



**Agilis Measurement Systems** specializes in developing solutions for measuring and analyzing **High Cycle Fatigue (HCF)** in Turbine Machinery. We deliver Blade Tip Timing technology software, hardware, consulting and customer test support. From Blade Health Monitoring to complete system validation and everything in between, Agilis' powerful software package is capable of handling any testing scenario. Our employees have been in the forefront of the industry since its earliest days and today continue to lead the advancement of the technology. Combined with the industry's most precise, robust hardware, it's easy to see why the Agilis system is the standard for Blade Tip Timing based vibration analysis.



**Providing Accurate and Complete Blade Vibration Analysis**



## What is Blade Tip Timing?

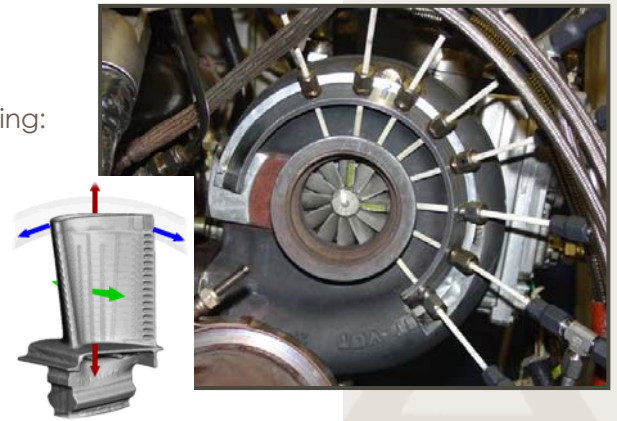
This measurement method is known by many names, including:

Non-Intrusive Stress Measurement Systems (NSMS),

Arrival Time Analysis (ATA),

Light Probes (LP),

and Blade Tip Timing (BTT).



The basic concept behind Blade Tip Timing is the use of case mounted external sensors to measure blade arrival times. The times are converted into deflections and then into vibratory responses. Tip Timing utilizes eddy current, capacitive, and optical probes built in-house and customized to every application. They can be configured to measure any component of static and dynamic deflections in the axial, tangential, and/or radial directions. A full vibratory analysis covers both synchronous and non-synchronous response characteristics and includes values for amplitude, frequency, nodal diameter, phase, fit quality, and much more. This technology has become a vital tool in studying and managing high cycle fatigue in rotating machinery and Agilis prides itself as the leader in the industry.

## Why Use Agilis Measurement Systems?



We offer an optical system utilizing fiber optics and lasers which allows us to resolve vibrations many times higher in frequency and lower in amplitude than with a field type sensor.

Our direct to digital and multiple data point approach to data acquisition provides exceptional signal to noise performance as well as infinite signal processing flexibility.

We are a group of scientists, engineers, software developers and technicians solely dedicated to the development of Tip Timing technology.

Our diverse testing experiences directly feed the development of our tools and software. Thus, we leverage the lessons learned in one industry to the others.

We utilize off-the-shelf components in our hardware wherever possible.

We are recognized as the leaders in the industry and lead the way in technology development.

We are entirely dedicated to the success of our customers with 24-hour engineering support.

# Turn-Key Tip Timing

From Hardware and Software sales to complete test support, AMS supplies a full range of products and services specialized to meet our customer's needs.

## Test Support

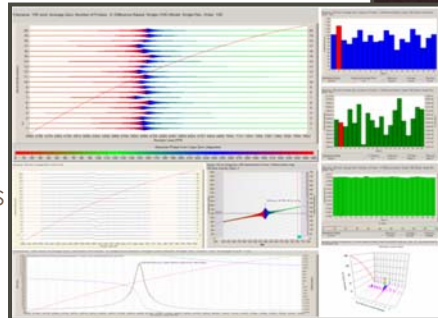
- International test support
  - Post processing of data
  - Remote test support via internet or satellite uplink
  - Complete system sales
  - System rentals
  - Training
  - 24hr engineer technical support
- 
- Tools
  - Software (Test Setup, Realtime and Post-Processing)
  - Probe support equipment (Optical Probes)
  - Signal conditioners (Eddy. and Cap. Probes)
  - Data acquisition system



Console Based System

## Blade Health Monitoring

- Automated triggering
- Automated data acquisition
- Over-limit warnings
- Batch file analysis
- HCF characteristic baseline comparisons
- System self-health monitoring



Presentation generation using AATAS

# Applications

All types of turbo-machinery are investigated with our system: Gas Turbines for Aero and Power generation, Turbo Pumps, Turbochargers, and Steam Turbines. Our sensors and probes operate in ambient, turbine-like heat and cryogenic environments.



Turbo Machinery

Aero Engine



Power Generation



# Hardware

## Optical Probes

### Spot Probes

- Lensed probes for use in applications with large optical paths (0.25" to 2.5") while maintaining an operating range of 1"
- Un-lensed probes utilized for near-blade applications ( $\leq 0.25$ " )
- High temperature (2000°F+) turbine and cryogenic versions

### Line probes

- Dual lens short line length applications

### V probes

- Measurements along the optical axis of the probe
- Tip Clearance measurement

The mechanical and optical designs are optimized for each installation.

## Eddy Current Probes

- Engine health monitoring and adverse environment applications exceeding 1000F un-cooled.

## Capacitance Probes

- Tip clearance measurement
- Engine health monitoring and adverse environment applications

## Probe Support Equipment

### Laser Illuminator

- 8 Channel
- ETL/CE-Mark certified
- High power to handle all applications
- Extreme environment enclosure
- Ethernet based controls
- Safety remote interlock

### Optical Detector

- 8 channel
- ETL/CE-Mark certified
- Very high signal to noise
- Optical filter capable for high temperature applications
- Extreme environment enclosure

## Data Acquisition System

- Direct Digitized Multiple Data Point Approach
- Scalable through multi-system Ethernet based network
- Off-the-Shelf components used
- No 1/rev needed
- Laptop , Console, and Portable based systems



Lensed Spot Probe



Un-lensed Spot Probe & Head



Optical Detector Box



Laser Illuminator Box



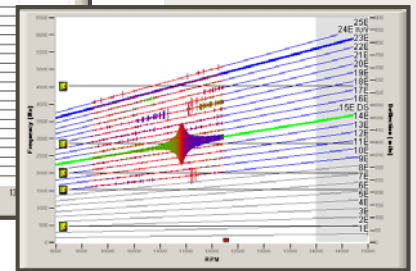
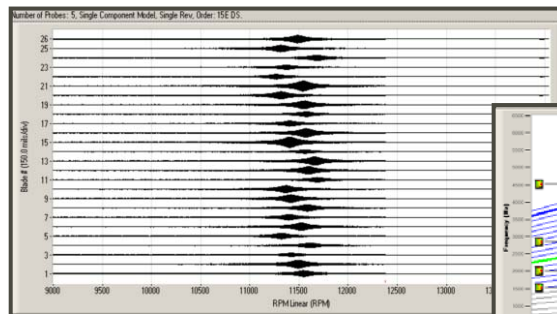
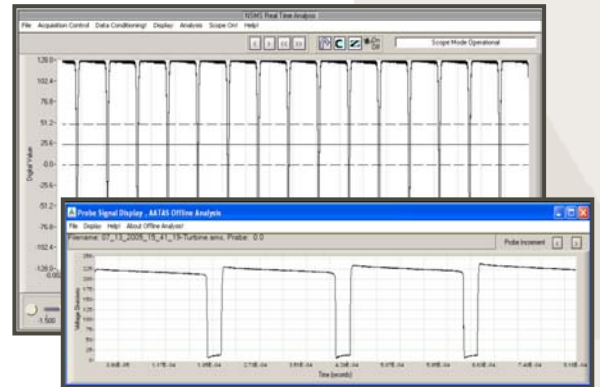
Portable DAQ

# Software

Agilis Measurement Systems software consists of a complete suite of tools for performing high cycle fatigue vibration testing and analysis in rotating turbo machinery. AMS also provides software for permanent blade health monitoring of turbo machinery. Our software tools are applicable for any sized hardware!

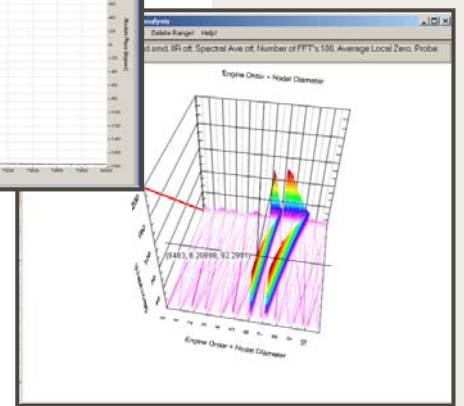
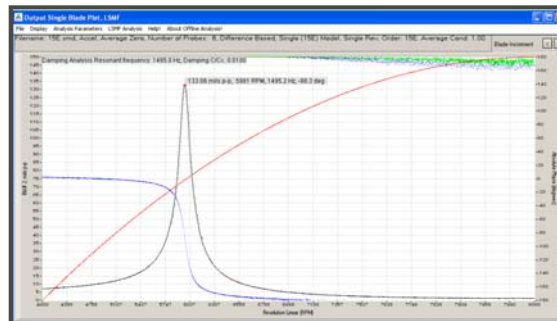
## Real-time

- **Integral Response analysis:** Amplitude, Frequency, Nodal Diameter, Simultaneous response decoupling
- **Non-integral Response analysis:** Amplitude, Frequency, Nodal Diameter
- **Static deflection analysis:** Un-twist, Axial position, etc.
- Tip clearance
- Remote control and monitoring
- Automated laser and trigger setup
- Automated data acquisition
- **Health Monitoring**
- Modal frequency shifts
- Static blade position
- Over limit warnings
- Baseline comparison
- System self-health



## Offline

- Post processing
- Integral analysis
- **Simultaneous Response** decoupling
- **Multiple Measurement Point** analysis
- Nodal diameter decomposition
- Damping calculation
- Non-integral analysis, Amplitude, Frequency, ND
- Stress conversion
- Single or multi-nodal diameter
- Batch file analysis

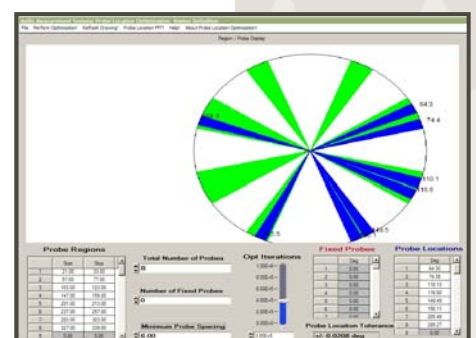


## Probe Location Optimization

Determine the optimum circumferential probe locations. The optimization is based on the expected resonant order responses in the hardware.

## Data Simulator

The data simulation software is useful for training, pre-test preparation and software validation. The numerical integration of the coupled system can be used to study mistuning effects in response to non-sinusoidal forcing functions.



## Contact details

Visit our website at [www.agilismeasurementsystems.com](http://www.agilismeasurementsystems.com) for additional technology explanation and a free software trial.



The screenshot shows the Agilis Measurement Systems website homepage. At the top, there is a navigation menu with links for Home, Our Company, NSMS, AATAS Software, and Contact Us. The main content area features a large image of a turbine engine with the text "Providing accurate and complete blade vibration analysis". Below this, there is a "Welcome to Agilis Measurement Systems" section with a brief description of the company's services and a link to "Learn more about Agilis Measurement Systems". To the left, there is a "Quick Reference" sidebar with links to various software components and services. At the bottom, there is a footer with a copyright notice for 2007.

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