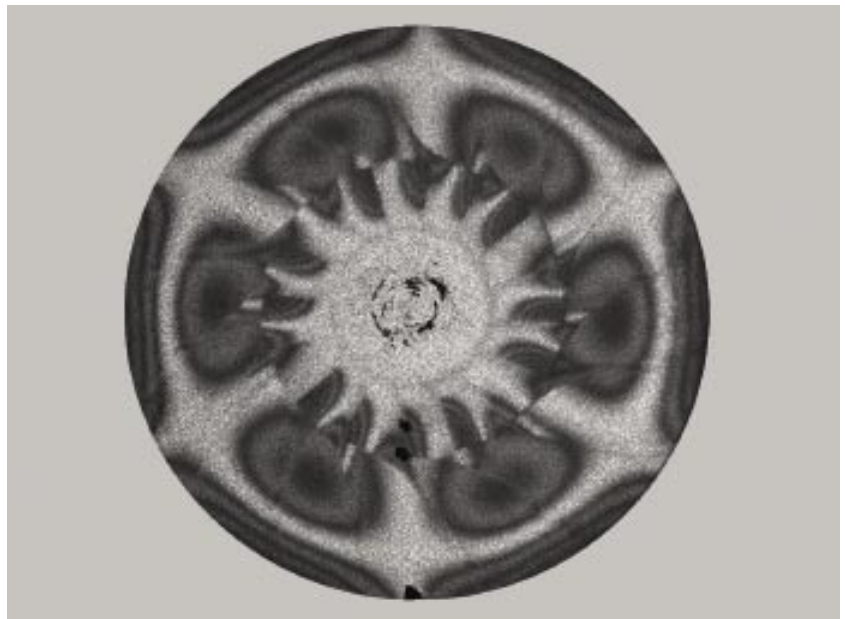




Vibratory analysis and response to shock

- Vibrations of complete mechanical assemblies
- Behaviour of materials and structures in response to shock
- Detecting causes of operating anomalies and of breaks
- Detecting noise sources
- Validating numerical modelling
- Predictive maintenance
- Noise reduction
- Modal analysis of turbine blades.



Eigenmode of a Compressor wheel.

MODAL ANALYSIS

The principle

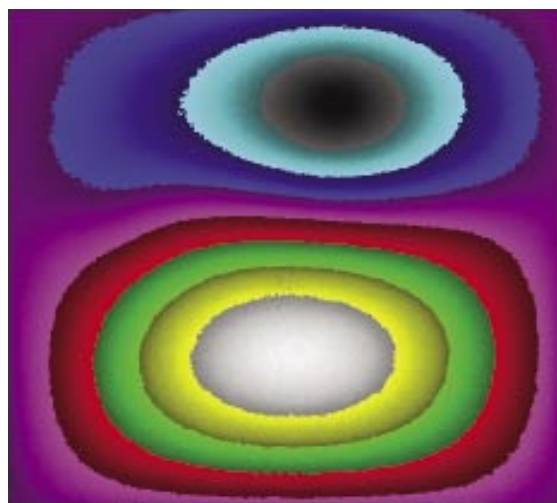
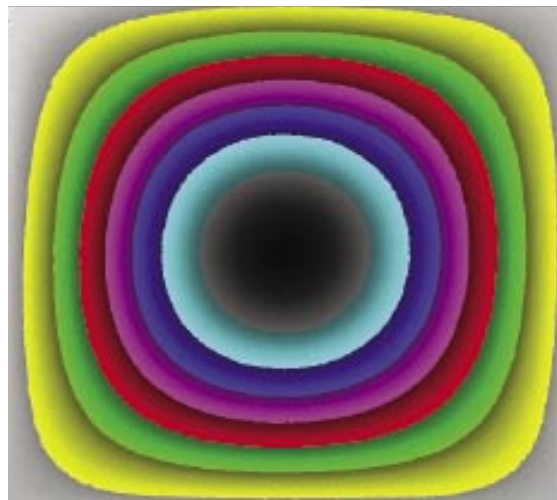
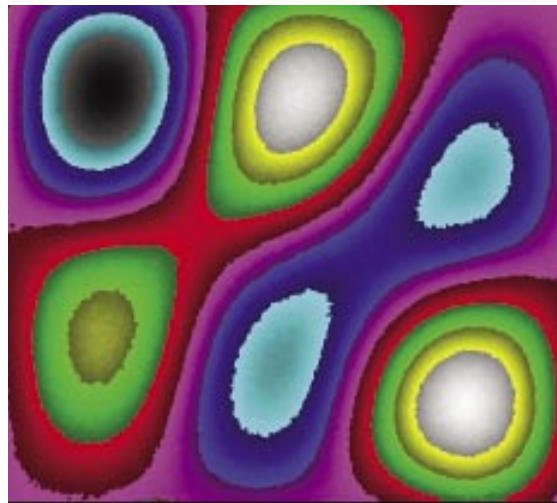
This high-performance tool enables you to predict or improve the performance of a structure in operation. Interferometric methods allow quick and accurate determination of the eigenmodes characteristic of a part.

Viewing vibration modes in real time

The item for testing, mounted on an anti-vibration bench, is excited by a vibration generator and illuminated by a continuous-wave laser. The deformation is viewed on a screen in real time. Various modal deformations can be viewed by altering the excitation frequency. The operation takes just a few minutes.

Using a pulsed laser

For objects with a surface area of more than one square metre or with significant deformation amplitudes, a pulsed laser is used instead of a continuous-wave laser. In this way, a surface of several square metres can be observed without using an anti-vibration bench. In situ modal analysis of a structure with its actual edge conditions (attachment to the ground, connection to other structures) then becomes possible. The range of instantaneous displacement speeds (instead of amplitudes) can also be viewed.



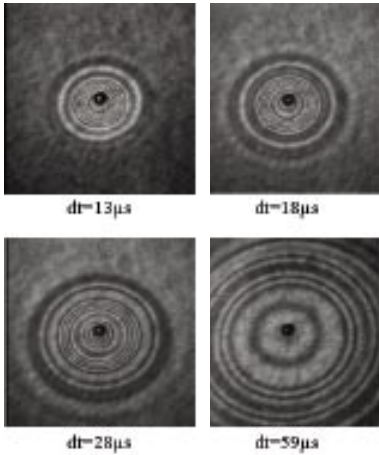
Eigenmodes of a clamped plate.



Modal analysis of a blade section - FRAMATOME

VIBRATORY ANALYSIS IN ACTUAL OPERATION

In general, a structure is subjected to multiple excitatory vibrations. By displaying and quantifying its dynamic deformation it is possible to determine the origin of a malfunction or a noise.



Deformation map of a plate loaded by a shock.

Pulsed-laser TV holography

More versatile than holography, this technique also enables structures to be studied in situ. The results are displayed after a short delay. Two images of the object under study are obtained, separated by 5 to 500 μs . Dephasing the reference image (fibre optic) reveals a network of micro-fringes on these images. Computer processing consists of a Fourier transformation of the images followed by subtraction to obtain a phase image, and finally measuring structural displacements by demodulating this phase image.

Vibratory deformation in actual operation

Pulsed-laser interferometric techniques enable vibratory deformations of an object to be quickly viewed while it is in operation.

The principle is based on recording two images separated by an adjustable time interval of between 1 μs and 800 μs . Image-processing software quickly measures the actual deformation of the structure in the time period selected and, in some instances, can show the contribution made by the various vibratory modes.

Hence this type of measurement complements modal analysis. By carefully synchronizing the exposures, one of the vibration modes can be eliminated in order to highlight the others.

Shocks and transient states

Structures subjected to rapid displacements or deformations can be 'frozen' by very short laser pulses (7 to 30 ns). Short, transient events can be displayed, and structural displacements are measured in the time interval separating the two exposures.

Vibratory analysis in a rotating body

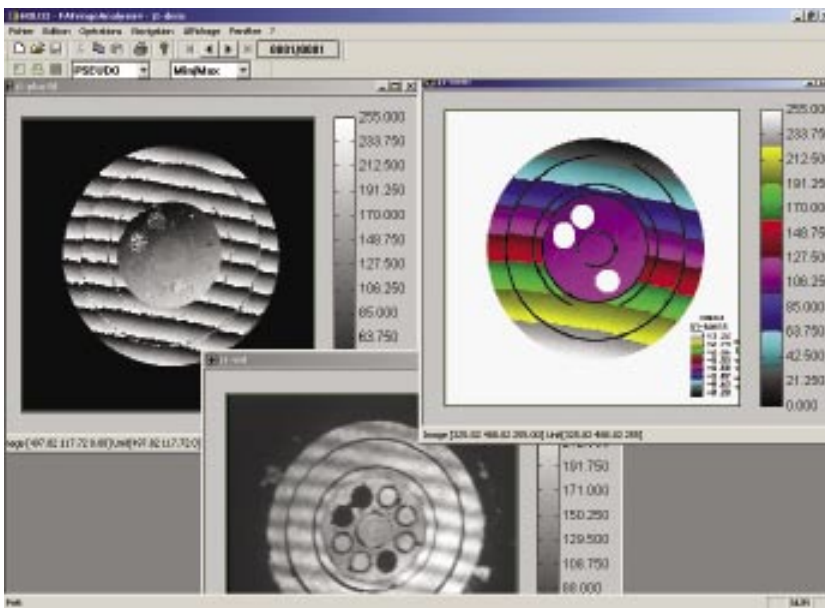
Using a derotator enables the rotatory motion of the object under study to be optically removed. The display and measurement techniques described above are used.

SOFTWARE

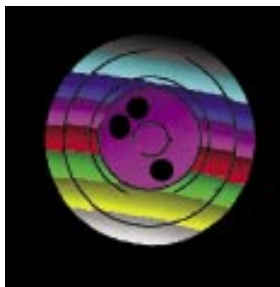
Image-processing software running on a PC enables deformations to be quantified.

This system provides:

- a false-colour display of the deformation
- a wire-frame representation (pseudo-3D)
- cross-section (profile)
- a view of modes in real time
- calculation of vibration amplitude and phase



Study of an automotive rotating part.



Références

FRAMATOME, ONERA, SNECMA, EDF, GDF, PSA, RENAULT, VALEO, CRYOSTAR.

Technical features

- Production of maps of different deformations (digital data)
- Real-time viewing (modal analysis) and delayed measurement (a few minutes)
- Non-contact full field approach
- Deformation resolution: 0.01 μm
- Frequency range: 0 - 50 kHz (continuous-wave laser)
0 - 100 kHz (pulsed laser)
- Structural dimensions: 16 cm^2 to 1 m^2 (continuous-wave laser) or 10 m^2 (pulsed laser)
- Spatial resolution: image 512 x 512 or 1024 x 1024 pixels
- Excitatory characteristics: 10 N, 500 N, 2200 N vibration shaker
- Measurement on anti-vibration bench (continuous-wave laser)
- In situ measurement (pulsed laser).

Holo3 

7 rue du Général Cassagnou F-68300 Saint-Louis T : +33 (0)3 89 69 82 08
F : +33 (0)3 89 67 74 06 info@holo3.com http://www.holo3.com