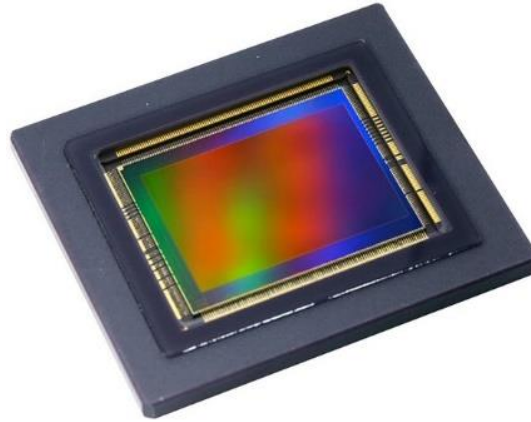
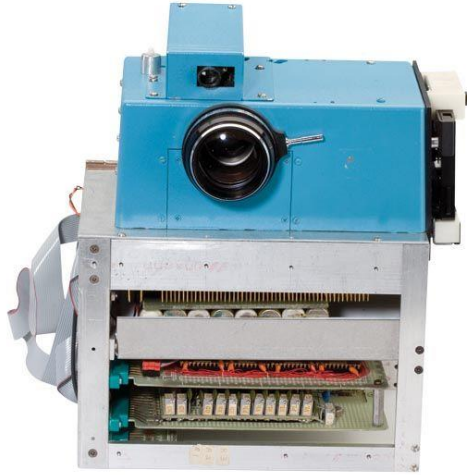


# Visualising vibration a 'gamechanger' for troubleshooting, diagnostics and root cause analysis

# ***Cameras Everywhere***





# ***Ever Growing Applications***

Discover new galaxies

Auto-pilot cars

Incorporate AI to distinguish objects

Show me who's at the door

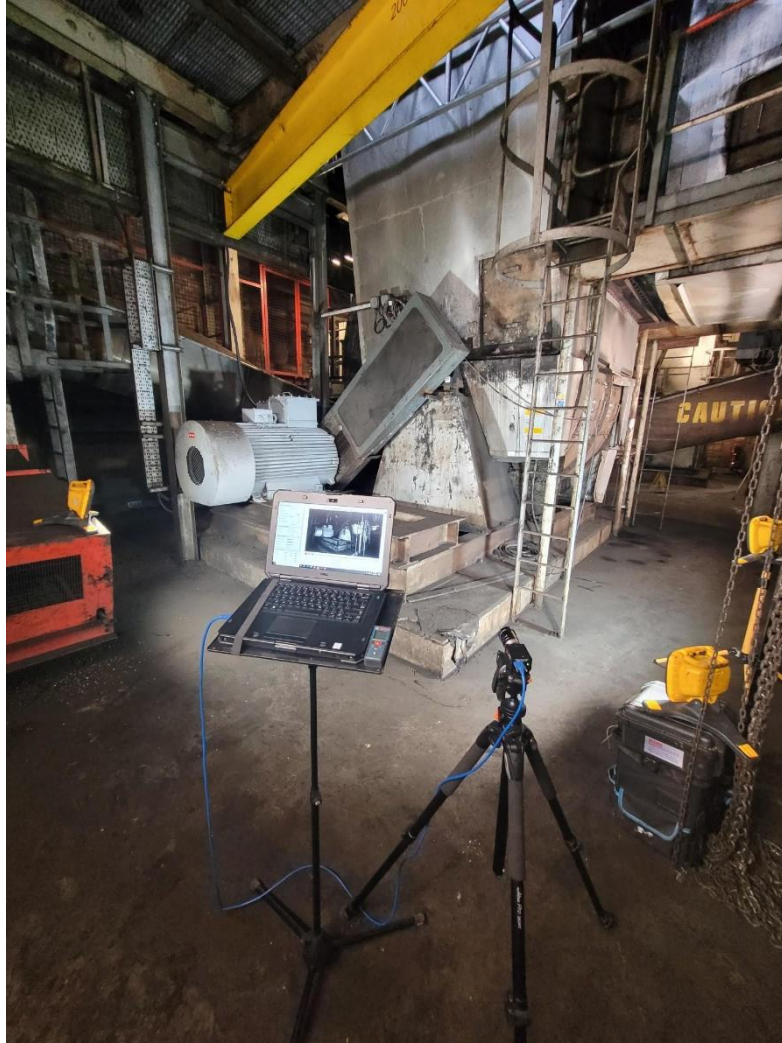
Control traffic

Sending me bills

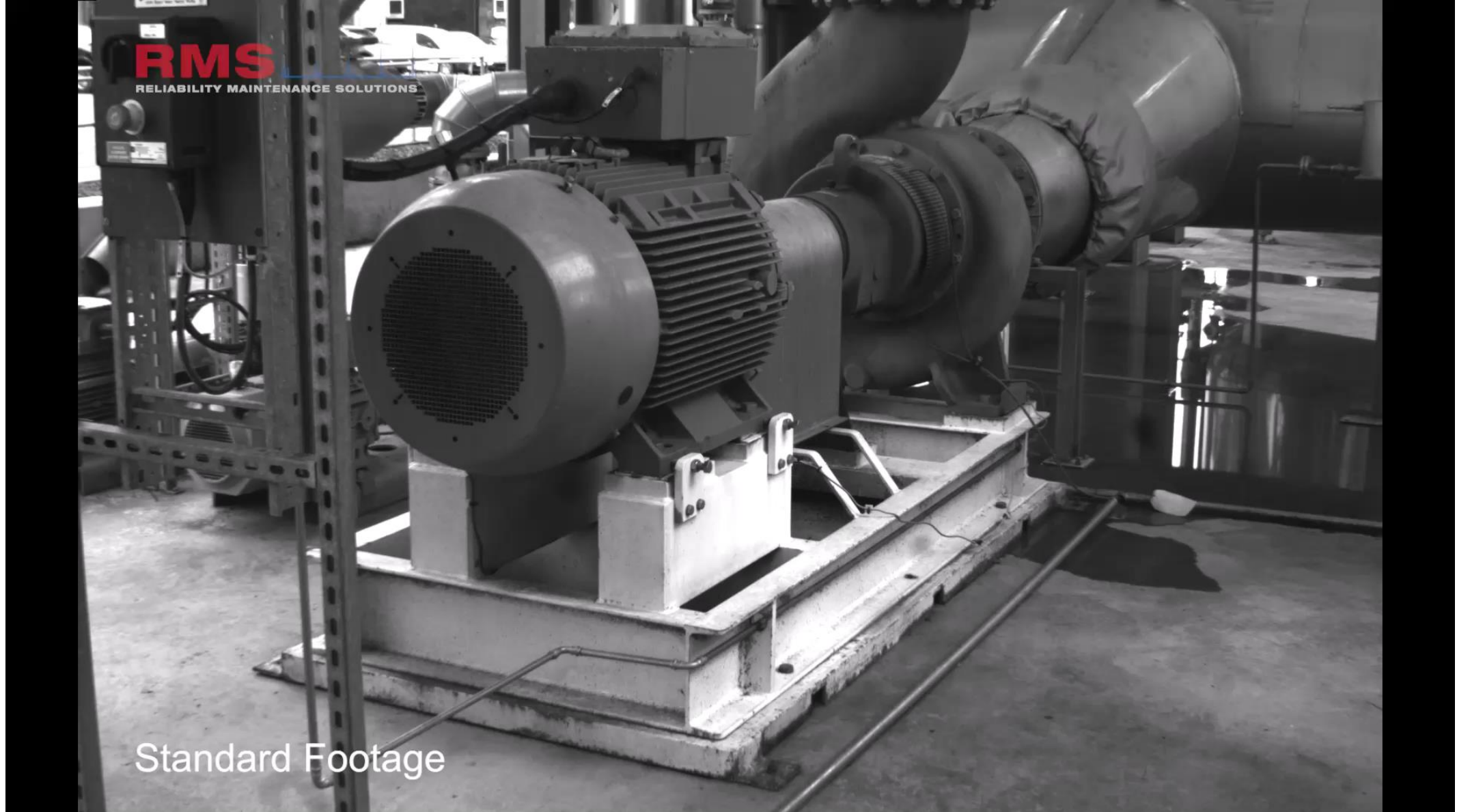
And now for vibration and machinery monitoring.....



# ***Cameras for vibration and machinery monitoring***



# *Visualizing Vibration*



Standard Footage



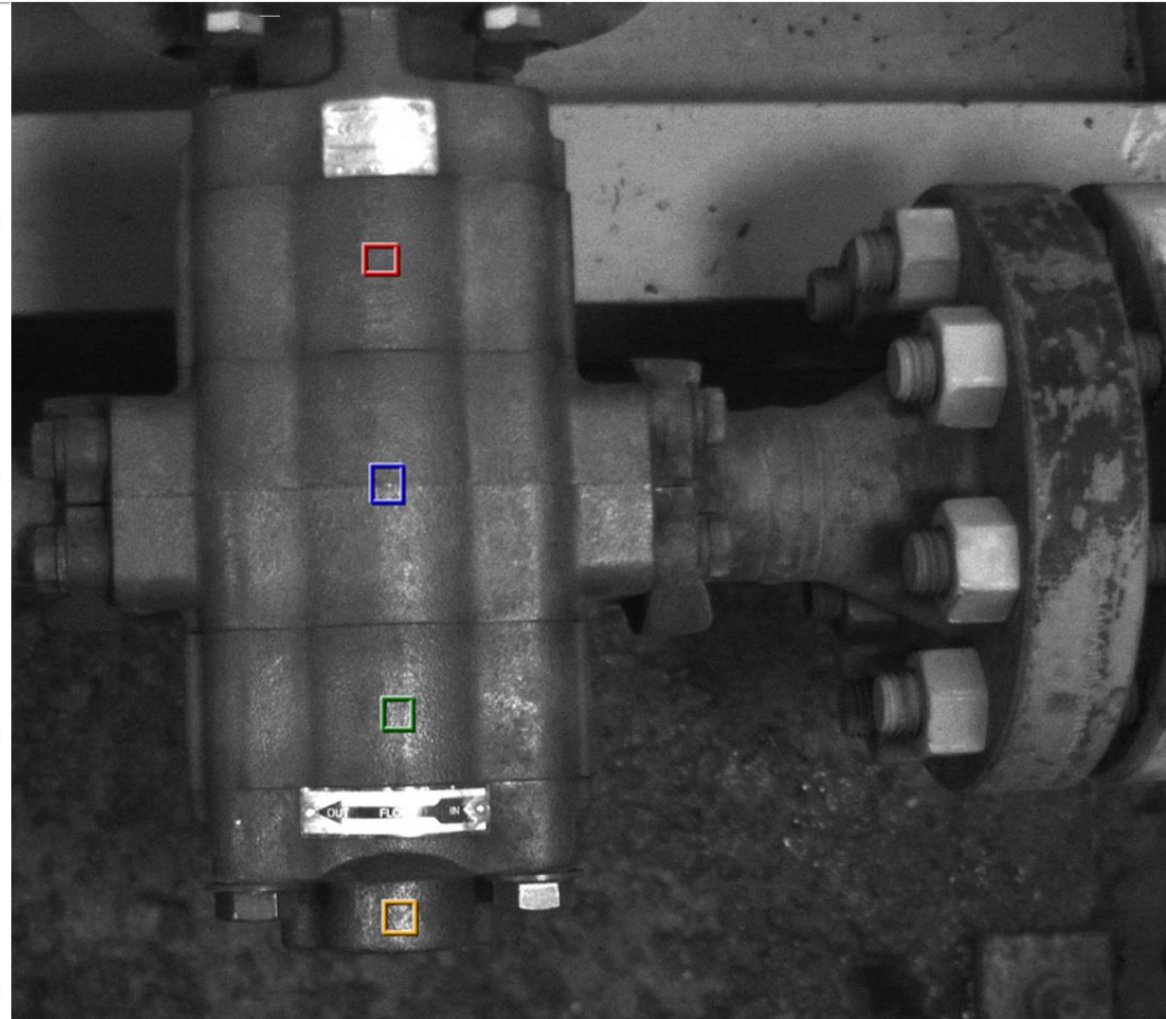
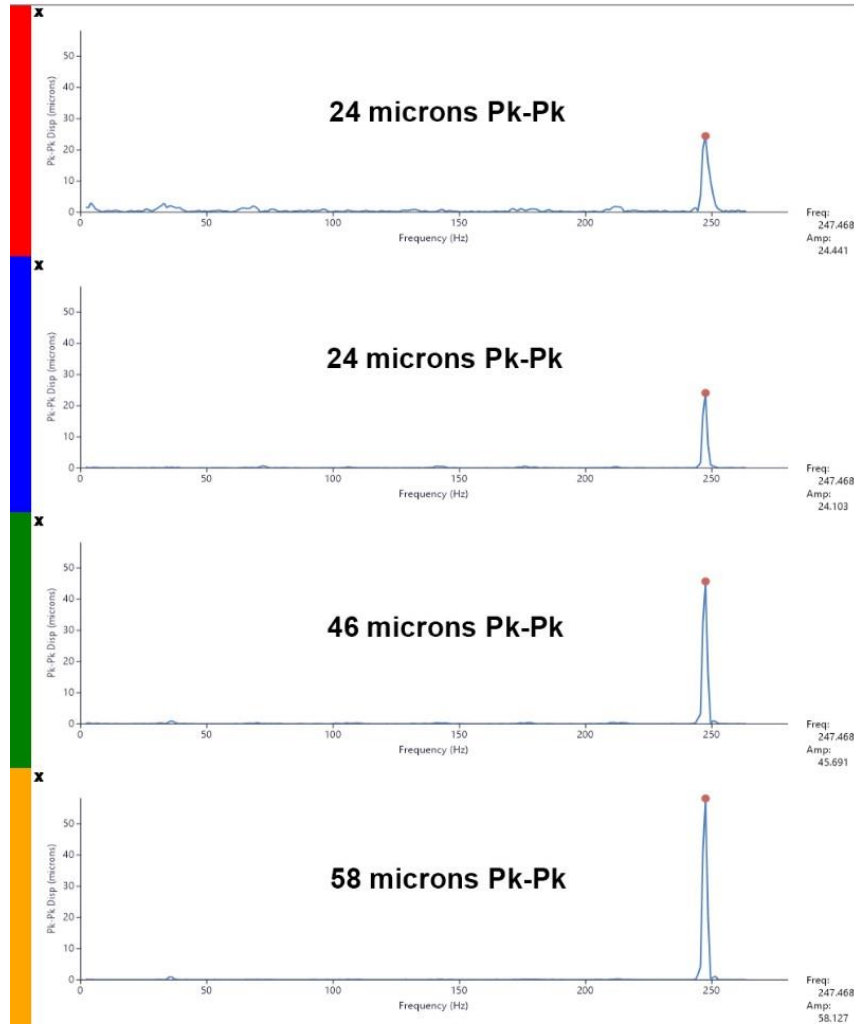
# Visualizing Vibration



# Visualizing Vibration Non-Contact Measurements

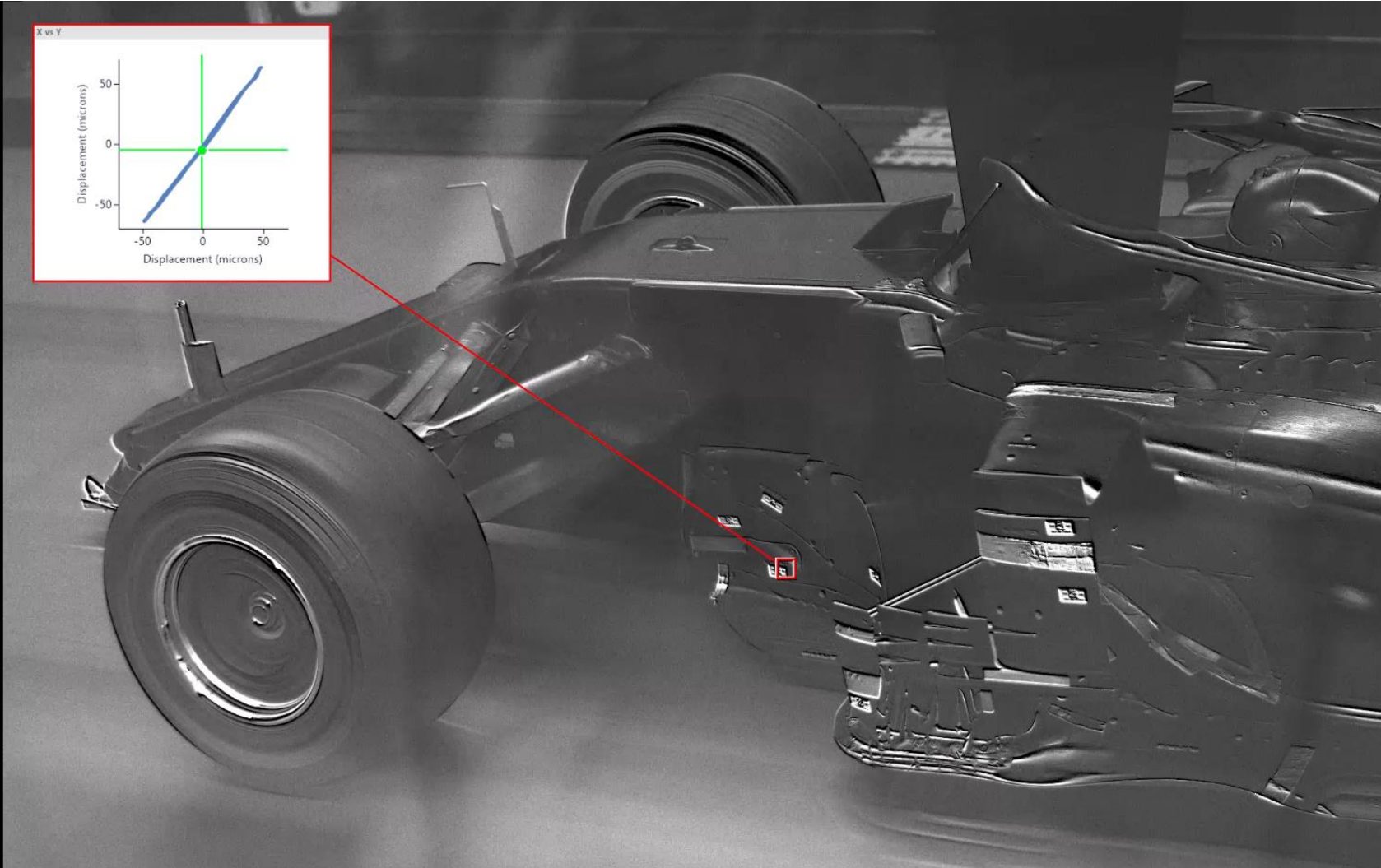
CATS - Train 1 - 2811B Glycol Pump

Displacement Levels - X Axis





# Visualizing Vibration - Non-Contact Measurements





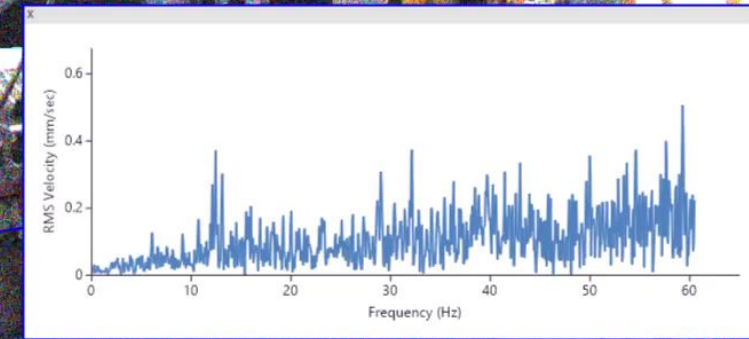
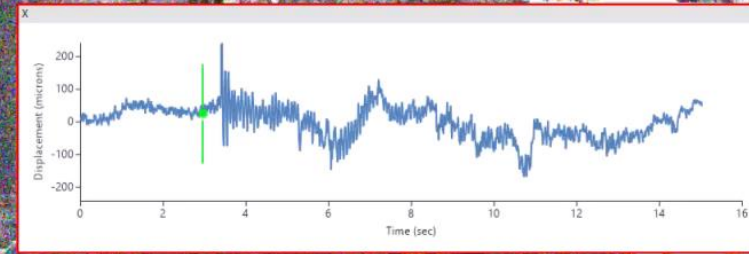
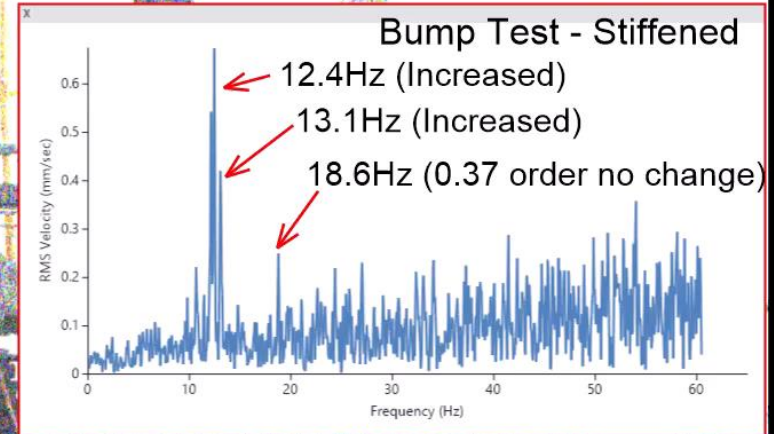
# *Transient Vibration Measurement*



Staple Machine - Real Time

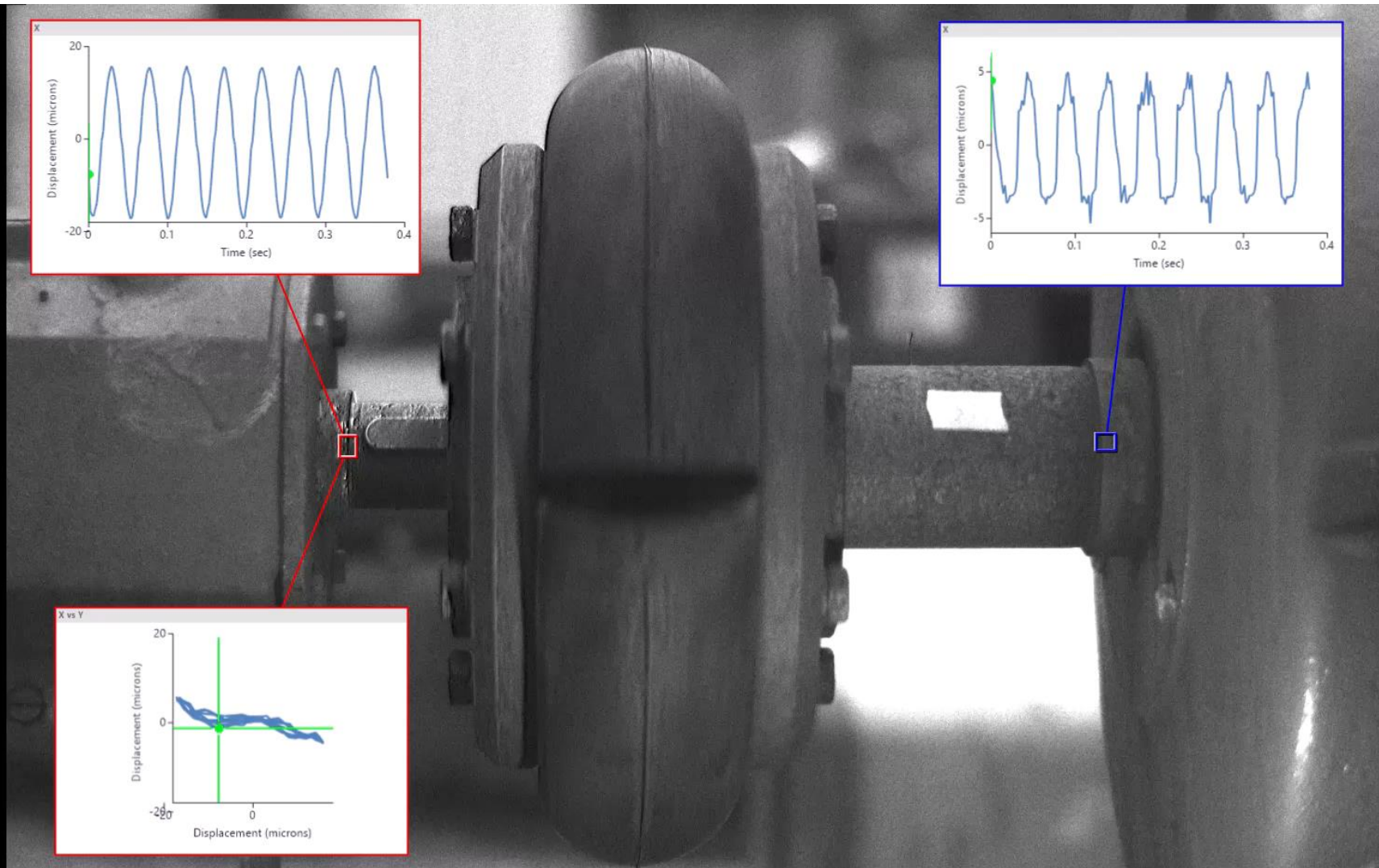


# Visualizing Vibration – Bump Testing





# Visualizing Vibration – MA Rotating Components





# *Visualizing Vibration Phase*





# Motion Amplification Technology Overview

- Measure movement not visible to the human eye
- Standard video Technology
- High Speed Machine Grade Camera
- Methods and processing algorithms to extract meaningful data
- Turns every pixel into a sensor that measures vibration or motion
- Capable of Sub-micron measurement
- Measurements over 2500Hz with reduced resolution



# Industries – Applications

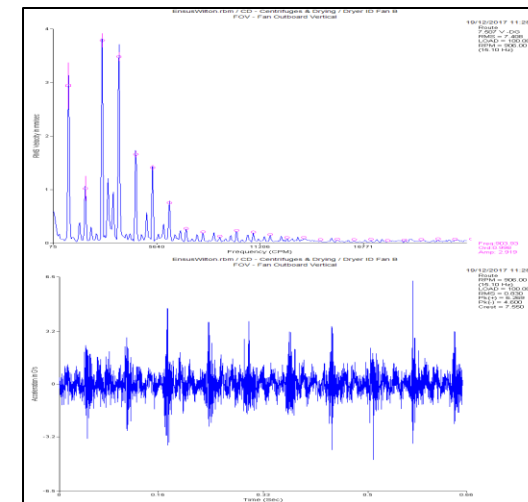
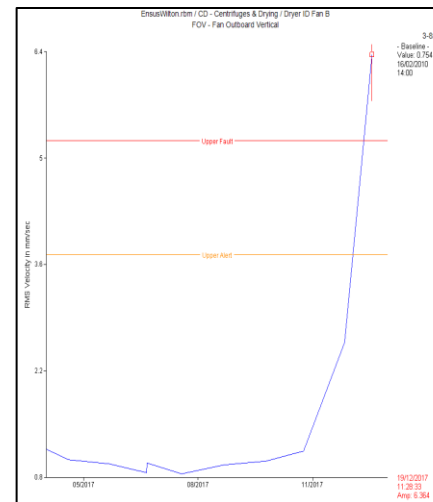
- **Aluminum** – Rolling Mills
- **Amusement Park** – Roller Coaster structures
- **Automotive** – OEM-lighting, Rivet Assembly Line, Presses
- **Bridges** – Cables, Load, etc.
- **Food & Drink** – Coffee Packaging
- **Machine Tools** – Centerless Grinders, CNC Machines
- **Machinery** – OEM Replacement parts
- **Marine** – Work Boats
- **Mining** – Drilling, Conveying, Mills, Crushers, Floatation Cells
- **Oil & Gas** – Pumps, Motors, Piping, Mechanical Seals
- **Paper Plant** – Pumps, Motors, Paper Machine
- **Pharmaceutical** - Packaging Lines
- **Polymer Plant** – Classifier, Vibratory Screens, Cooling Tower
- **Power** – Turbine-Generator, Critical Pumps, ID Fans, Cooling Towers
- **Radio & Cell Towers** – Static Cables
- **Robot Facility** – Testing
- **Steel** – Rolling Mill
- **Structures**
- **Water Treatment** – Pumps, Agitators





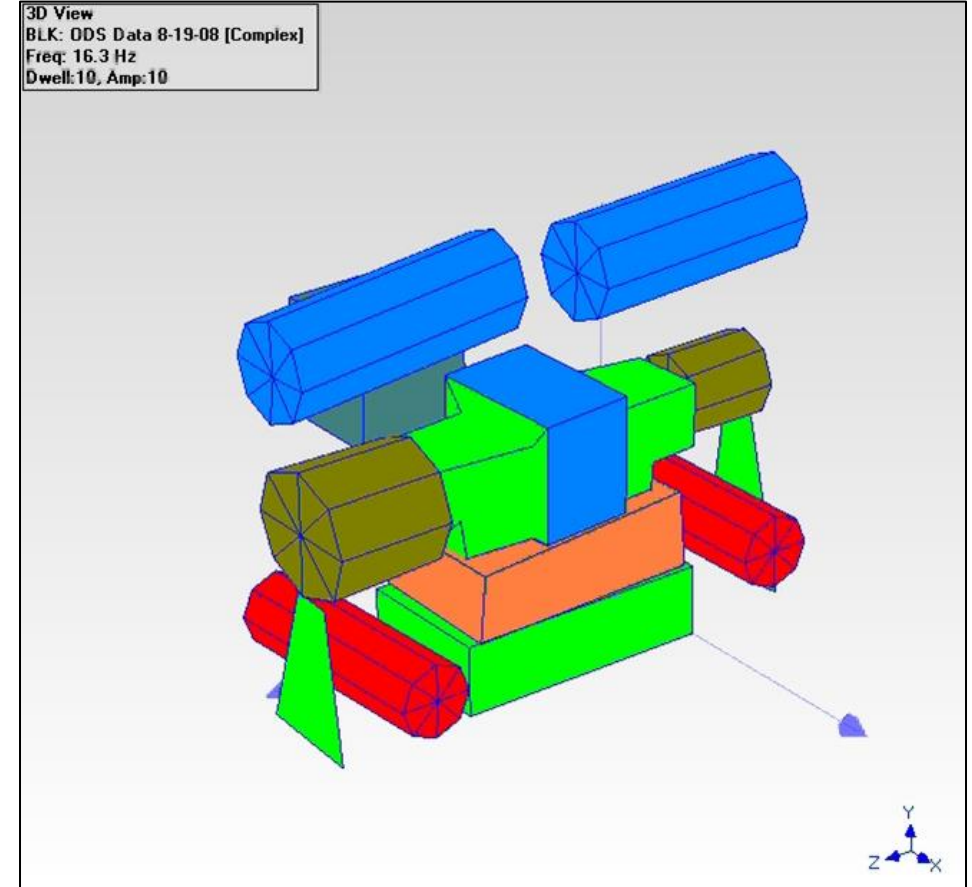
# Vibration Analysis

- Visualize single point accelerometer output with Time Waveforms and FFT Spectrums
- Visualize multiple point parameter sets over time – trends
- Low cost per point



# Operation Deflection Shapes (ODS)

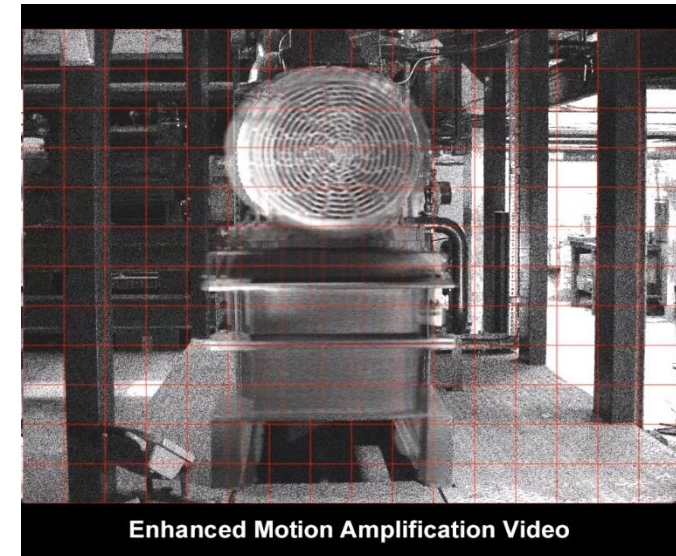
- Visualize a larger structure to understand its response to vibration.
- High cost per point
- Time consuming





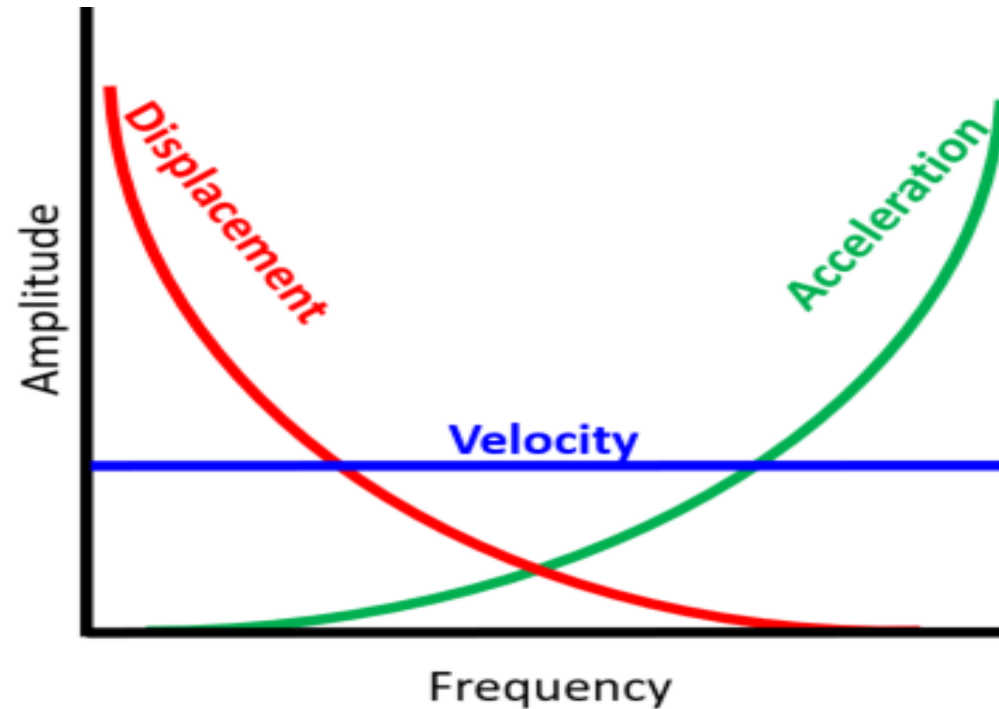
# Motion Amplification

- Video visualization of vibration measured using camera pixels.
- Measurement points 'amplified' – vibration becomes visual in playback
- Non-contact
- Low cost per point
- Very fast



# Motion Amplification Technology Overview

## Vibration Amplitude Units



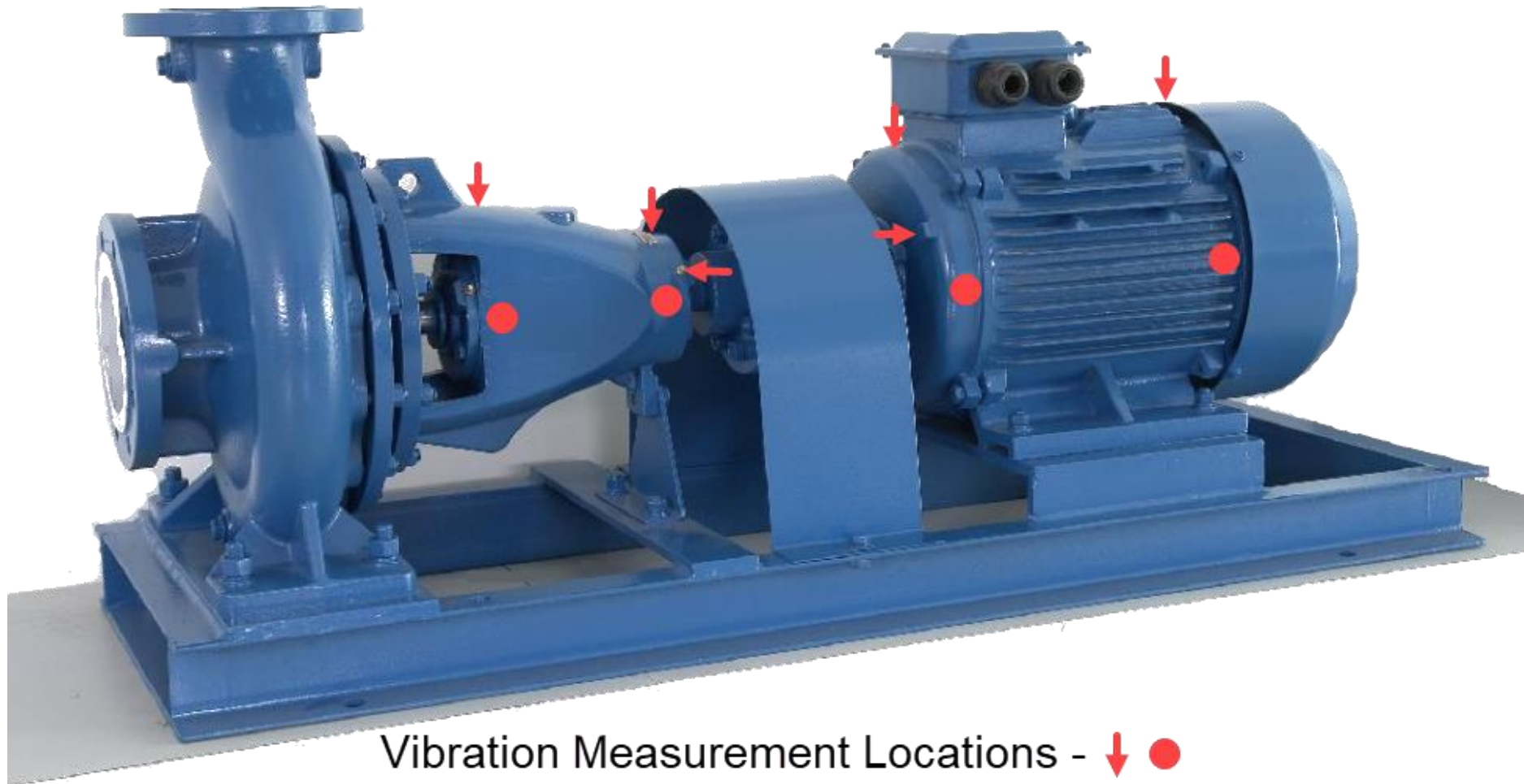
Motion Amplification:  
**Displacement in Microns**

Traditional Vibration  
Analysis:  
**Acceleration in G's**



# Traditional Acquisition

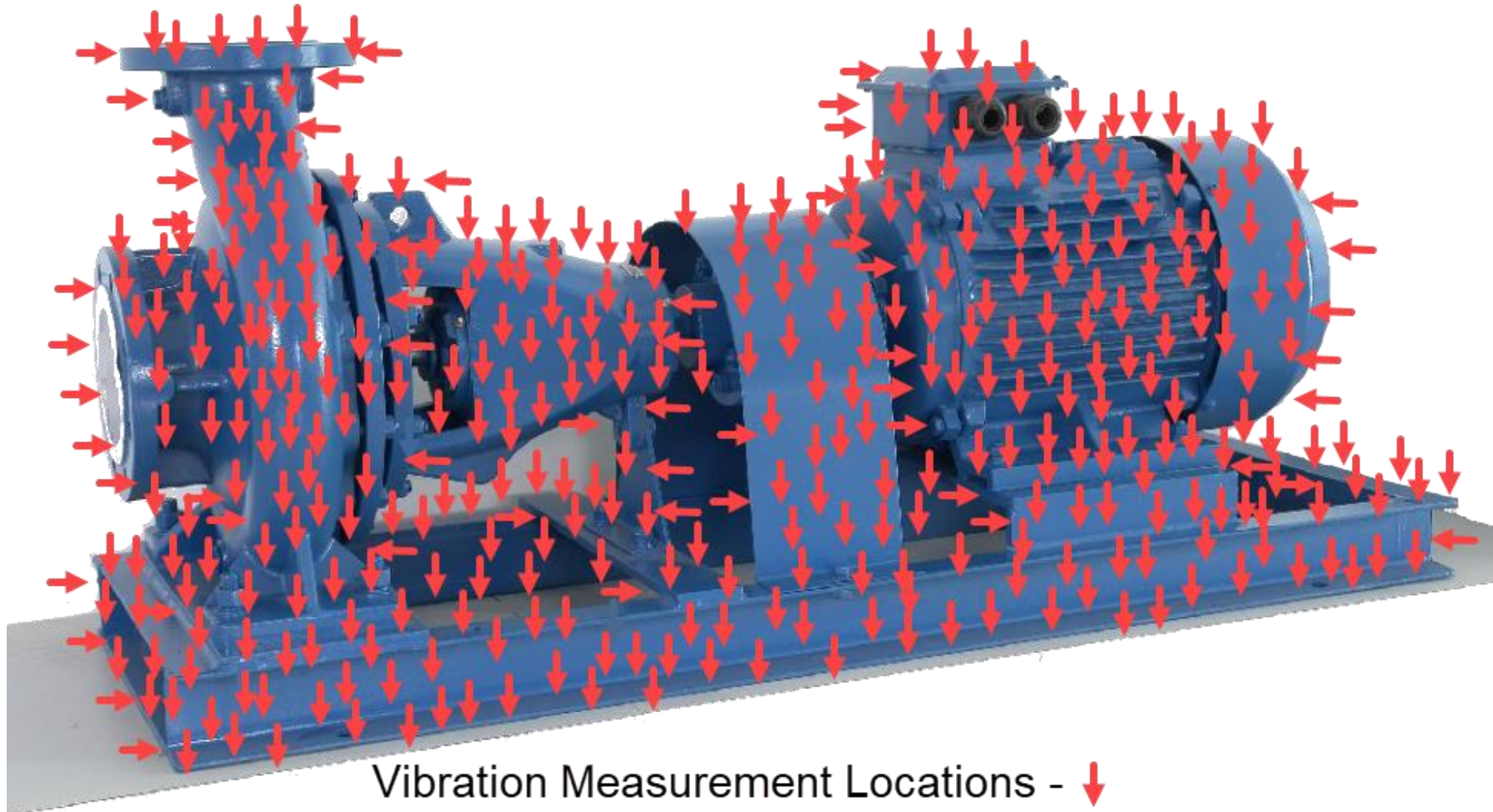
Typical Acquisition Process, Traditional



Vibration Measurement Locations - ↓ ●

# Motion Amplification Acquisition

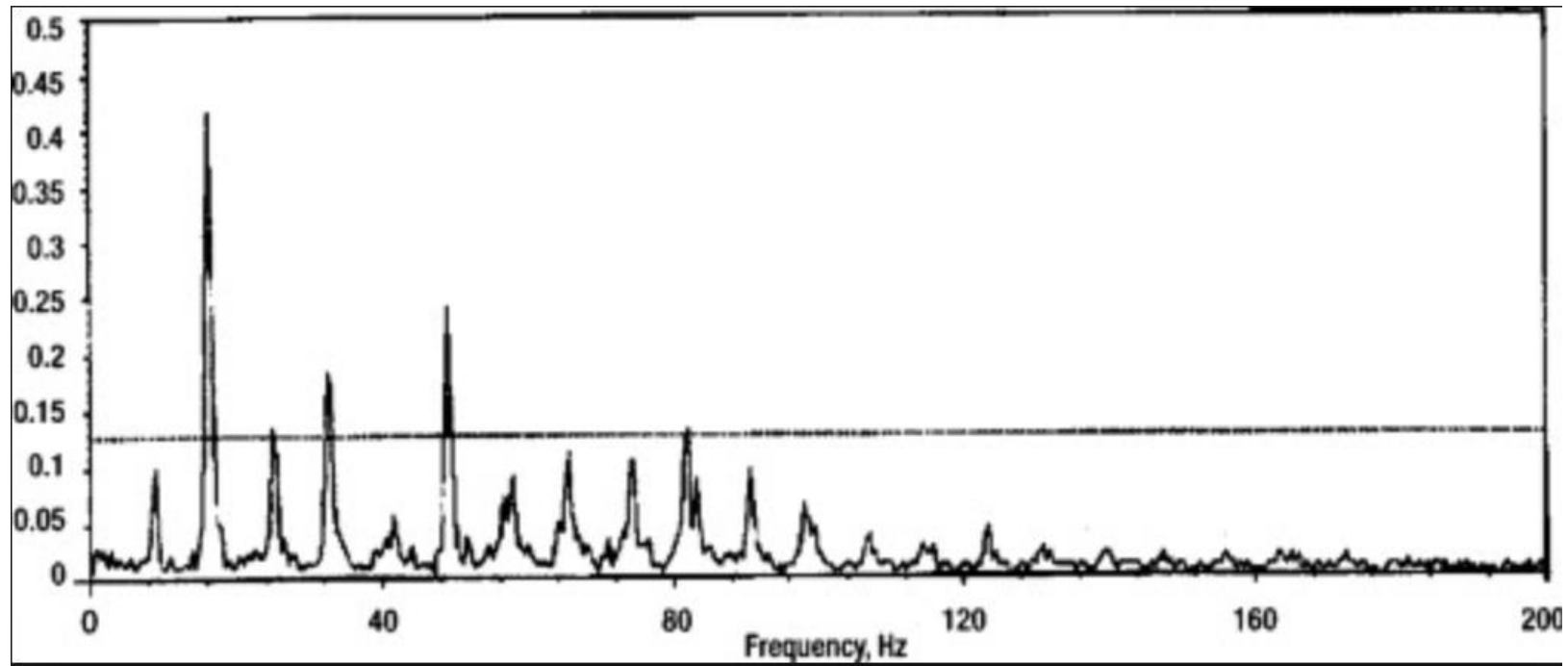
Typical Acquisition Process, MA (Visual)



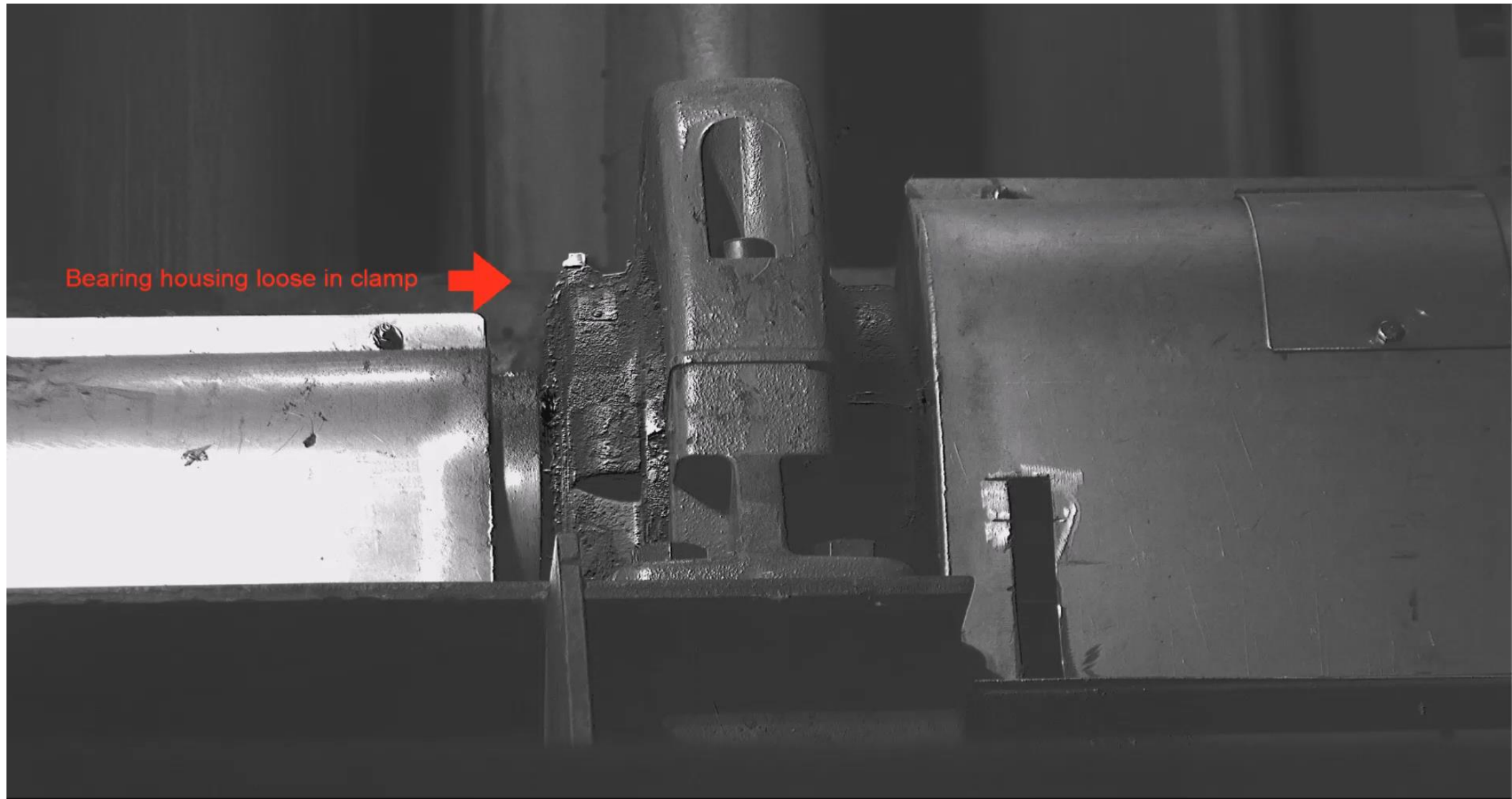


# Traditional vibration analysis data/report

## FFT Spectrum



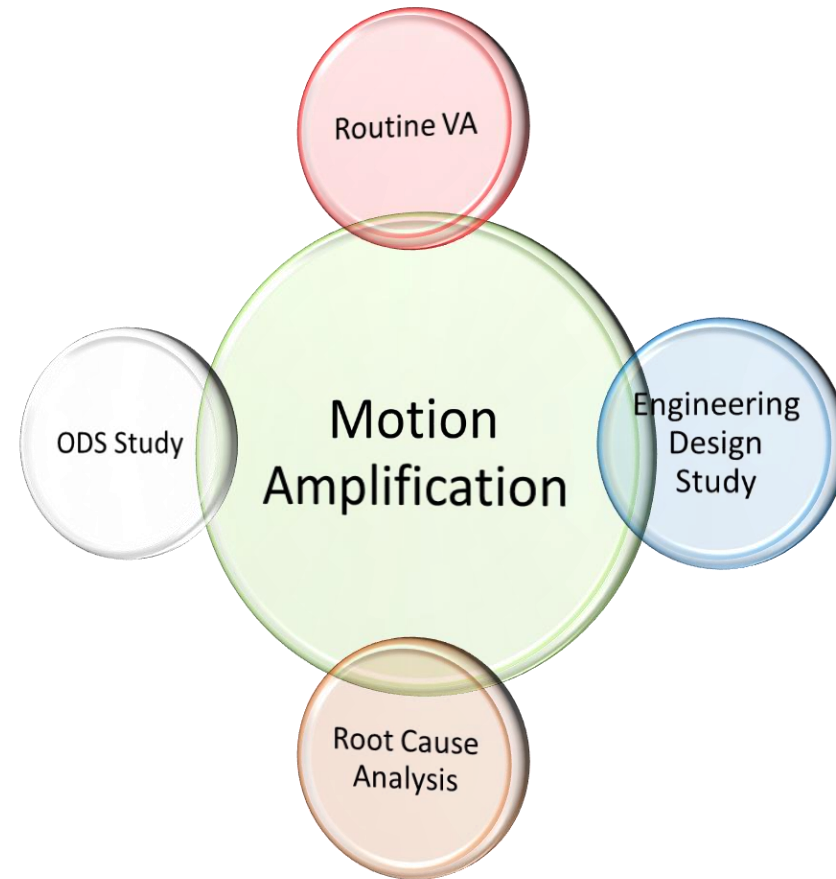
## Motion Amplification customer report:





# A new tool in the box...

- **‘Game Changer’:**
- Quick, simple to use technology
- Non - contact
- Enhances routine inspections, brings root causes to fore, quickly
- Cuts out lengthy process of ODS making it more accessible on assets not previously considered.
- Wide scope of use: Rotating Assets, Structures, Process and more

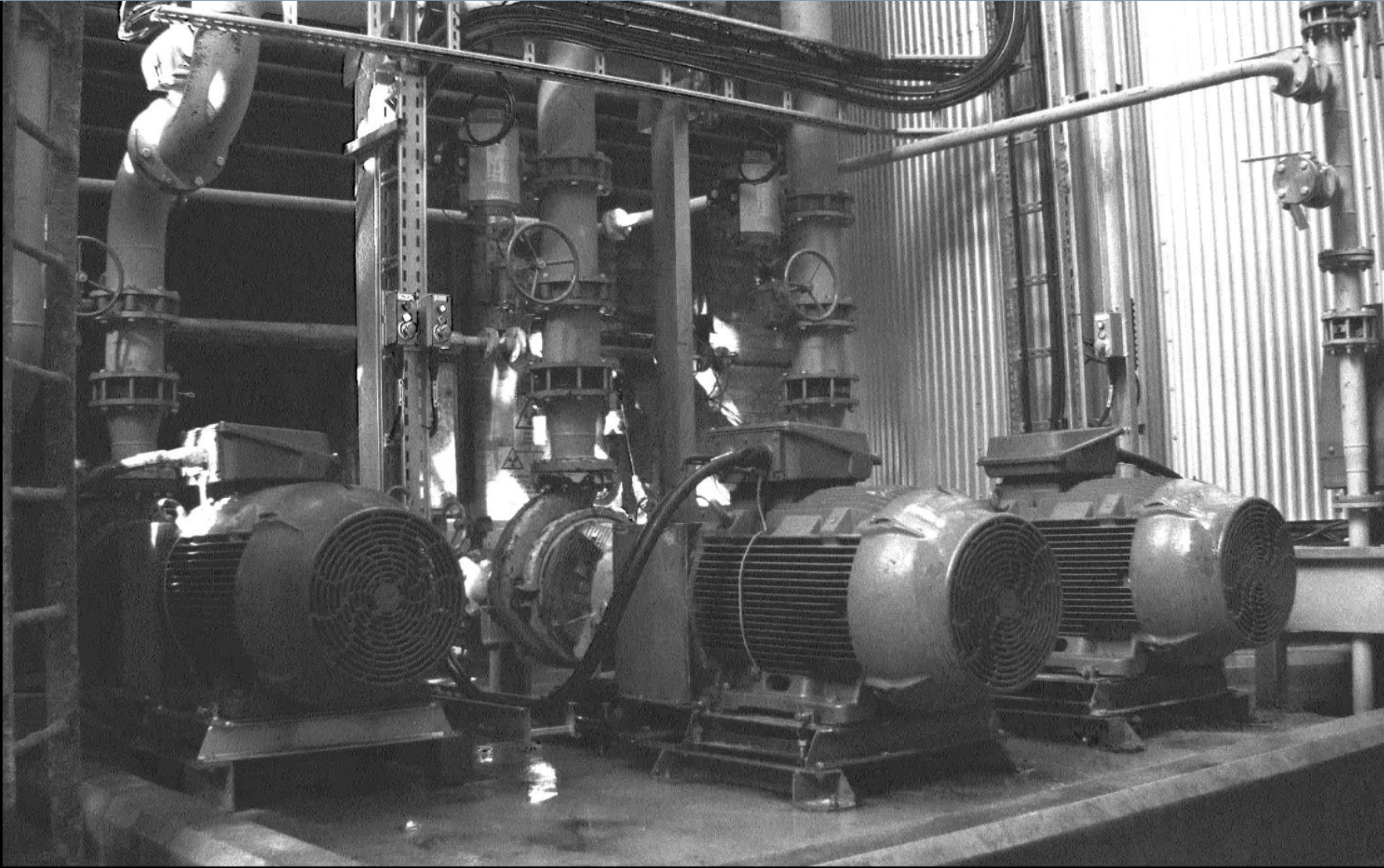


# Motion Amplification

## **ROTATING EQUIPMENT**

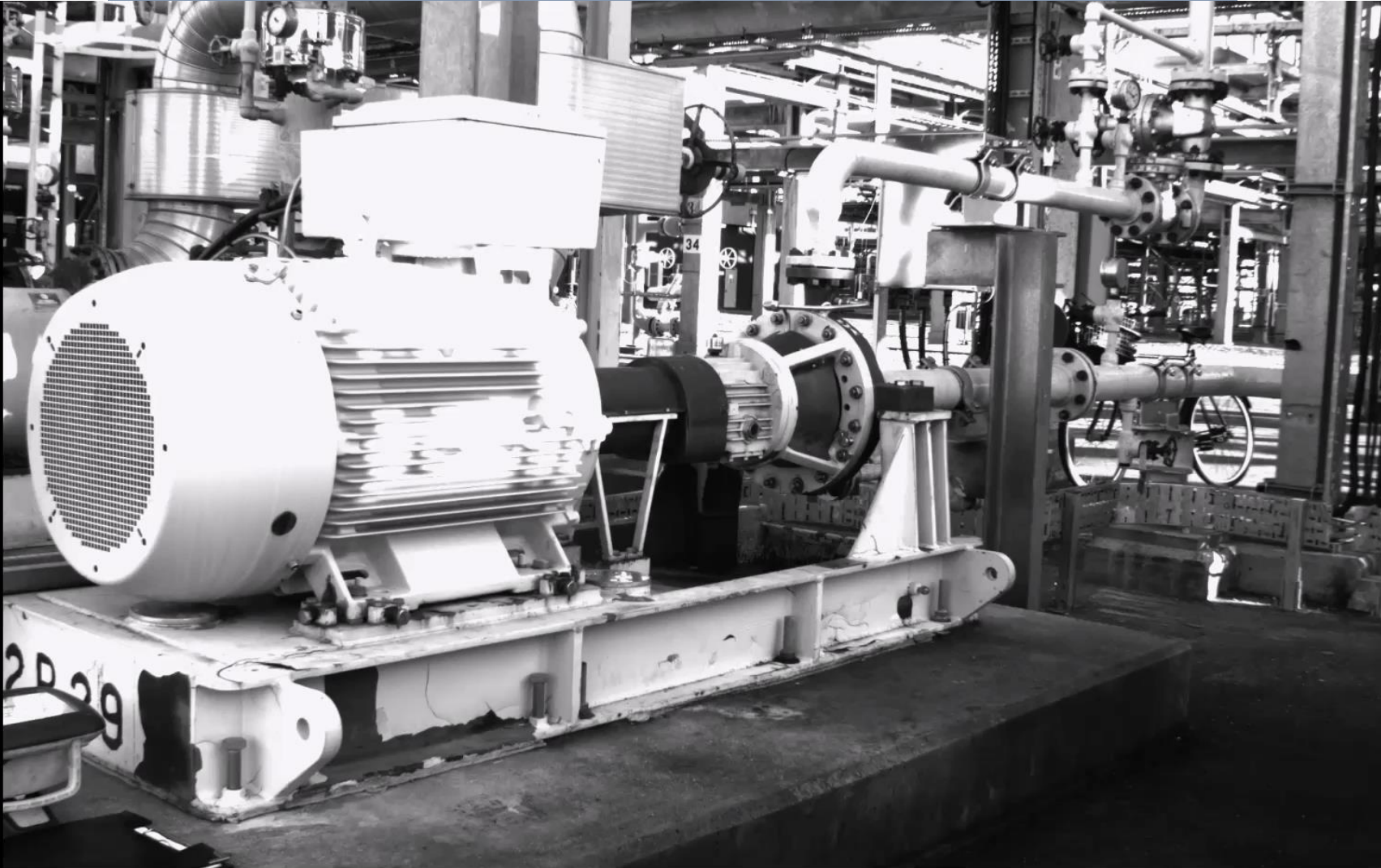


# Commissioning– Visualizing Vibration



BEFORE REPAIR - Motion Amplified Footage  
1xRPM - 20mm/sec, seal and bearing defects within 3 months

# Critical Pump – Resonance



Standard Footage



# Problem Solving: Repeat Failures



# Critical Pump – Resonance



Motion Amplification - Filtered 880 RPM

# Motion Amplification

**PIPING**



# Steam Turbine Pipework: Before / After

## **Motion Amplification Camera RDI Technologies IRIS M System**

Used to visualize the pipework vibration problem and accurately measure vibration levels.

Camera settings:  
100 FPS  
Footage filtered to 25Hz  
(Generator excitation frequency)

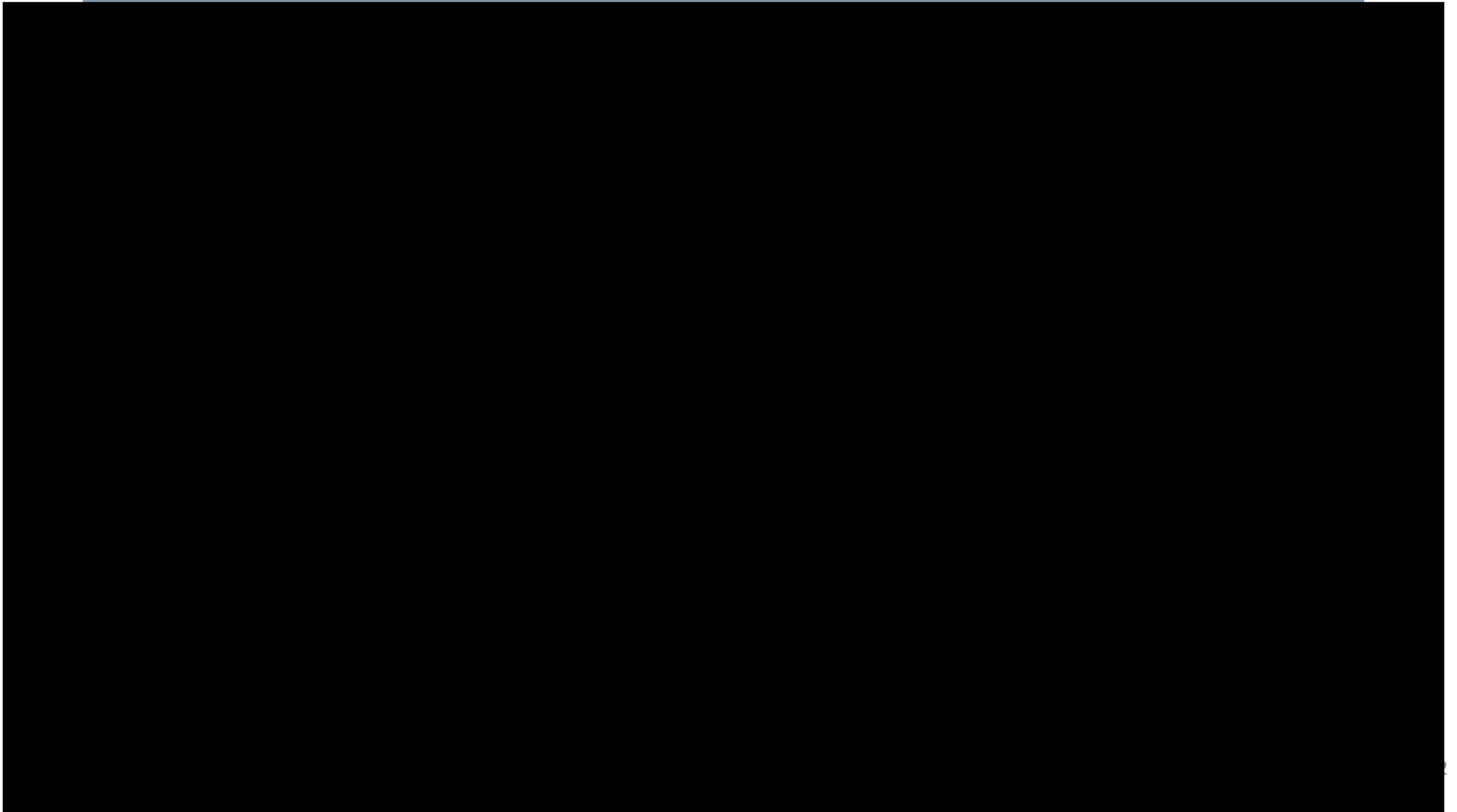
Assessment Criteria  
Energy Institute Guidelines for  
Piping vibration



# Motion Amplification

## **MA ON ROTATING COMPONENTS**

# Fan Blade Cracking Issue





# Motion Amplification

## **TRANSIENT EVENTS**

# Fan Vibration – Transient MA Online

## IRIS CM - FD Fan No.1

### Problem

Intermittent vibration on the fan casing and inlet ductwork.  
Previous instances of impellor contacting the casing.

### Set-Up

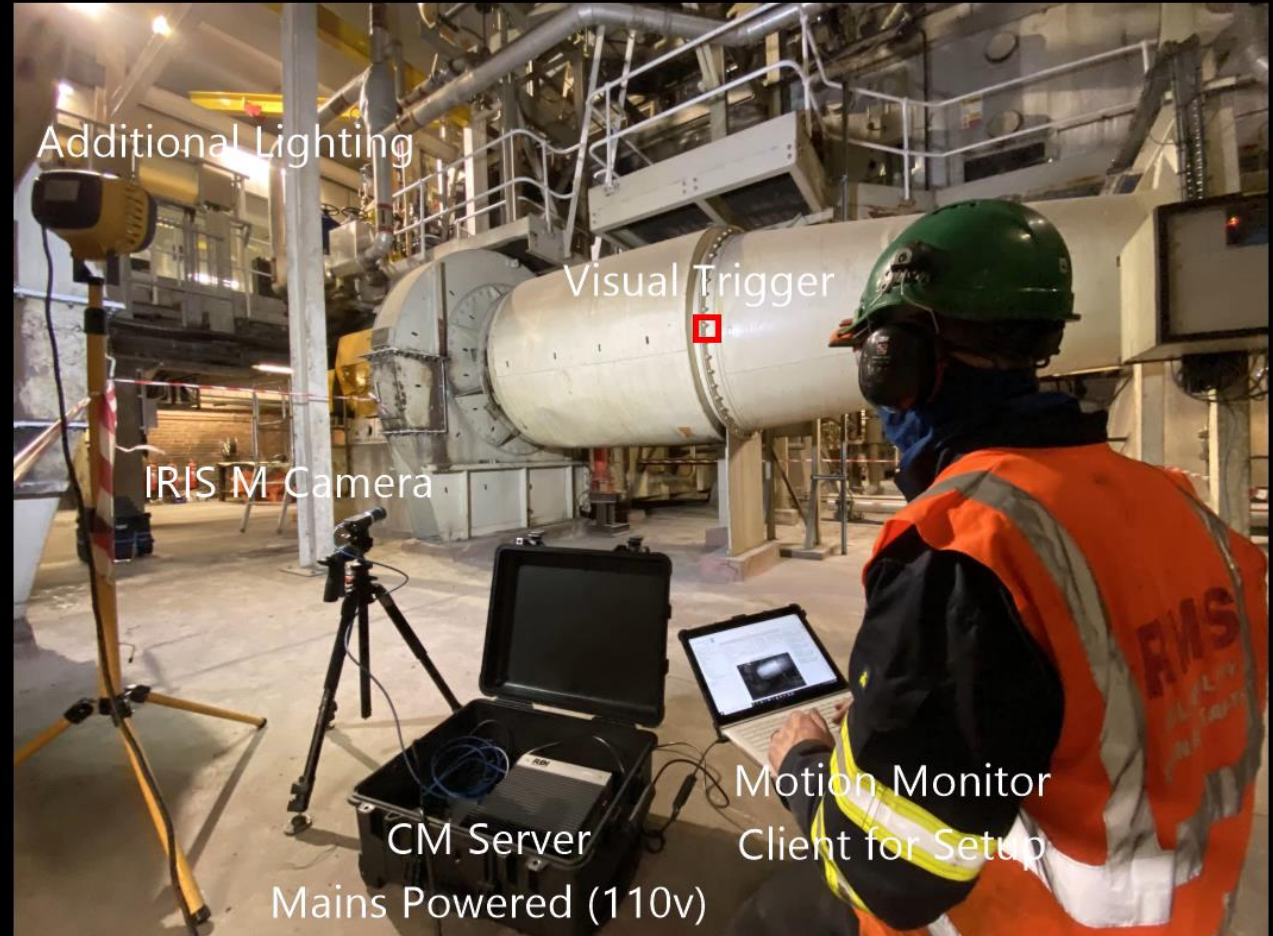
IRIS CM setup to continuously monitor the fan duct work vibration.  
Visual trigger setup to initiate data storage when motion > 1500 microns X axis.

*Event triggering options:*

*Visual, 4-20mA, Accelerometer,*

*IEPE (E.g. Impact Hammer, pressure sensor)*

*Tachometer, Time Based Triggers, Manual*



# Motion Amplification

## **STRUCTURES**



# Structural Issue / Washing Plant



Standard Footage

# Motion Amplification

## **QUESTIONS**

# Motion Amplification

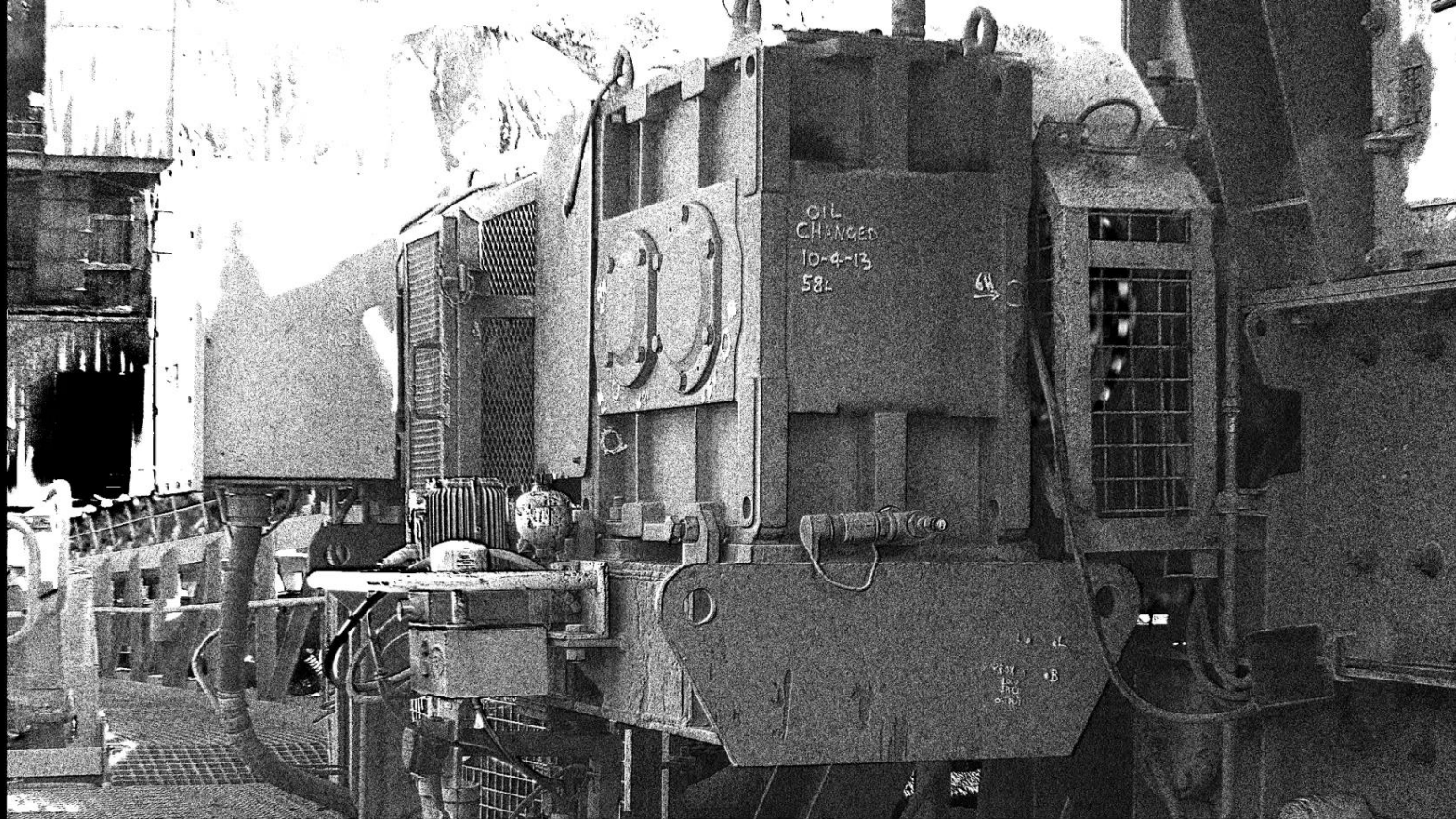
## **FREQUENCY FILTERING**



# Frequency Filtering



# Frequency Based Filtering – No Filter





# Frequency Based Filtering – 2 Hz Band Pass





# Frequency Based Filtering – 25 Hz Band Pass



# Frequency Based Filtering – 4 Hz Band Pass

