Motion Amplification: rapidly evolving technology for vibration monitoring

Jeff Hay, RDI Technologies



Meet the Speaker



Jeff Hay

CEO RDI Technologies

- Interests in Photography
- Started research in Astronomy
- PhD in Applied Optical Physics
- Originally developed optical technology for DOD and DHS
- Left research to work within large CBM service company and then full time at RDI to bring products to market





Jeff Hay, CEO RDI Technologies



Ever Growing Applications of Cameras

Discover new galaxies Auto-pilot cars Incorporate AI to distinguish objects **Show me who's at the door** Control traffic

Sending me bills

And now for vibration and machinery **monitoring**.....





Expanding our toolbox. The 6th sense.

- 1. Vibration
- 2. Ultrasound
- 3. Thermography
- 4. Oil Analysis
- 5. Motor Circuit Analysis
- 6. Motion Amplification









Motion Amplification the case for a camera

What is Motion Amplification®





What is Motion Amplification







Reliability

What is Motion Amplification®





Technology Overview

- Measure movement not visible to the human eye.
- Visualization allows to leverage the human brain
- Technology turns every pixel in the camera's view into a sensor
- Quantification makes it more than just qualitative
- Visualization becomes a useful communication tool
- Measure and quantify any structure or assets that the camera can see.







See the Big Picture

- Traditional Vibration is limited by cost and access to sensors
- Motion Amplification[®] allows you to scale data collection without adding cost



• Every point is measured and quantified. No guessing between points





Some Technical Details

- Fundamental Measurement is Displacement
- Live Motion Amplification and no processing time
- Amplification factor to 500x
- Shows Overall and Frequency Based Motion
- <0.01 mils measurement</p>
- 180 fps/1,400 fps in HD
- Up to 650 Hz/14,500 Hz in frequency at reduced resolution
- 2-axis measurement orthogonal to line of sight
- Synchronous measurement across image for Phase Measurement
- Measures Shaft Displacement





Benefits of Motion Amplification

- Measure large fields of view
- Complementary Tool
- Communications Tool Technical and non-technical
- Improved Safety: Totally non-contact
- Inaccessible location
- Diverse applications Test Stands, Machines, Structures, Manufacturing Processes, Piping, Visual ODS
- Setup & acquire data in minutes, portable and easy to deploy
- Actionable information: Results are easy to see in a standard video

Multiple ways to deliver Camera







Demonstration

Implementation of Motion Amplification

A foundation for camera industry and reliability

Foundational Elements of Motion Amplification in Reliability

- 1. Bad Actors and Complex Assets
- 2. Higher on the DIPF Curve Design and Commissioning
- 3. Complementary to Route Based Methods
- 4. New Types of Assets with a Lack of Coverage Pipework, Bases, Foundations
- 5. Broaden the Coverage Lower on Criticality
- Comprehensive Scan You Don't Know What You Don't Know
- 7. Continuous Monitoring

Bad Actors and Complex Assets

Case Study - Stator Motor Pump

Company: AGL Loy Yang Location: Latrobe Valley, Victoria, Australia Service Provider: Optical Motion Technologies (OMT)

- \$120,000 USD in repairs over 11 years
- 500 Man-hours expended
- Problem still existed
- Motion Amplification process completed in less than 1 hr.
- Root Cause Identified

Piping Vibration





Stator Motor Pump





FLUKE — Reliability



Case Study Results Stator Motor Pump

- Main indicator was that there was relative motion (soft foot) between the steel motor/pump frame and the common skid steel base plate
- "There was simply insufficient weld to secure the motor/pump frame properly to the skid base plate"
- ~2 mils Pk-Pk (Red Box on motor/pump frame) vs ~0.4 mils Pk-Pk (Blue Box on skid base plate)



Case Study Results Stator Motor Pump

- Root Cause Issue Identified
- Vibration reduced from 0.55 in/s to 0.15 in/s
- This is before realignment- expected to improve more.
- "This has proved to be a great assistance to rectifying a longterm plant issue. After only a short set up time it confirmed our vibration and phase measurement's without physically touching the plant."

Peter Fanning, Condition Monitoring Team Leader, AGL Loy Y

Higher on the DIPF Curve

Commissioning





Commissioning



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27



Reliability

Commissioning





Complementary to Route Based Methods

Route Alarm: High 2x Vibration



New Types of Assets with a lack of Coverage

Transient Piping Issue



Standard HD Video

Enhanced Motion Amplification Video



Broaden the Coverage



Entire View





I solate components





Hone in on problem





Comprehensive Scan



Scanning a Structure



Motion Amplified Footage -Filtered 7-12Hz



Continuous Monitoring



Continuous Full Field Vibration





The future of cameras in industry and reliability



"I know of no way of judging the future but by the past."

• - Patrick Henry



Since Inception

- Displacement with Time Waveform and Frequency
- Stabilization
- Frequency Based Filtering
- Database Functionality
- Annotations
- Bulk Filtering
- Video Editor
- Plug and Play High Speed Camera





Since Inception

- Shaft Inspection
- Speed Detection
- Phase Calculations
- Motion Vectors
- Transient Measurements
- Transient Motion Amplification
- Top Frequency Filtering
- Motion Map





Since Inception

- Extreme Amplification
- High Density Recordings
- Live Motion Amplification
- Iris CM and Continuous Monitoring
- Software Triggering
- Long Term Thermal Growth Measurement
- Phase Map
- Audio in Recording















FLUKE Reliability













OUESTIONS?

Thank you!

Jeff Hay

Jeff.hay@rditechnologies.com

www.rditechnologies.com

www.youtube.com/rditechnologies

www.linkedin.com/in/jeff-hay



