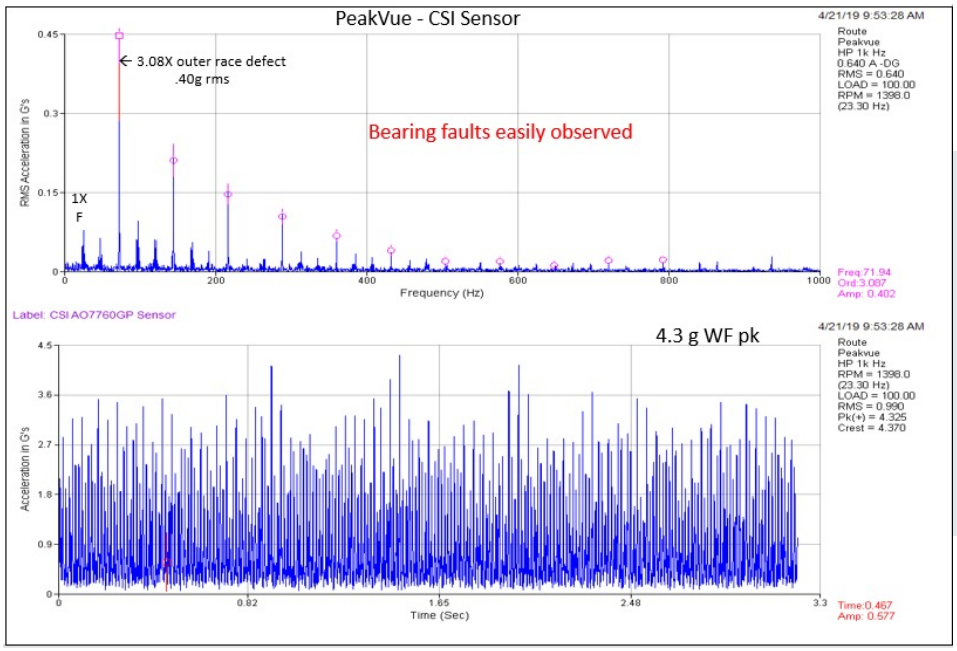
Hardware & Software Used

IMI Accelerometer
Used & supplied by Emerson for PeakVue software

CTC UEB332
IEPE ultrasound sensor, 100 mV/g, ±10% sensitivity tolerance

Emerson PeakVue Software

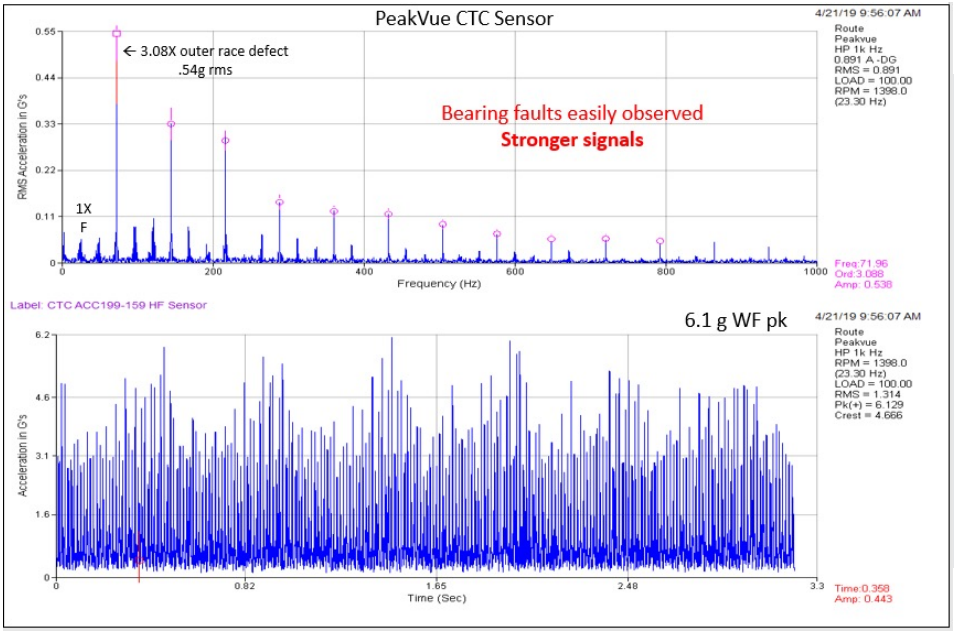
Results



IMI Accelerometer

3.08X outer race defect

0.40g RMS



UEB332 Ultrasound Sensor

3.08X outer race defect

0.54g RMS

More Accurate Reading

Summary

CTC's UEB332 ultrasound sensor provided a more accurate reading than the IMI accelerometer, showing higher RMS and clearer defect identification.

TRIAL 2 - Stress Wave Detection

Conducted by Jake Ford, Category IV Analyst - PFE Limited

Objective

Compare the results of a standard 100 mV/g accelerometer and a UEB332 ultrasound sensor in detecting stress waves from a defect introduced to the non-drive end bearing of a test rig rotor.

Hardware Used

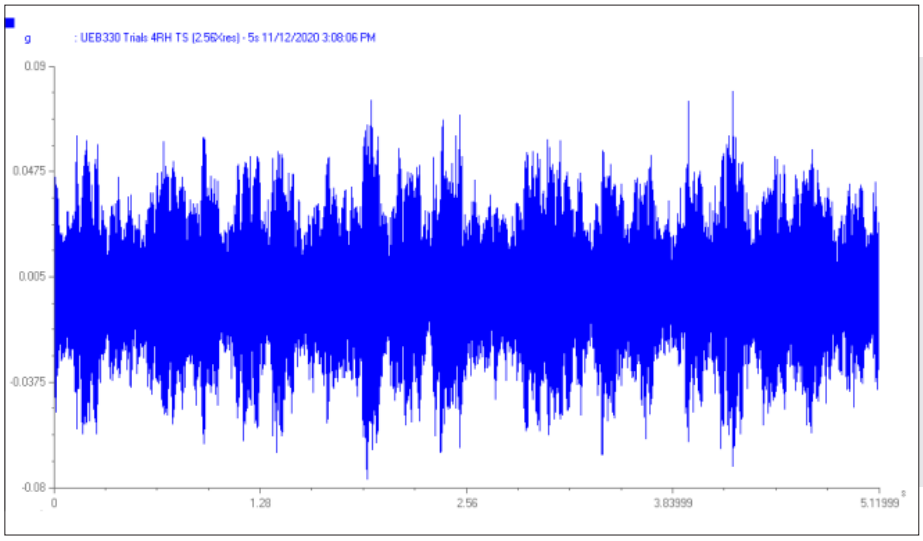
Standard 100 mV/g Accelerometer

CTC UEB332 Ultrasound Sensor

Results

The following testing data was compiled using:

- 10 Hz high pass filter
- 102.4 kHz sampling frequency (2.56 x 44 kHz)
- 512,000 samples



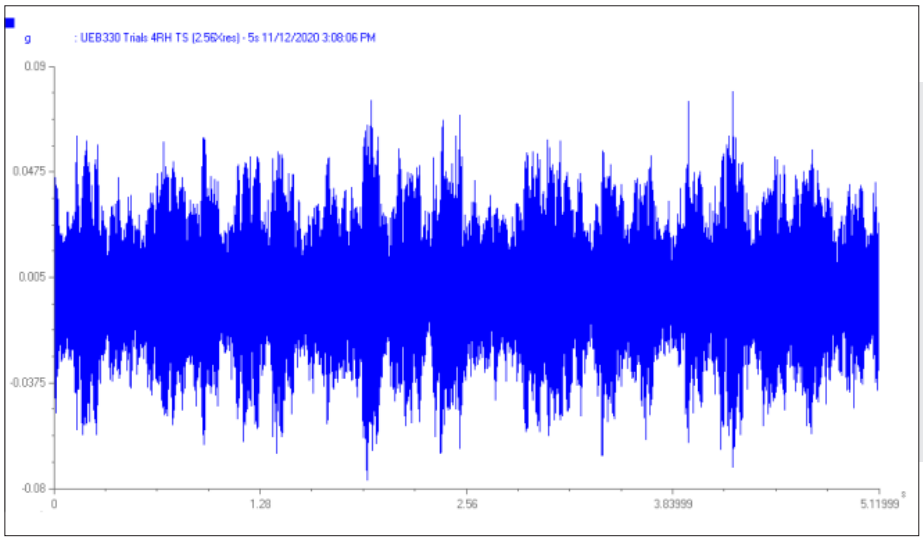
Standard 100 mV/g Accelerometer

Low Level Modulation

~0.085 g's pk (+)

~0.078 g's pk (-)

~0.157 g's pk-pk



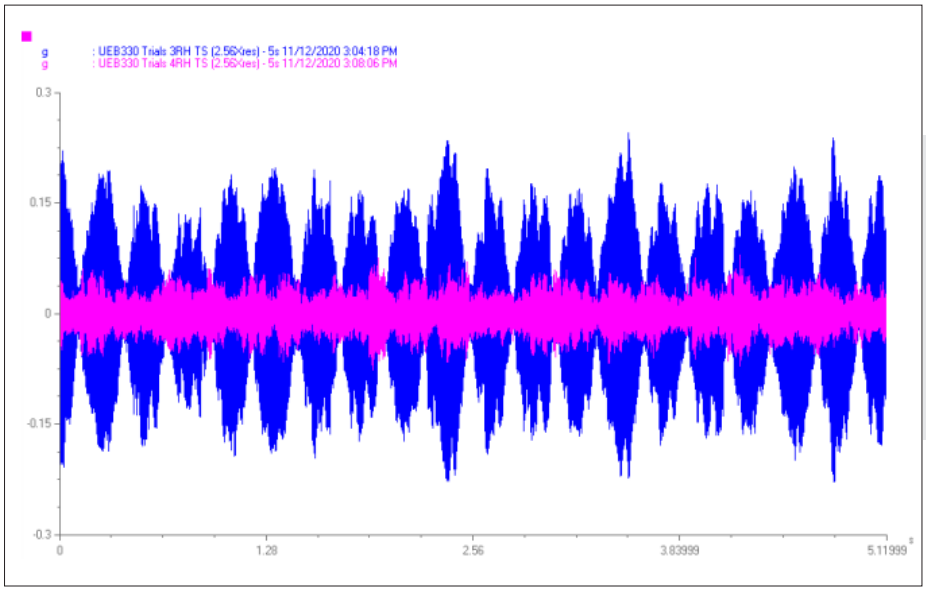
UEB332 Ultrasound Sensor

Low Level Modulation

~0.085 g's pk (+)

~0.078 g's pk (-)

~0.157 g's pk-pk



Standard 100 mV/g Accelerometer

UEB332 Ultrasound Sensor

Summary

CTC's UEB332 ultrasound sensor captured low-level modulation signals more effectively than the standard 100 mV/g accelerometer, confirming its superior high-frequency sensitivity.

TRIAL 3 - Harmonic Content Detection

Conducted by Jake Ford, Category IV Analyst - PFE Limited

Objective

Compare the results of a standard 100 mV/g accelerometer and a UEB332 ultrasound sensor in detecting harmonic content at high frequencies.

Hardware Used

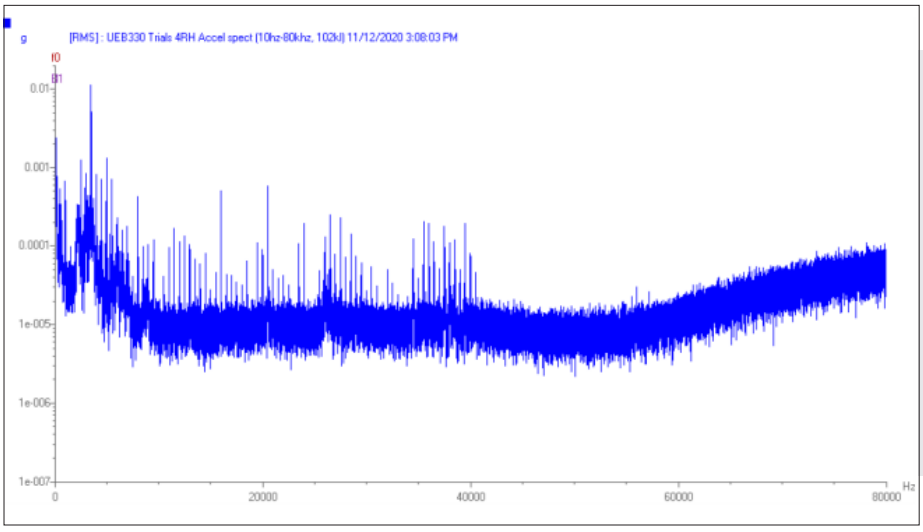
Standard 100 mV/g Accelerometer

CTC UEB332 Ultrasound Sensor

Results

The following testing data was compiled using:

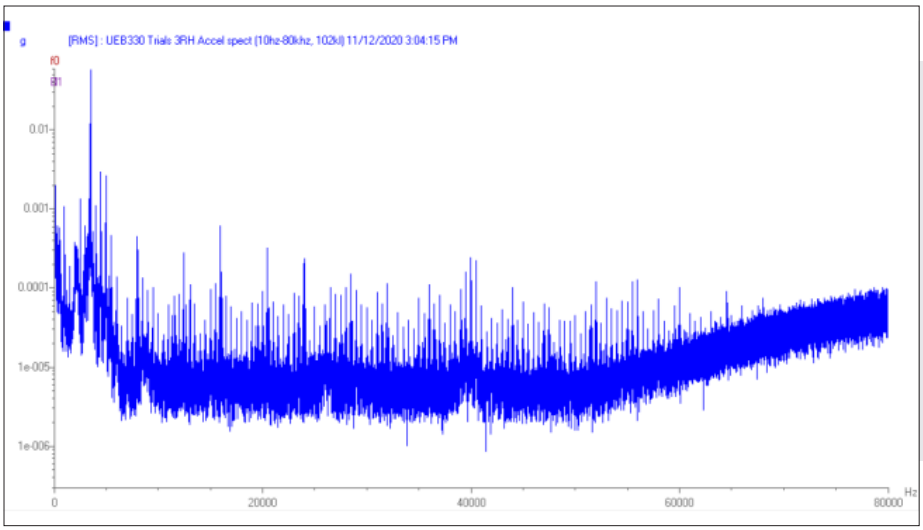
- 10 Hz high pass filter
- 80 kHz Fmax
- 102,400 lines



Standard 100 mV/g Accelerometer

Some harmonic content up to just under 40 kHz

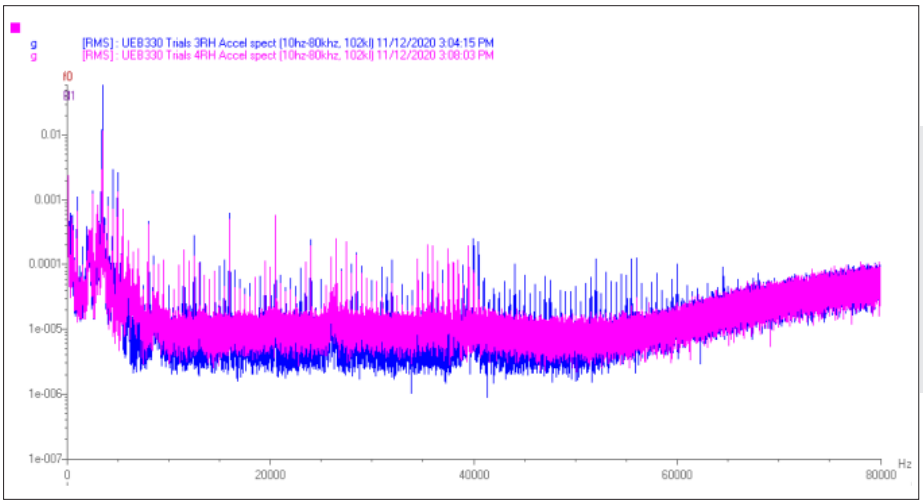
Low amplitude (due to the speed)



UEB332 Ultrasound Sensor

Harmonic content exceeding 40 kHz up to ~65 kHz

Low amplitude (due to the speed)



Standard 100 mV/g Accelerometer

UEB332 Ultrasound Sensor

Summary

CTC's UEB332 ultrasound sensor detected harmonic content up to ~65 kHz, while the standard 100 mV/g accelerometer only reached just under 40 kHz.

TRIAL 4 - Harmonic Content Detection

Conducted by Jake Ford, Category IV Analyst - PFE Limited

Objective

Compare the results of a standard 100 mV/g accelerometer and a UEB332 ultrasound sensor in detecting harmonic content and sideband clarity in the enveloping range.

Hardware Used

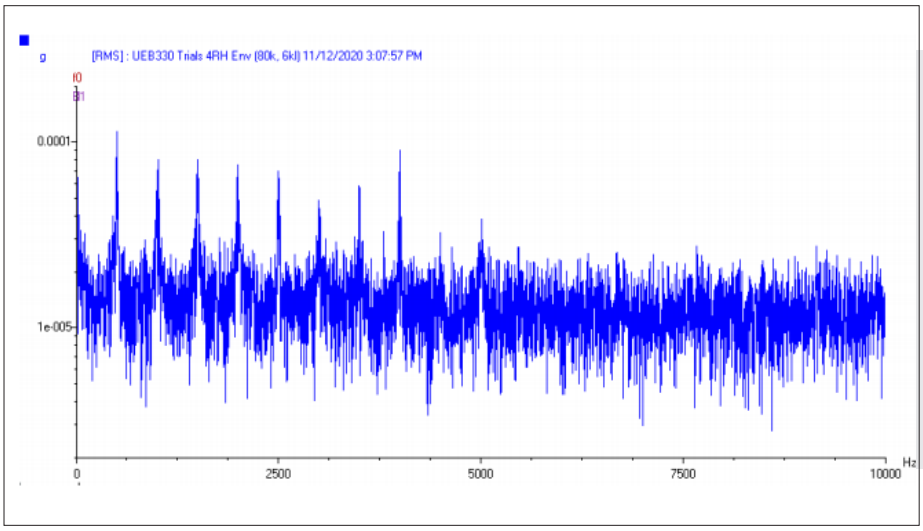
Standard 100 mV/g Accelerometer

CTC UEB332 Ultrasound Sensor

Results

The following testing data was compiled using:

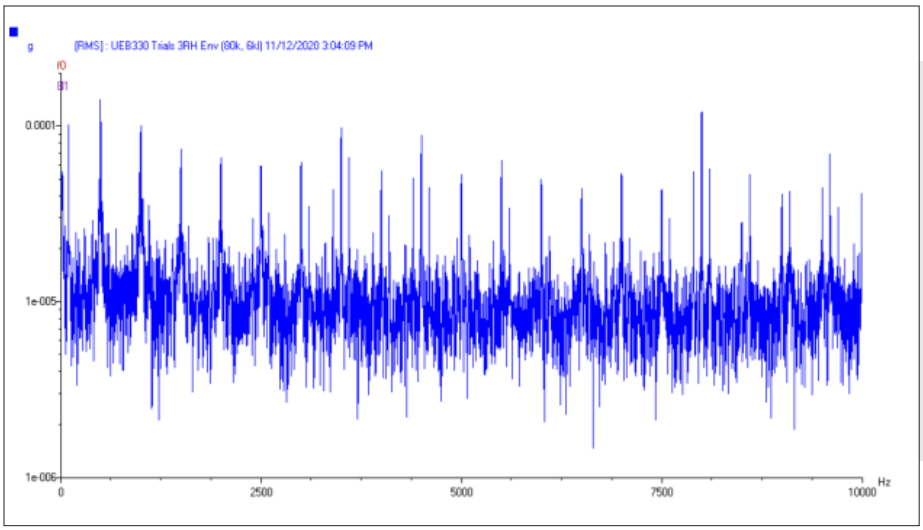
- 10 Hz high pass filter
- 80 kHz Fmax
- 64,000 lines
- 20 kHz band pass width
- 44 kHz center frequency



Standard 100 mV/g Accelerometer

Some harmonic content up to ~4 kHz enveloped frequency

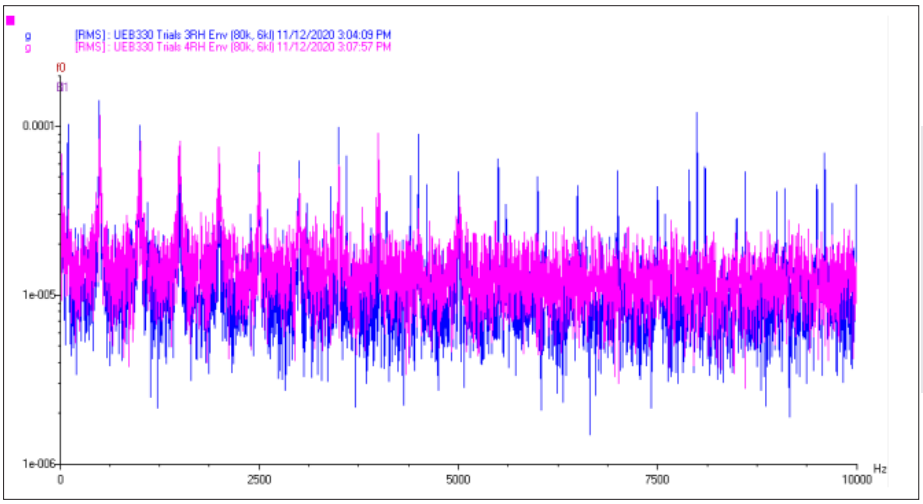
No clear sidebands



UEB332 Ultrasound Sensor

Harmonic content throughout the enveloping range

Clear sidebands in the mid-range



Standard 100 mV/g Accelerometer

UEB332 Ultrasound Sensor

Summary

CTC's UEB332 ultrasound sensor displayed harmonic content throughout the enveloping range and clear sidebands, outperforming the standard 100 mV/g accelerometer.