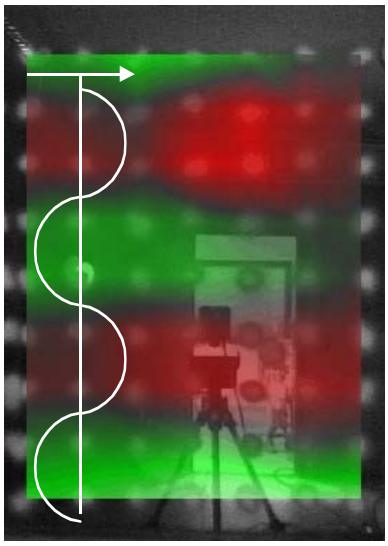
Fraunhofer Institut Bauphysik

# Vibration at a glance

Localisation and analysis of structural vibrations and acoustic weak points with appropriate measurement technique



Scanning and presentation of a mode shape on a glass pane.

## Instrumentation

Employing a Laser vibrometer is a well known procedure for the analysis of the vibration behaviour of structural component parts. Vibrations are detected and visualised independently of the excitation mechanism. The method is contactless, avoids the need for many accelerometers and is applicable to the investigation of objects of almost any size. The influence of boundary restraints or reinforcements is recognisable, acoustic weak points are detectable and, together with sound measurements (e.g. by means of a microphone array), radiation factors of structures may be determined. Unwanted vibrations and structure-borne sound are the cause of many noise problems and the scanning laser vibrometer is a useful tool to identify, localise and analyse these causes.

Measurement system Laser vibrometer: sensor head, controller, computer and junction box.

## Mode of operation

The laser beam is divided into two beams in the sensor head. The beam leaving the head hits the structure under investigation and is reflected. On a vibrating surface additional delays are present, which are related to the amount of vibration. That allows calculating the amplitude and vibration velocity of a component as a function of frequency. With the scanning method the probing of many points on the surface is accomplished in rapid succession. The analysis delivers an image of the deflection shape for a specific frequency. Such images can be combined to an animation or can serve as input data for further investigations, such as a modal analysis.

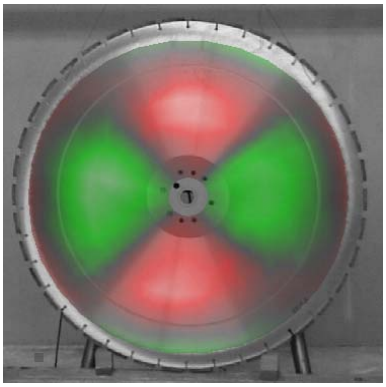
## Fields of application

**Technical Acoustics**, e.g. vibro-acoustic analysis of machines, devices, component parts and tools with identification and localisation of acoustic weak points.

Two typical noise polluters investigated.

Left:
Vibration mode shape of a stone saw blade (278 Hz) at lateral excitation by a shaker.

Right:
Vibration mode shape of a gearwheel (steel, 5713 Hz) at lateral excitation by a shaker.



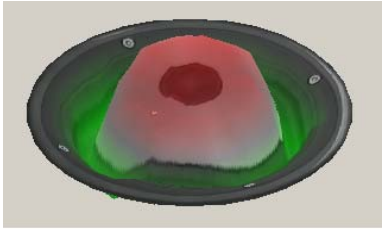
**Building Acoustics**, e.g. vibro-acoustic detailed analysis of walls, doors, windows, ceiling systems and installations as well as panels, sandwich elements and curved component parts.

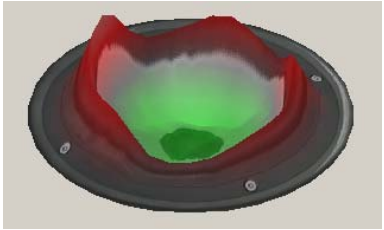
**Musical Acoustics**, e.g. vibration measurements at musical instruments.

**Active Noise Control**, e.g. components of active silencers (loudspeaker).

Vibration mode shape of a loudspeaker in 3-D-presentation.

At low frequencies a piston radiator, at high frequencies (at 1744 Hz) opposite movement of membrane and boundary.





## Offer

The IBP offers investigations in the laboratory but also measurements at objects on site. As result you obtain a detailed vibration analysis of the structure under investigation. This often is the first step towards a successful reduction of noise and vibration.

Use the Scanning Laser Vibrometer for your projects and developments. You save time and improve the acoustic quality of your products.

**Fraunhofer-Institute of Building Physics**
Department Acoustics
Dr.-Ing. Philip Leistner
Nobelstraße 12
D-70569 Stuttgart
Phone +49 (0) 711 970 3346
Fax +49 (0) 711 970 3406
E-mail philip.leistner@ibp.fhg.de

www.ibp.fhg.de/akustik