RDI TECHNOLOGIES

RMS RELIABILITY MAINTENANCE SOLUTIONS

SEEING IS BELIEVING

Modal Amplified

Accelerating time to insight

We are RDI Technologies

RDI Technologies® is the global market leader in Motion Amplification® solutions. Since 2015, we have supported government and corporate customers with camera-based vibration analysis solutions, helping them optimize reliability and asset performance, while reducing risk and cost.

- **INNOVATION:** Inventor of Motion Amplification® technology; pioneer of the camera as the industrial sensor
- **EXPERIENCE:** 200+ years vibration solutions and industry experience
- **SOLUTIONS:** Non-contact, camera-based Monitoring, Measurement, Robotic and High-speed camera solutions
- **INVESTMENTS**: Acquired Fasted Imaging, Inc., 2022

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Modal Amplified™

Accelerating time to insight

Bringing the power of **Motion Amplification® to Modal Testing**.

MODAL TESTING IS A TIME-INTENSIVE, COMPLEX PROCESS REQUIRING RE-WORK AND A HIGH LEVEL OF EXPERTISE.

When designing, prototyping, certifying or qualifying structures and materials, you need to find the inherent natural vibration properties of a structure to understand/analyze the structural dynamics and limits of a structure when subject to different forces and loading. This allows you to predict and identify issues or weakness in the design before it goes to market.

MODAL AMPLIFIED CHANGES THE GAME WITH MOTION AMPLIFICATION TECHNOLOGY

Modal Amplified allows you to get Modal results in a matter of minutes all the way from capture to visualizing the modes shapes, complete with dozens, even hundreds of sensors measured across the structure.

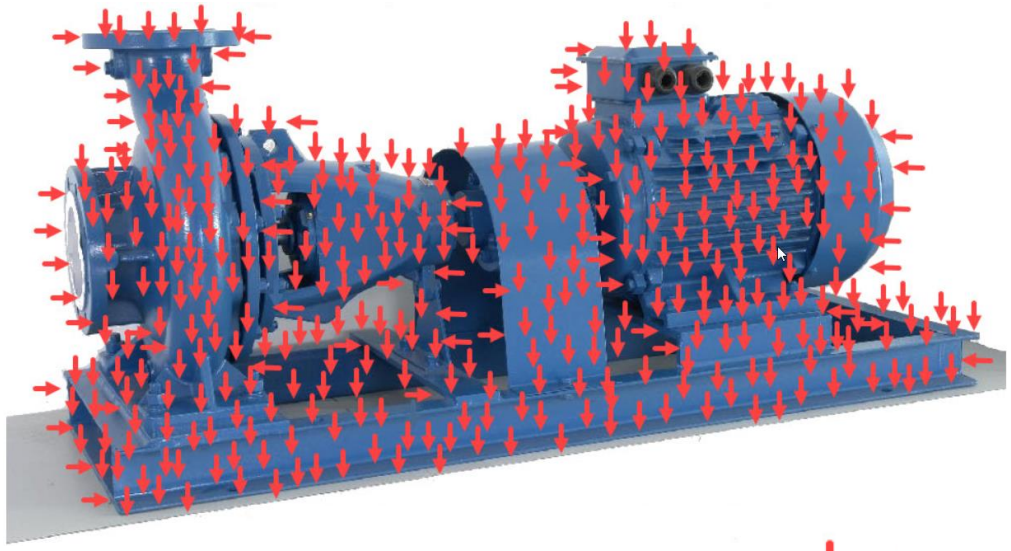
Modal Amplified™

Uses Motion Amplification technology - See what you've been missing - Measure movement NOT VISIBLE to the human eye

Modal Amplified is a camera-based solution that uses Motion Amplification technology to detect subtle motion and make it visible to the naked eye in order to understand the interrelationships and causes creating the motion.

THIS MEANS...

- Over 2M pixels become a virtual motion sensor
- You can cover 100% of an asset, large, small and inaccessible. Every point is measured and quantified. No guessing between points
- Results are immediate and easy to see in a standard video



Vibration Measurement Locations

Motion Amplification sees it all; 2.5m data points

- Non-contact measure
- Simultaneous data
- 360° full field of view vibration

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Modal Amplified™

The power of **Motion Amplification in Modal Testing**.

Get Modal results in a matter of minutes all the way from capture to visualizing the modes shapes

- Leverage simultaneous measurement of the force input with the response measured directly from the camera.
- Immediately visualize the resulting modes shapes all the way from capture to visualizing the modes shapes, complete with dozens, even hundreds of sensors measured across the structure.
- Place dozens, even hundreds of sensors across the structure through virtual regions of interests.

GET TO YOUR DATA FASTER

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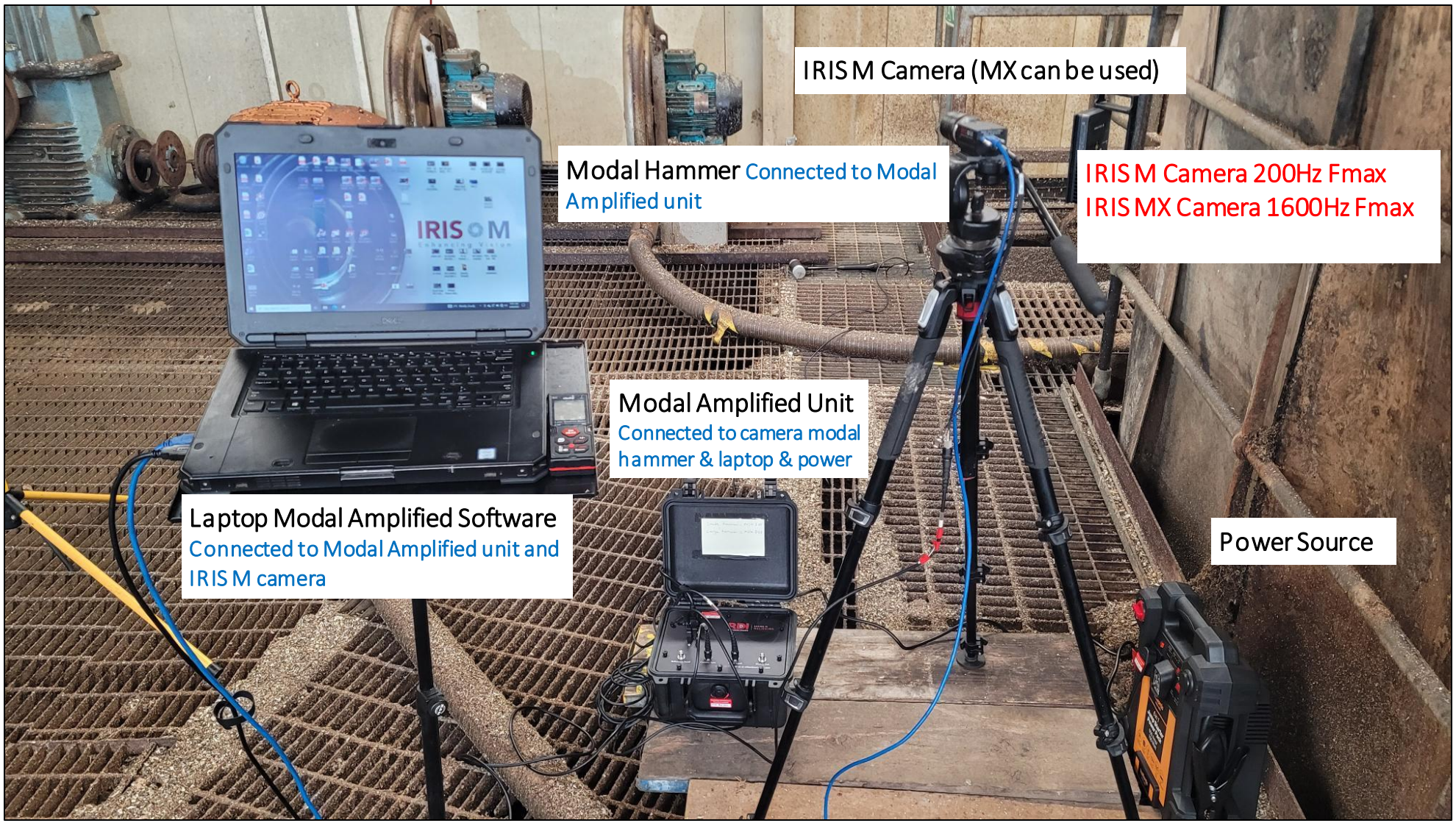

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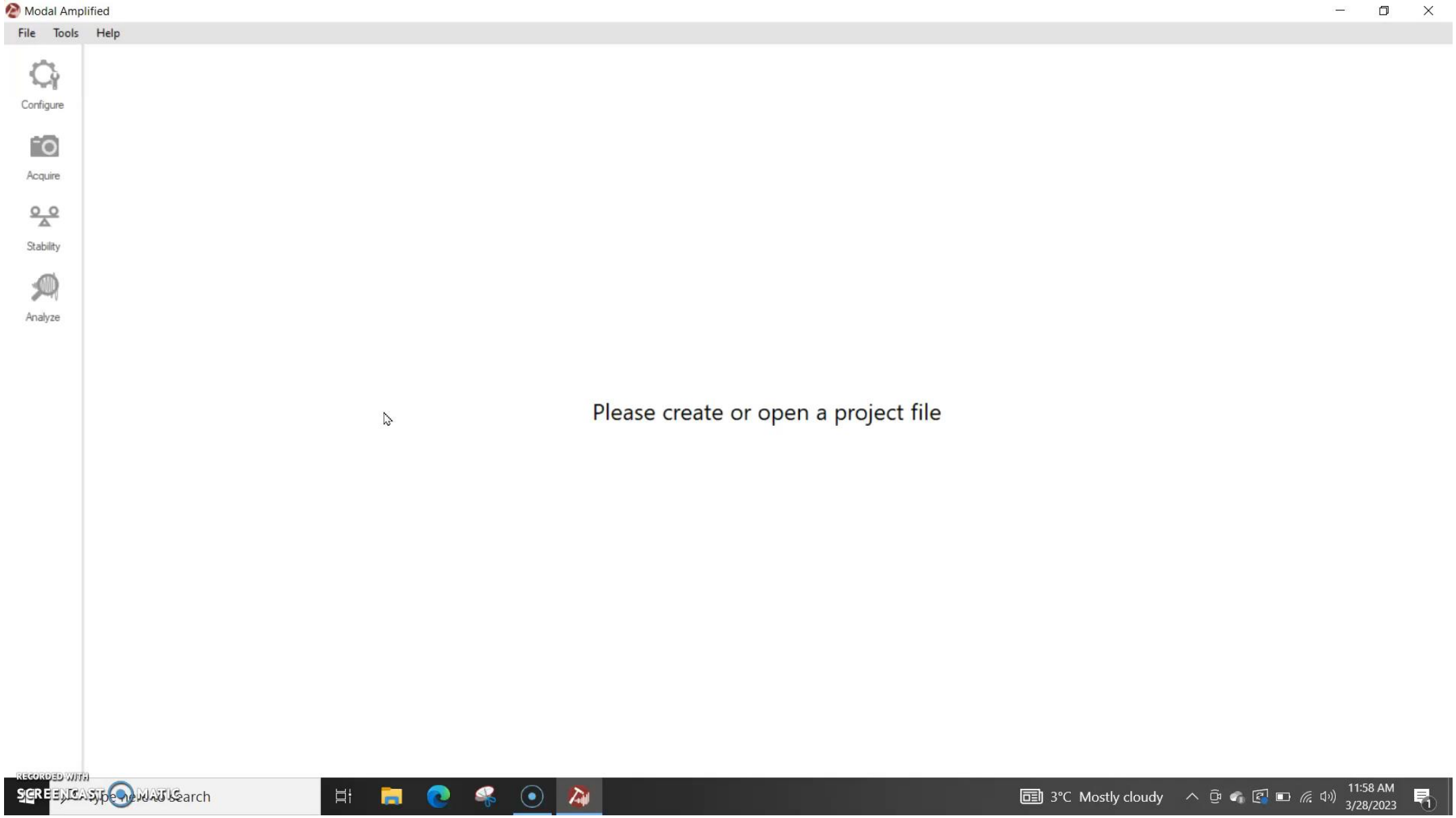

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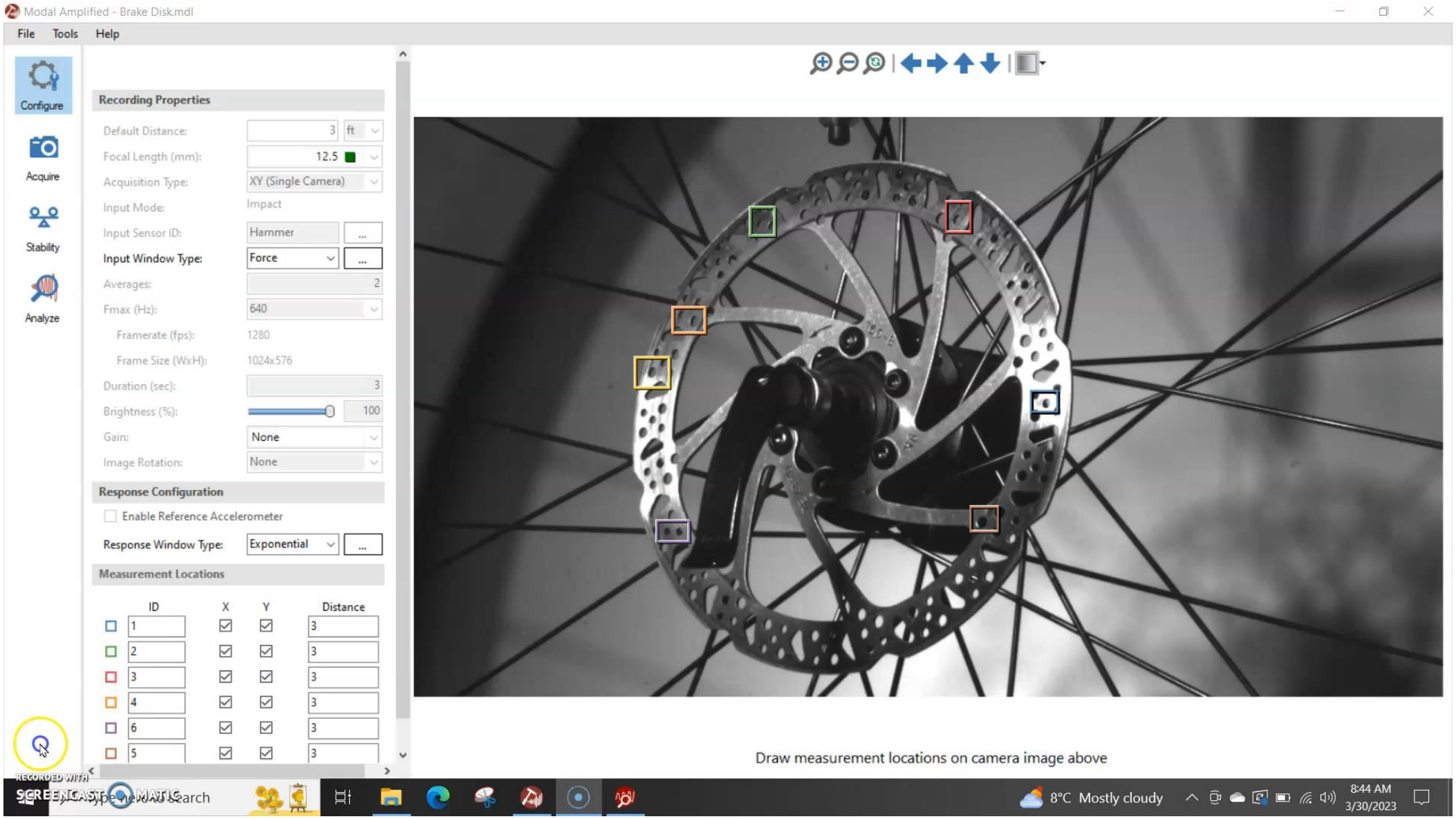

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Why Use Motion Amplification® for Modal Testing?

MODELING	VS	MOTION AMPLIFICATION®
Animation, not real recorded images.		Framing camera on subject instantly creates a real test model.
Polygons determined by number of measurement points collected, data may be interpolated for more density.		Measurement points equals number of pixels in frame (Full HD 2.3M points).
Complex test subjects require complex modeling skillset. Difficult to capture aftermarket component characteristics.		Collect data on objects too small or out of reach of physical sensors; captures real-life aftermarket structure, eliminating need to capture non-OEM parts.
Various levels of setup are required including sensor mapping, placement, fixation, wiring; DAQ setup and programming; Collect data.		Camera and lens selection based on field of view (non-contact measurement).
May need to export data into visualization software (specifically vibration data collectors).		Review findings on same computer, software suite.

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Why change what works?

Everyday challenges of Modal Testing

TIME INTENSIVE PRE-WORK/POST MODELING

Projects involve a lot of pre-work, sketches, notetaking, and exploratory impacts (finding a single driving point that excites all modes of interest).

- 4-6 averages per testing
- Check for good coherence (> 80%)
- Animating, ODS data requires building models of the machine, specific knowledge.

DIFFICULT TO RECORD SIMULTANEOUSLY

The analyzer must record the impact and response simultaneously and in its entirety for accurate data.

- With windowing turned off, a response that continues to "ring" and not go to zero will have leakage and thus a bad result. Triggering helps ensure impacts include a pre-trigger dead spot and the response the same.

MISLEADING DATA TIME CONSUMING

Number of data points (or lack thereof) can create misleading data. Not uncommon to find mode shapes that seem to be inaccurate – they may just be very low amplitude Fn's (heavily damped) or otherwise false signals that can only be identified as false by viewing coherence, phase or the corresponding mode shape.

EXTERNAL FACTORS

External vibration or noise can corrupt data (machine turns on unexpectantly).

UNIQUE HAMMERS REQUIRED TO CAPTURE DIFFERENT FREQUENCIES

- Soft tip sets input energy in lower frequency range
- Hard tip, high frequency range
- Trying to only excite frequencies of interest
- Hammer size just for force

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Modal Amplified™

Adding Motion Amplification to Modal Testing and Analysis creates significantly improved changes to workflow for users

- With Modal Amplified, you can **collect simultaneous data** from an input device used to excite a structure like an impact hammer, modal shaker, and operational methods to not only measure the response but also ***instantly visualize*** the response.
- Supports SIMO, allowing you to perform measurement with a single excitation and any number of response channels.
- Draw regions of interest directly into the solution **without the need for animating structures.** Perform analysis within the software or export your data.

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Modal Amplified™

Main Features/Value

- Leverages simultaneous measurement of the force input with the response measured directly from the camera
- See your structure respond real world vs model
- Test on small/large components
- Capture and analyze findings in one platform
- Automatically creates master lists of mode shapes
- Eliminates need to recapture data
- Non-contact; Test structure never altered or destroyed- Fast, easy set-up
- View data in platform, or export easily

Automatically calculates mode shape measurements and filters video to the vibration frequencies that are of interest, instantly capturing mode shapes, natural frequency, associated dampening and movement the human eye and sensors cannot always detect, all within the software.

Modal Amplified™

Supports a number of critical measurement techniques/tests

EMA

Experimental Modal Analysis

Modal Amplified eliminates the need for dozens of sensors, protects against incorrectly placed sensors, and allows for experimental testing

VCT

Vibration Control Testing

Modal Amplified easily measures complicated event simulations like aircraft take-off/landing, rocket launch, and transportation over rough terrain. These tests screen for manufacturing defects and premature component failure.

ODS

Operating Deflection Shapes

Easily perform dynamic analysis and see how a machine or a structure moves within its operational conditions.

SIMO

Single Input Multiple Output

Modal Amplified is designed as a SIMO system, allowing you to perform measurement with a single excitation and virtually unlimited response channels.

OMA

Operational Modal Analysis

Modal Amplified is uniquely powerful for OMA as it can easily capture structural dynamics of a system in operation without the need for contact sensors or input force in this response-only technique.

GVT

Ground Vibration Testing

Modal Amplified reduces the need for multiple accelerometers mounted on an aircraft and sub-assembly components. Large sections of the aircraft are captured instantly without the need to model.

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Questions?

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First, what is Modal Testing and Analysis?

Modal Testing and Analysis is the process of finding the inherent natural vibration properties of a structure, primarily to understand/analyze the structural dynamics and limits of a structure when subject to different forces and loading. If the natural vibration states are known, much of the vibration behavior of a structure can be predicted to identify issues or weakness in the design.

A natural vibration state is defined by its mode shape, its natural frequency and the associated damping. Vibration modes of a structure can be either purely simulated, e.g. from Finite Element (FE) Models or can be derived out of physical measurement results by fitting a mathematical model to these results. This latter process is called experimental modal analysis.

Several instruments are typically used to perform Modal Test and Modal Analysis:

- One or more exciters, such as modal shakers or an impact hammer
- Force transducers that acquire the input excitation signals
- Accelerometers that record force
- Non-contact laser vibrometer
- A data acquisition system (DAQ) device to record the test
- A computer with Modal Test and Analysis software to perform calculations, display the results and create reports