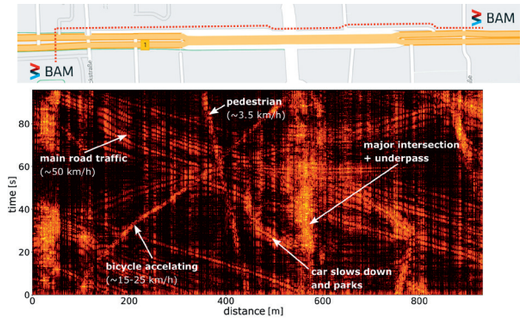
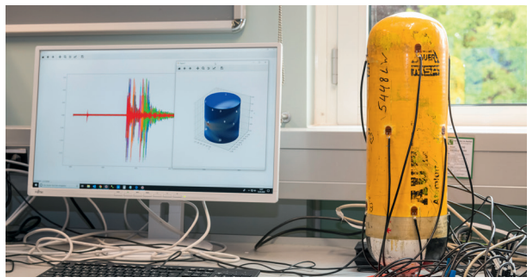
STRUCTURAL HEALTH MONITORING



Online traffic monitoring using distributed fibre optic acoustic sensing along roadside fibre optic cables.

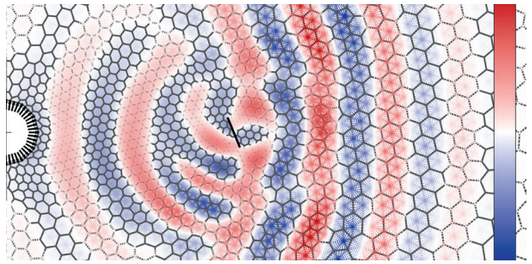
Fibre optic sensors are suitable for continuous condition monitoring of large structures and technical facilities. Strain, temperature, vibrations, and radiation can be measured.

Structural health monitoring (SHM) with ultrasonic guided waves is particularly suitable for plate-shaped components, pipelines, and fibre-reinforced composites.



Monitoring a pressure vessel with guided ultrasonic waves: Demonstrator.

NDT/NDE 4.0



Simulation of ultrasonic waves in a composite panel with reflections at a crack.

The complex physical relationships and diverse influencing variables of the individual test and measurement methods require the use of simulation procedures. Both commercial software products and self-developed programs are used here.

We also use machine learning methods, e.g. for the evaluation of results, and provide data for maintenance predictions of critical components using digital twins.

Automated non-destructive testing / evaluation (NDT/NDE) is realised by integrating various stationary and mobile robot systems.

For the validation of measurement systems in terms of reliability, detection probability, and precision, we also use our expertise in the investigation of human and organizational factors.

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Sicherheit in Technik und Chemie

Cover photo: "Thermographic inspection of wind turbines during operation".

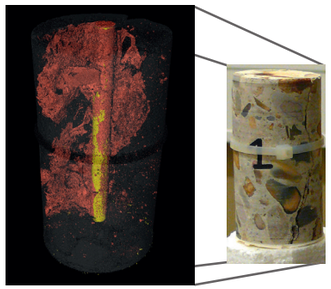
KM. Medienteam 202300040

NON-DESTRUCTIVE TESTING AND SENSORS

Status: April 2023

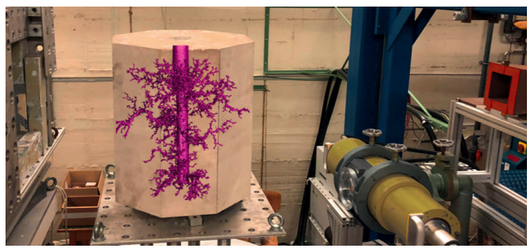
X-RAY IMAGING

2D and 3D imaging using laboratory and synchrotron X-ray radiography and computed tomography (CT) is used for quantitative characterization of materials, non-destructive testing (NDT), and quality assurance. Micro and macro defects can be precisely measured.



Distribution of corrosion products in concrete.

Typical applications are metallic alloys and their composites, structured materials (e. g. concrete, composites), and components (e. g. pressure vessels, concrete walls).

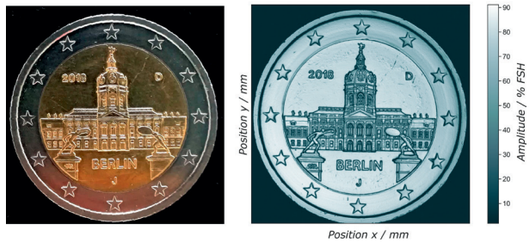


Visualization of the capillary channels in a limestone sample; diameter 400 mm.

VOLUME AND SURFACE METHODS

Radar investigation of a bridge to localize reinforcement and tendon ducts.

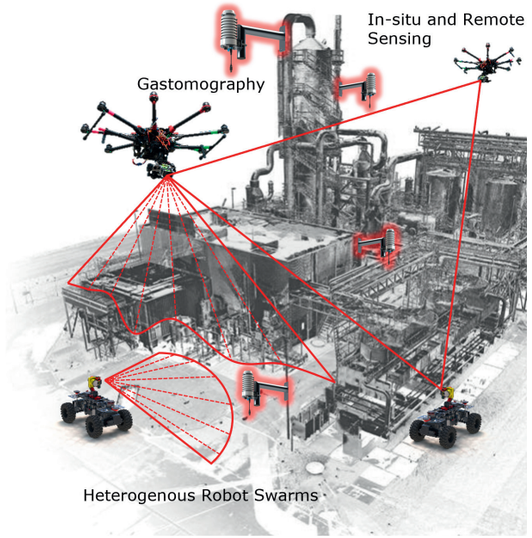
Non-destructive testing methods for civil engineering (e. g. radar, ultrasound, LIBS) provide information on the component geometry, the exact position of built-in parts such as reinforcement, pipes or tendon ducts, as well as the condition of a component.



High-resolution ultrasonic scan of a surface compared to a photograph to demonstrate the possible detail resolution.

Ultrasonic immersion tank testing enables high-resolution inspection of complex components. On electrically conductive components, near-surface inhomogeneities such as cracks, pores, inclusions, and corrosion can be detected by eddy current testing methods.

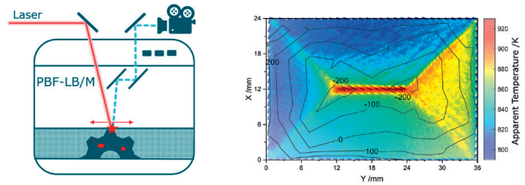
SENSORS



Mobile sensor systems for plant monitoring, e. g. through integrated open-path gas sensors.

The development, validation, and application of sensors and metrological processes aim to ensure the safe and controlled conditions of materials, components, plants, and structures. Heterogeneous sensor systems are developed and used (also AI-based) to comprehensively and efficiently record complex scenarios. The accredited calibration laboratory for force, temperature, and electrical quantities and the test laboratory for gases and gas humidity are used for metrological traceability in many areas of application at BAM.

MATERIAL CHARACTERISATION



Left: Principle of in-situ monitoring of additive manufacturing processes (laser-based powder bed fusion of metals; PBF-LB/M) using thermography. Right: Superposition of measured manufacturing temperature and residual stress distribution in a test specimen.

In-situ sensor technology, such as thermography, can be used to monitor additive manufacturing processes and thus draw conclusions about defects and component properties (e.g. residual stress).

Nuclear magnetic resonance (NMR) tomography can be used to measure water content, hydrogen bonding state, and pore size distribution. In this way, moisture penetration profiles can be recorded, and transport properties derived, e.g. for the durability assessment of building materials.

Left: NMR tomograph. Right: 3D-NMR image of a sandstone sample in a water-filled glass container, highly porous water-filled inclusions are visible in blue.