Laser vibrometry can be used for the following examinations, amongst others:

- Characterization of ultrasound transducers during development or quality control
- Analysis of the natural vibration behavior of vibration-critical components like brake disks
- Visualization of sound or ultrasound waves
- Verification of simulation results and evaluation of material data

Are you familiar with our industrial-grade accredited inspection services?

- Accredited laboratory in line with DIN EN ISO / IEC 17025, to qualify and validate new non-destructive testing (NDT) processes for industrial applications
- Accelerated time-to-market and opportunity for qualified, norm-compliant deployment in industrial applications as well as for complete new in-house developments or custom adaptation of innovative NDT technologies, even in fields where norms have not been established
- Certification of the corresponding quality management system in accordance with DIN EN ISO 9001

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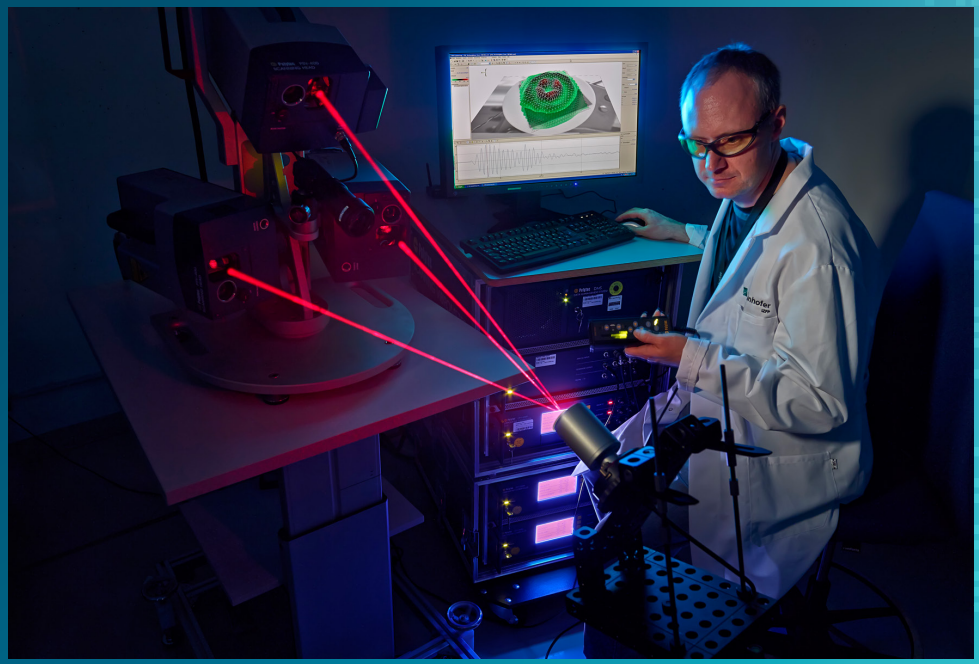
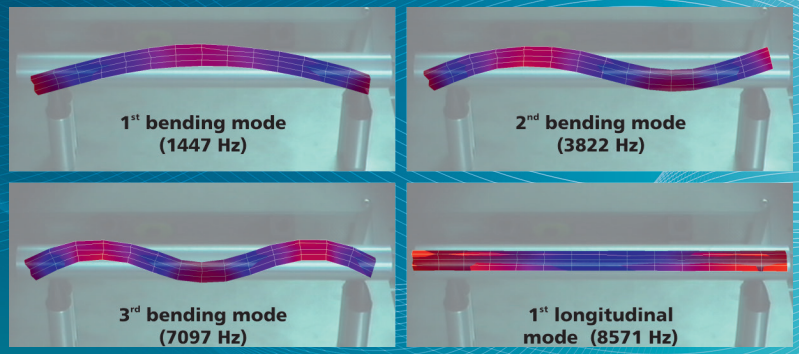
Fraunhofer IZFP

Sensor and Data Systems for Safety, Sustainability and Efficiency

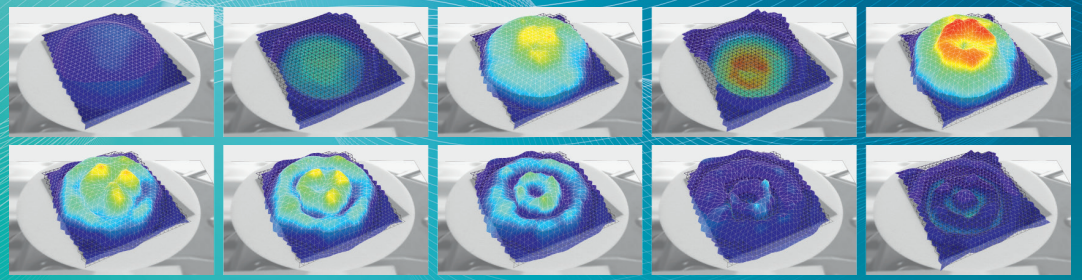


3D noncontact measurement and visualization of high-frequency component vibrations

Laser vibrometry



Frequency measurement: Selected eigenmodes of a cylindric rod (aluminum alloy, diameter: 29 mm, length: 300 mm) due to an impulse excitation by a modal hammer



Time measurement: Vibration behavior of a circular air-coupled ultrasound ceramic at different times due to a periodic excitation with 180 kHz

Laser vibrometry – 3D noncontact measurement and visualization of high-frequency component vibrations

Laser vibrometers enable contactless and reactionless vibration measurement and visualization. They are mainly suitable for analyzing vibration processes where conventional procedures reach their limits. Laser vibrometers make use of the Doppler effect, analyzing the specific frequency shift of a coherent laser beam impinging onto a vibrating object and being reflected from there. The evaluation of the frequency shift comes from the interferometric comparison between the measuring beam and a reference beam. Laser vibrometers allow for the measurement of very high-frequency vibrations or vibrations with minute amplitudes. Unlike measurements by acceleration sensors, the contactless technique ensures that the vibration to be measured remains unaffected. By scanning the surface of a vibrating object fast vibration measurements at many surface points of the object are possible.

Fraunhofer IZFP's laser vibrometer allows one-dimensional and three-dimensional measurements of vibrations. In one-dimensional mode the measurement is performed by a single measuring head which captures the vibration components running along the length of the impinging measuring beam, i.e., perpendicular to the measuring plane. In three-dimensional mode three measuring heads are used, all of them being arranged in different angles to each other. Hereby, vibrations perpendicular and parallel to the measuring plane can be detected. The measuring laser beams can be positioned by integrated reflectors, allowing for the scanning of the object surface and hence enabling the spatial capturing of a vibration. A subsequent user-friendly visualization completes the measurement.

Benefits of vibration measurement

- Noncontact measurement: Vibration to be captured is unaffected; damaging or contamination of the object is avoided
- Surface scans: Very fast vibration measurements covering some hundred points can be performed.
- 1D mode (detection of vibrations perpendicular to the measuring plane) or 3D mode (detection of vibrations in all directions using three measuring heads)
- High frequencies up to 1 MHz in 3D mode or 24 MHz in 1D mode and minute amplitudes down to a few nanometers depending on frequency can be evaluated.
- Measurement in time or frequency mode: In time mode the temporal course of a complete vibration process can be analyzed enabling, e.g., the examination of engaging and subsiding. In frequency mode single frequencies of a vibration can be extracted from a sum signal and depicted independently from each other.
- Ease of use: Measurement results can be visualized in a user-friendly way and can be exported in multiple data formats.

Areas and Examples of Application

Laser vibrometry in general can be used for measurement and visualization of various vibration processes. Fraunhofer IZFP's laser vibrometer is universally applicable over a broad range of frequencies and structures, starting from small components of some square millimeters up to huge assemblies like complete car components. Even in case of unfavorable reflection characteristics of the sample (concerning, e.g., color or surface structure) the vibration measurement stays possible using reflective tape or a spray.