

Using Voyager OMA Intelligence and Observer Automation for continuous structural behavior assessment**ABSTRACT**

Voyager OMA Intelligence is an advanced module for automated Operational Modal Analysis in permanent Structural Health Monitoring systems. It connects Voyager's acquisition, storage, and web interface with Observer's OMA, signal-processing, verification, 3D visualization, and reporting capabilities. This technical note describes the workflow, architecture, outputs, and engineering use cases of the module.

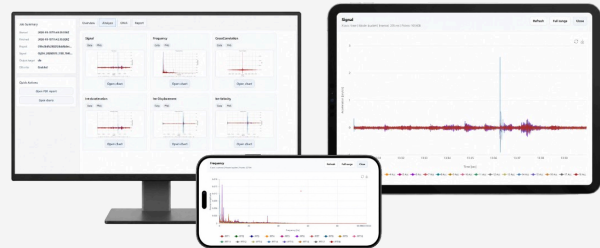
PURPOSE

The purpose of Voyager OMA Intelligence is to automate the process of converting measured vibration data into engineering-level modal information. Instead of manually exporting files and running desktop analysis, the system can periodically or near real-time process monitoring data and store complete OMA results for review.

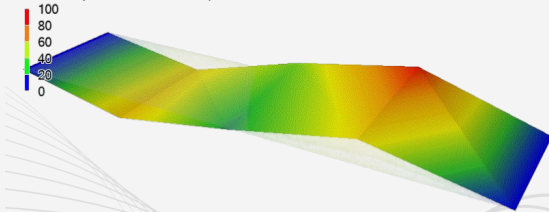
SYSTEM ARCHITECTURE

The module consists of:

- Digitex SHM sensors and acquisition devices
- Voyager acquisition and database system
- Observer Automation command-line execution
- Observer Broker service for communication between Voyager and Observer
- OMA result storage in the local database
- Voyager web interface for visualization, review, and download

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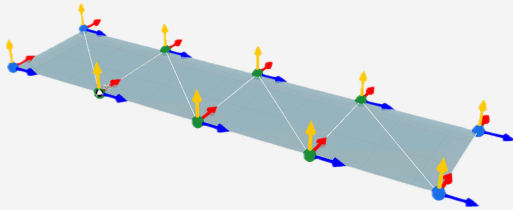
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0**ANALYSIS WORKFLOW**

- Voyager collects and stores live structural data.
- A configured analysis job selects the required time window.
- Voyager sends the job to Observer Broker.
- Observer Automation runs the configured analysis.
- Results are exported as charts, reports, metadata, animations, and database entries.
- Voyager presents the results to authorized users.
- Optional triggers compare new results with baseline modal behavior.

SYSTEM ARCHITECTURE

The module can provide:

- OMA method results
- Natural frequencies
- Damping ratios
- Mode shapes
- 3D modal animations or visual outputs
- MAC matrices
- OMA verification charts
- OMA information charts
- FFT
- PSD / power spectrum
- Integration outputs
- Correlation outputs
- PNG / GIF previews
- PDF reports
- Historical trend charts



MAC-BASED TRIGGER CONCEPT

A reference modal state is selected, typically from the first validated analysis or a known healthy condition. Each new analysis can be compared against this reference using MAC-based verification. If the difference exceeds the configured threshold, Voyager can register a modal change event.

HISTORICAL MODAL TRACKING

Every analysis can be stored with time, configuration, modal results, charts, and verification outputs. This allows long-term tracking of modal parameters and structural behavior. Engineers can review how frequencies, damping ratios, MAC values, and mode shapes evolve over time.

APPLICATIONS

Voyager OMA Intelligence is suitable for:

- Bridges
- Buildings
- Dams
- Mines
- Towers
- Industrial structures
- Critical infrastructure exposed to traffic, wind, earthquakes, machinery, or operational loads

ENGINEERING VALUE

The module helps engineers and asset owners:

- Reduce manual post-processing
- Maintain a consistent analysis workflow
- Detect significant modal changes
- Review complete historical analysis records
- Support maintenance and inspection decisions
- Provide traceable engineering reports
- Improve the value of permanent SHM systems

RECOMMENDED CONCLUSION

Voyager OMA Intelligence extends SHM from monitoring to interpretation. By combining live data acquisition, automated Observer-grade analysis, MAC-based verification, historical tracking, and secure web access, the module provides a practical path toward continuous structural behavior assessment.

