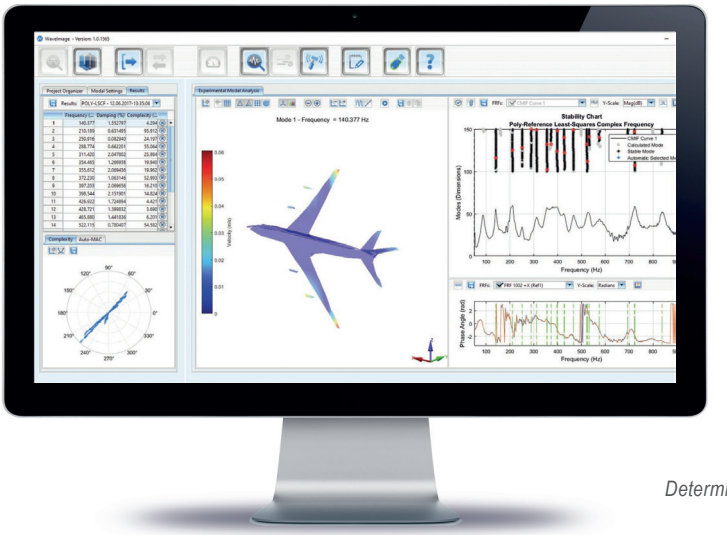
WaveImage

WaveImage MODAL

MEASUREMENT, ANALYSIS AND MONITORING OF STRUCTURE- AND AIR-BORNE SOUND



Software WaveImage
Determining the natural vibration of an airplane

WaveImage Modal is a software that allows determining vibrational properties via known **Experimental (EMA)** and **Operational Modal Analysis (OMA)** methods. The software features a unique combination of modal analysis algorithms.

Furthermore, WaveImage Modal features **Operating Deflection Shapes Analysis (ODS)**, which is used to calculate vibrational properties under actual operating conditions.

To analyse rotational structures, WaveImage Modal offers algorithms for **Order Analysis (OA)**. Order analysis is the analysis of noise or vibrations of rotating structures. In contrast to frequency analysis, the energy content of sound is not plotted against frequency but against the order. The order is a multiple of the speed.

Environmental influences, such as temperature and humidity, are taken into account in the module **Environmental Factor Analysis (EFA)**. This component allows determining modal parameters normalized by environmental influences.

In addition to data-based modal analysis, WaveImage Modal offers a **Finite Element Analysis (FEA)** component for simulating vibrational properties based on structural geometry and material properties. To adjust the FE model to measured data-based modal results (through OMA and EMA) a **Structural Dynamics Modification** component **(SDM)** is also available.

Measurement data for dynamic structure analysis can be recorded by means of acceleration, speed and displacement transducers and processed using WaveImage Modal.

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Version 2.1

WaveImage MONITORING

COMPLETE SOLUTION FOR ONLINE CONDITION MONITORING

Fig. 1: WaveImage Monitoring
Software interface for online condition monitoring / quality control: green = no damage / red = damage

WaveImage Monitoring offers an automated and real-time system for online condition and structural health monitoring via sound. To allow use of the software in a wide range of applications, a modular user interface for the classification of sound data (structure-borne, air-borne and ultra sound) for the optimization of maintenance and quality control processes is provided.

For monitoring, a signature containing the sound response at several locations of the corresponding structure with a suitable description of the current state is created under actual operating conditions. The selection of the characteristics and sensors for generating this signature and the definition of the classes are problem-related and can therefore be set separately in the software.

UNIVERSAL APPLICABILITY

To provide universal applicability for a wide range of applications, a modular system consisting of three components was designed for classification.

The three components are listed in their processing order in Figure 2. The modular design allows for the single components to be compiled individually according to the requirements of the user. The modular design and diversity of various methods of artificial intelligence and signal processing presented here are currently not achieved by any other software on the market.

Fig. 2: Flow chart for the design phase of the classifier

1. Feature Extraction

The component extraction feature comprises current filtering (high or lowpass or bandpass) and (background) noise removal methods.

2. Feature Selection

The subsequent component uses the preprocessed time data to characterize significant features. This allows the best possible separation between classes. For this purpose, methods from the time domain (eg. statistical measures eg kurtosis and skewness) or frequency domain (spectrum, octave spectrum, third-octave spectrum, spectrogram, scale, order spectrum) can be used. The selected features are then used to construct the classifier (single or multiple class classifier possible).

3. Classification

The following procedures are offered for classification:

- Support Vector Machines
- Hidden Markov Modelle
- Distance-based Classifiers (K-Means, Fuzzy C-Means, Ellipsoid)
- Distribution-based Classifier (Bayes Classifier)
- Density-based Classifier (K-Nearest Neighbor)

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