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# Ultrasound for slow-speed bearings

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# What is Ultrasound?

- High frequency sound beyond human hearing
- Working in the range 36-40kHz
- Sound travels through gases, liquids and solids

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# Why Ultrasound?

- Detects three important parameters:
  - Friction
  - Impacting
  - Turbulence

- When you perform your FMEAs how many times do you find one of these three?

# Is slow-speed special?

- From an ultrasound perspective? Not really
  - Friction
  - Impacting

- From a vibration perspective? Absolutely yes!
  - Measurement is much more complex
  - More care required
  - More time required

# Four stages of failure

- Vibration training always talks about four stages of failure
  - Friction
  - High frequency random impacts
  - Bearing defect frequencies
  - A mess, just a lot of noise, looseness
- Nothing in that training limits this process by a minimum speed

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# Reliance on the FFT

- Fourier's mathematics should only be applied to continuous and repeating signals
  - Early stage defects are neither
- The FFT process creates noise
- The accelerometer creates noise

# Reliance on post-process

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- Few post-processing methods like peak view, enveloping, etc. are live
- Ultrasound *is* live
- Slow bearings need grease
- Slow bearings have intermittent failure

# Noise problems

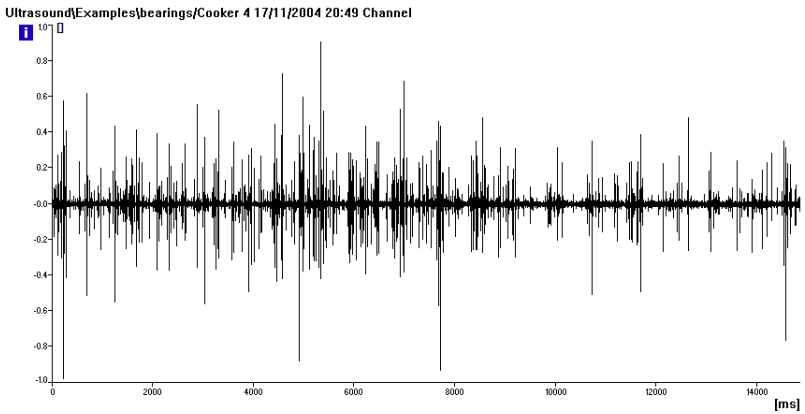
- Sensor noise
  - A typical accelerometer is100mV/g with a 20µV noise floor.
  - At 3000 rpm, 1mm/s is 0.03grms or 3mV
  - At 300 rpm, 1mm/s is 0.003grms or 300µV
  - At 30 rpm, 1mm/s is 0.0003grms or 30µV
- The noise floor of some ultrasound devices is as low as $^{1}/_{3}$µV

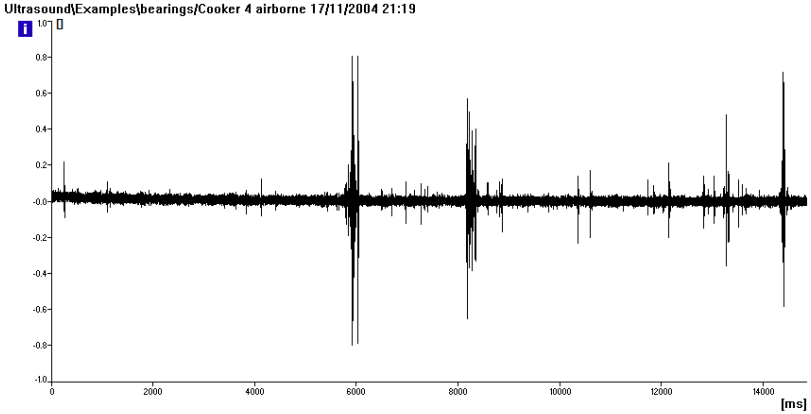
# Noise problems

- FFT process itself  generates noise
- To reduce noise you need to have lots of lines and full averaging
- This all takes time
  - 10Hz and 3200 lines is a 320 second time block
  - Four averages would take 21m20s to acquire – it could be a long day!

# Time vs. Frequency

- Consider these two time signals:

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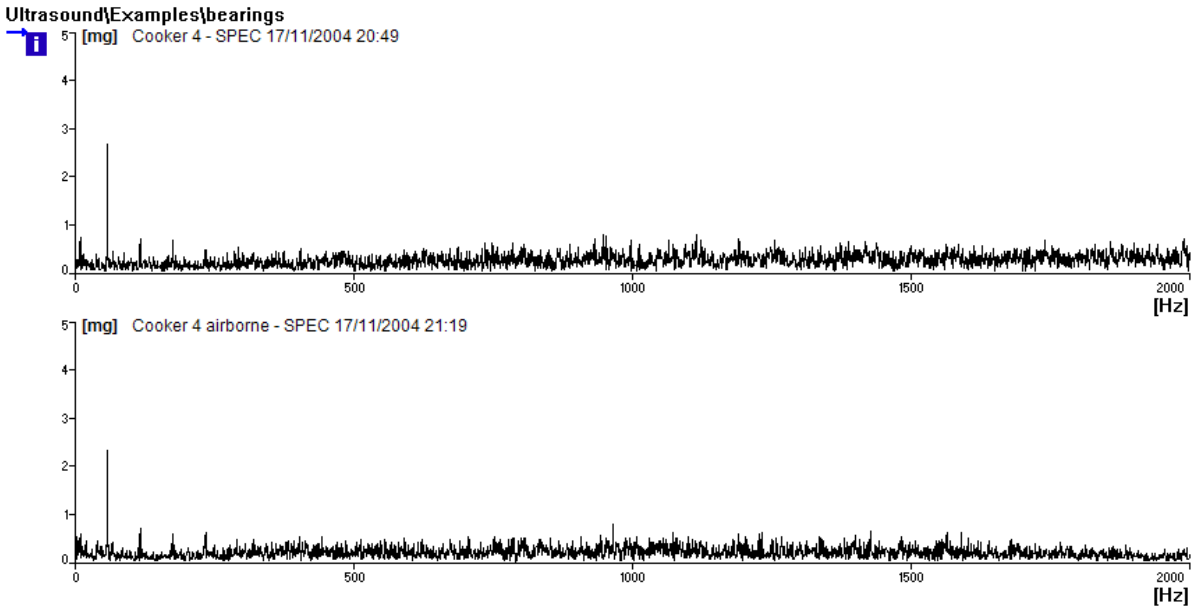
# Time vs. Frequency

- So why are their spectra almost identical?

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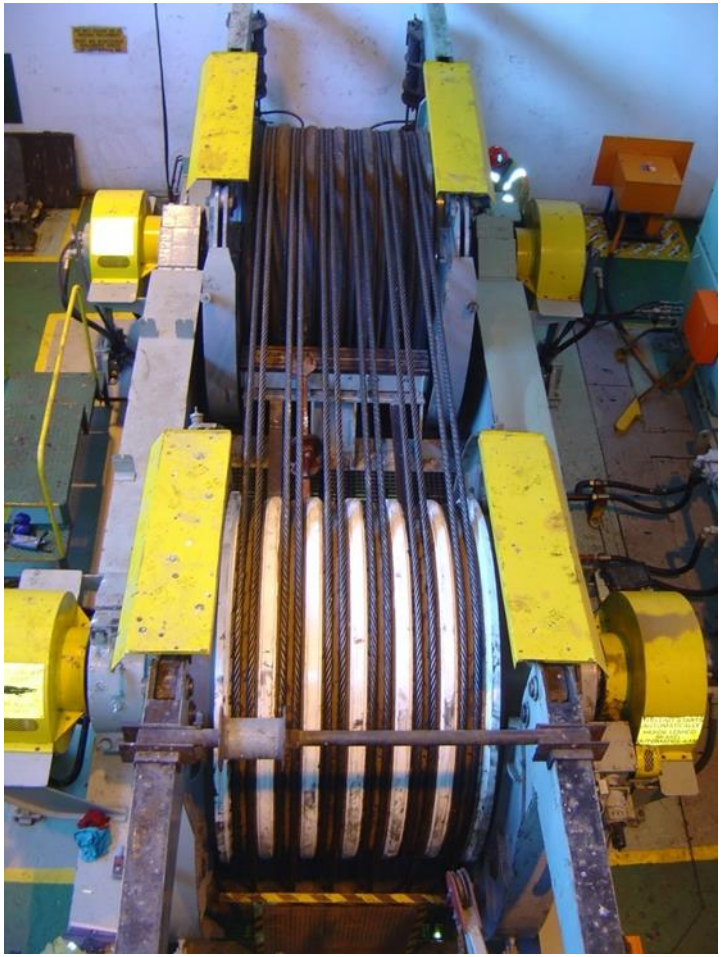
# Hoist bearing

- 21-minute measurement in vibration
- Only 30 seconds of travel from start to stop



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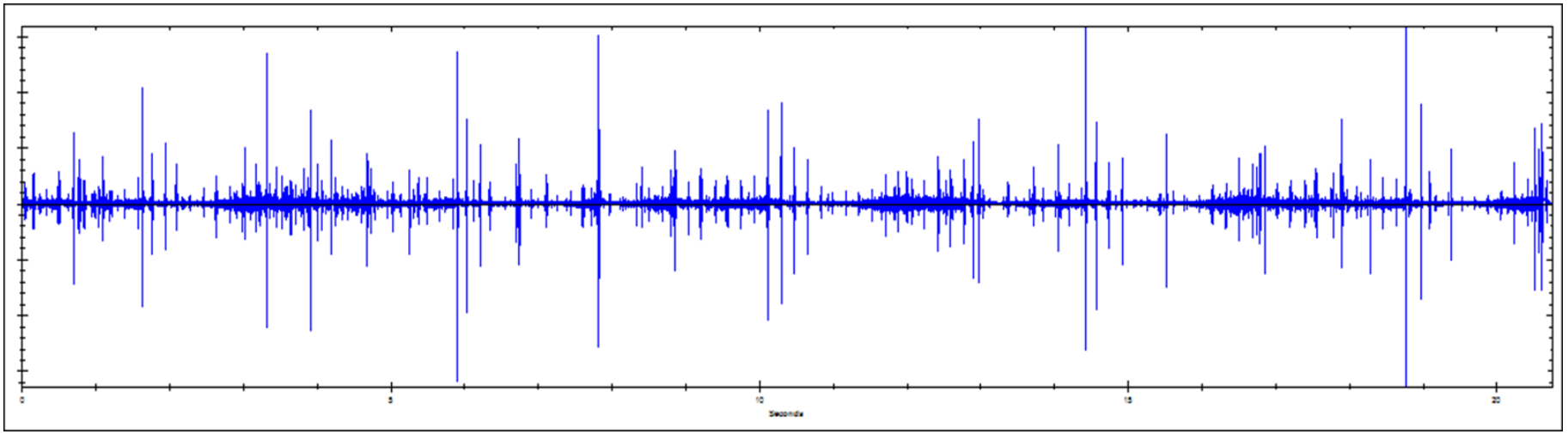
# Hoist bearing



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# Hoist bearing

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# How is this possible?

- 14rpm
- BPFI at 2.88Hz/173cpm
- How can I find this working at 36-40kHz?

# How slow can you go?

- Don’t really care

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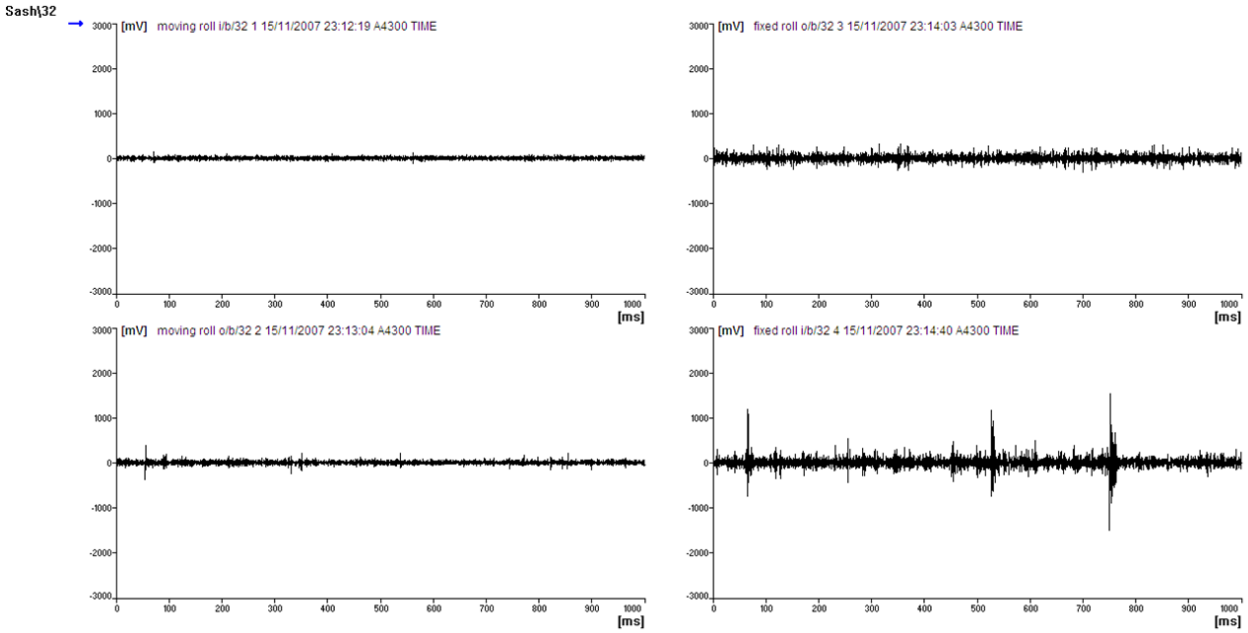
# Nip rolls at 14rpm

- 4 bearings @ 21mins each = long day!!!
- 4 bearings @ 20sec each = manageable

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# Maintenance or process?

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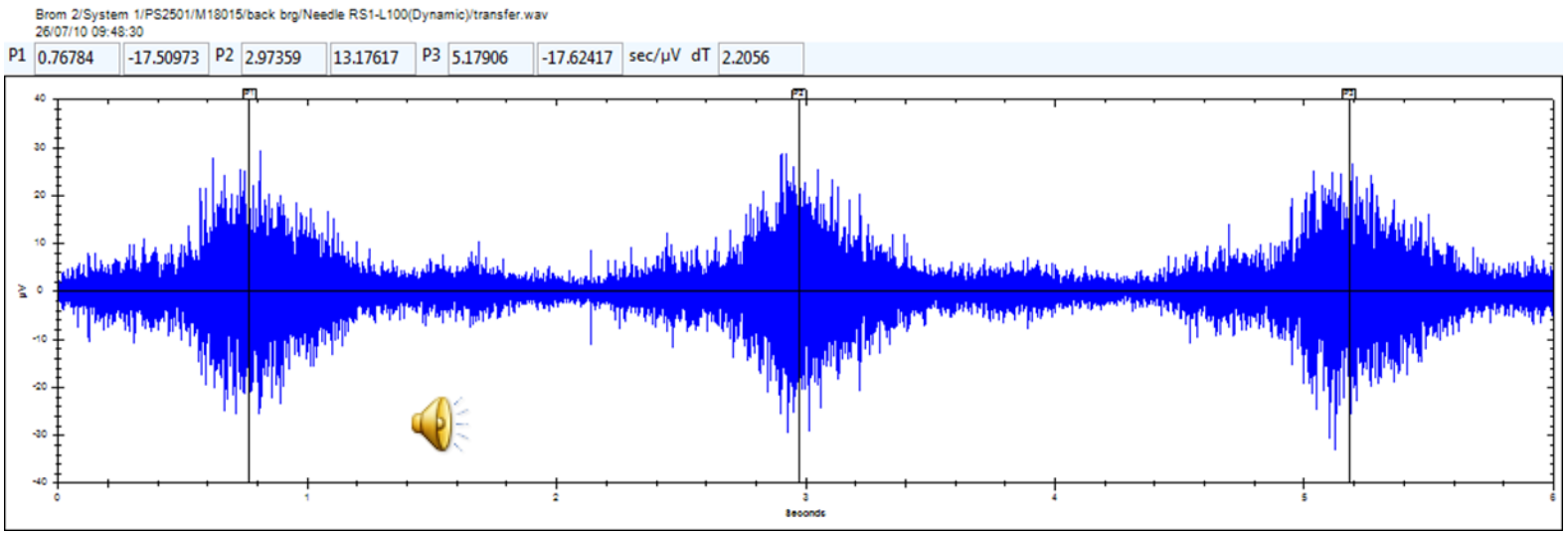
- Rub on a screw at 30rpm
- This isn't a bearing problem

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# Conclusions

- Ultrasound can offer significant assistance to anyone trying to take care of slow-moving assets
- Ultrasound can still be used for lubrication
- With the right hardware and software, Ultrasound can be used for diagnostics