Further applications

Applications are found wherever existing infrastructure is subject to ageing or to possible damage so that a periodic monitoring is important to prevent physical injury or loss of property. Additionally, our technology is applied for quality control immediately after the production process. This comprises amongst others

- Measurement of relative and absolute stress values
- Distinction between load and residual stresses
- In situ stress measurements

Are you already familiar with our industry-standard services?

- Accredited testing laboratory in accordance with DIN EN ISO/IEC 17025 for various NDT methods
- Certificate of competence of the accredited laboratory to qualify and validate (new) nondestructive testing methods for industrial testing practice in the field of ultrasonic testing
- Rapid transfer to market readiness for qualified, standard-compliant use in industrial applications, both for new developments (in-house developments) or for adaptations
- Our associated quality management system is certified in accordance with DIN EN ISO 9001

Contact

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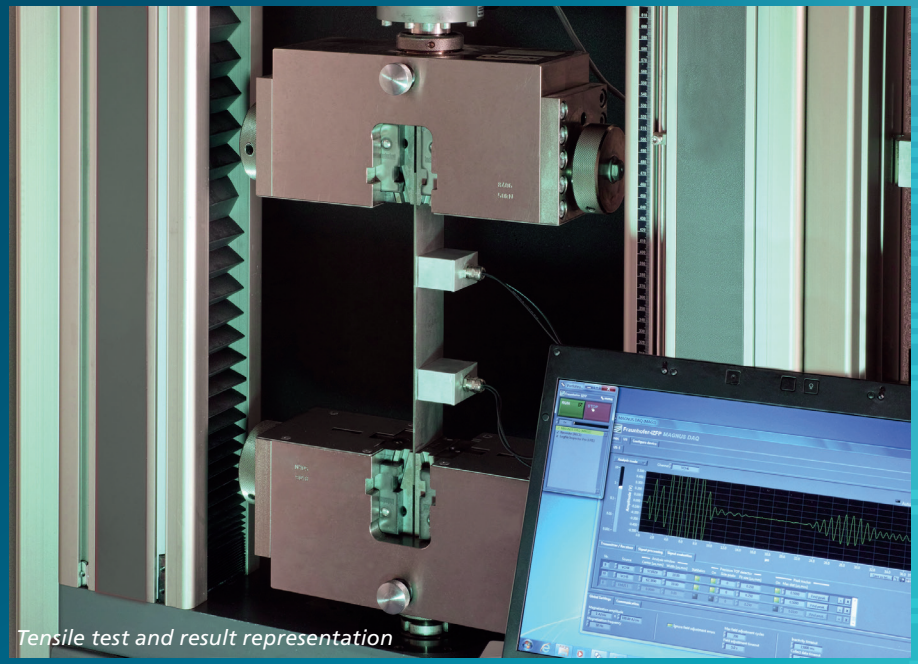
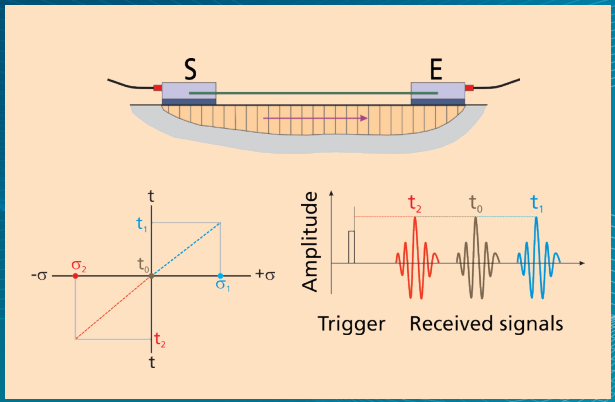
Fraunhofer IZFP

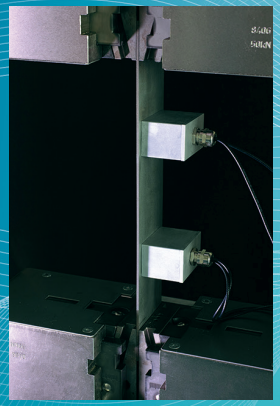
Sensor and Data Systems for Safety, Sustainability and Efficiency



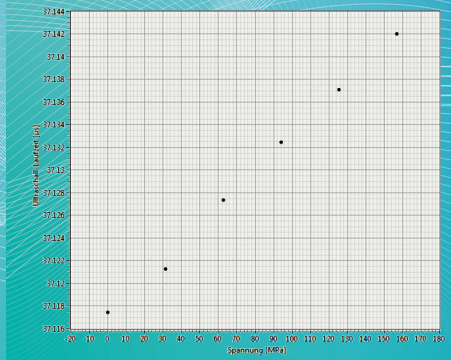
Tensile test and result representation

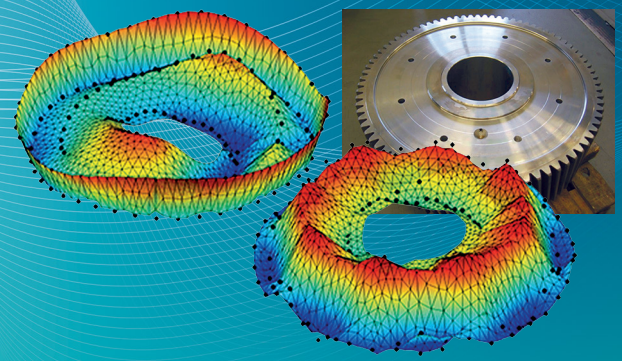
Stress measurement by ultrasound





Change of sound velocity of a transmitter / receiver setup as a function of the applied strain of a tensile test; transmitter / receiver setup





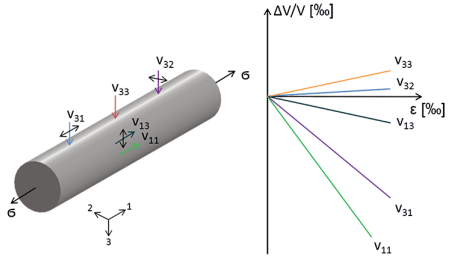
Ultrasonic tof as a function of the applied strain; determination of circumferential, radial residual stresses before (top left) and after (down right) hardening of a cylindric gearing component

Stress measurement by ultrasound

In the volume of virtually any metallic material's micro-texture so-called lattice defects (imperfections, inclusions, voids, dislocations) crop up. The texture state is crucial for the material's behavior and is subject to long-term load-based changes all over the life cycle of components such as temperature or constant and changing mechanical loads. Thus, in case of safety-related components the early detection of material changes and stress states is an essential constituent of the component's reliability of operation.

Inspection by ultrasound is an eligible procedure to evaluate both, residual stresses and incipient load-induced changes of materials and stresses in metals. Basically, all tension and strain changes in materials are subject to the so-called acousto-elastic effect which raises measurable changes regarding the velocity of propagation of ultrasound waves. Hence, measurements of ultrasonic velocity of propagation are used to detect emerging material and stress changes.

Depending on the applied wave modes (longitudinal, transversal (SH, SV)) and their propagation and polarization direction in relation to the stress direction additional changes of the measured ultrasonic time-of-flight occur (see figure). According to the inspection conditions conventional piezo-electric probes or electromagnetically excited ultrasound transducers (EMAT) are applied. Due to the excitation mechanics of the ultrasound wave EMAT is suited but for the inspection of ferromagnetic and/or electrically conductible materials.

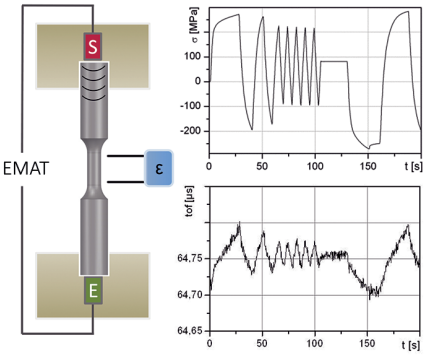


Relative change of sound velocities of different wave and polarization modes as a function of strain

Results

The adjacent figure represents the in-situ application of EMAT on a cyclically loaded sample including (down right) the results of the time-of-flight (tof) measurement in relation to the occuring tensile and pressure stresses (top right).

The results of the measurements prove a good correlation to the corresponding fatigue processes in the loaded sample. Applied tensile stresses result in solidification processes, intrusions and extrusions at the sample surface and martensite formation, all of them leading to an increase of tof. Pressure stresses, however, result in softening processes redounding to a decrease of tof. Thus, a sample breakdown can be spotted early by an increase of tof. Moreover, this project was the first one worldwide to successfully monitor fatigue tests by integrated EMAT technology at temperatures of up to 300 °C and to document the results in realtime.



In situ measurements by EMAT (collective operational load)