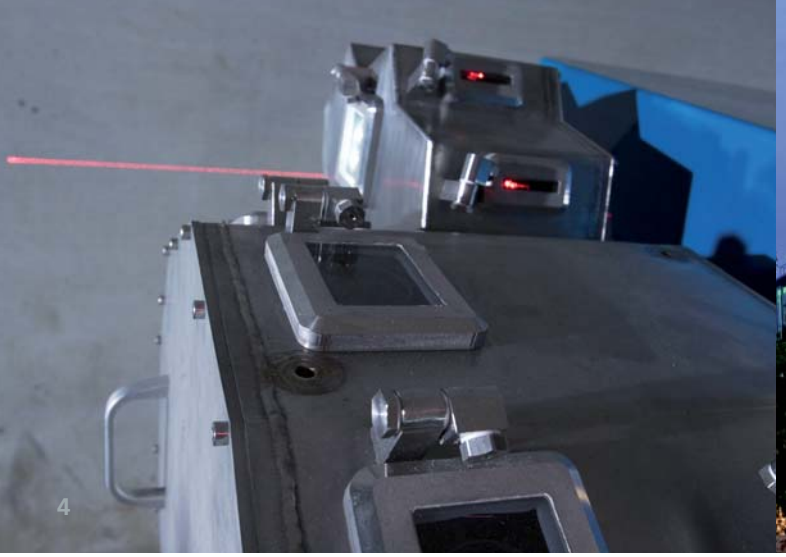

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CUSTOMIZED IMAGE PROCESSING FOR INSPECTION TASKS

Our range of services encompasses the applied development and implementation of visual inspection systems. We cover a comprehensive range of work, starting with the configuration of sensor arrays to the development of specific evaluation algorithms through the documentation of results in compliance with mandatory guidelines.

Acquisition

- sensor configurations and systems
- (distributed) data acquisition
- multi-sensor systems: multi-camera and hybrid systems
- design and construction of complete inspection robots

Detection

- identification of relevant objects and structures
- object tracking
- contextual environment understanding
- parallel and distributed data processing
- fusion of different data sources

Quantification

- determination of dimensions for object features
- incremental scanning of large spaces and structures
- integration with position detection
- interactive visualization and evaluation systems

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Photos: Title photo, 4 B. Liebl ; 1, 2, 3 Fraunhofer IFF; 5 A. Lander

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IMAGE PROCESSING FOR INSPECTION TASKS

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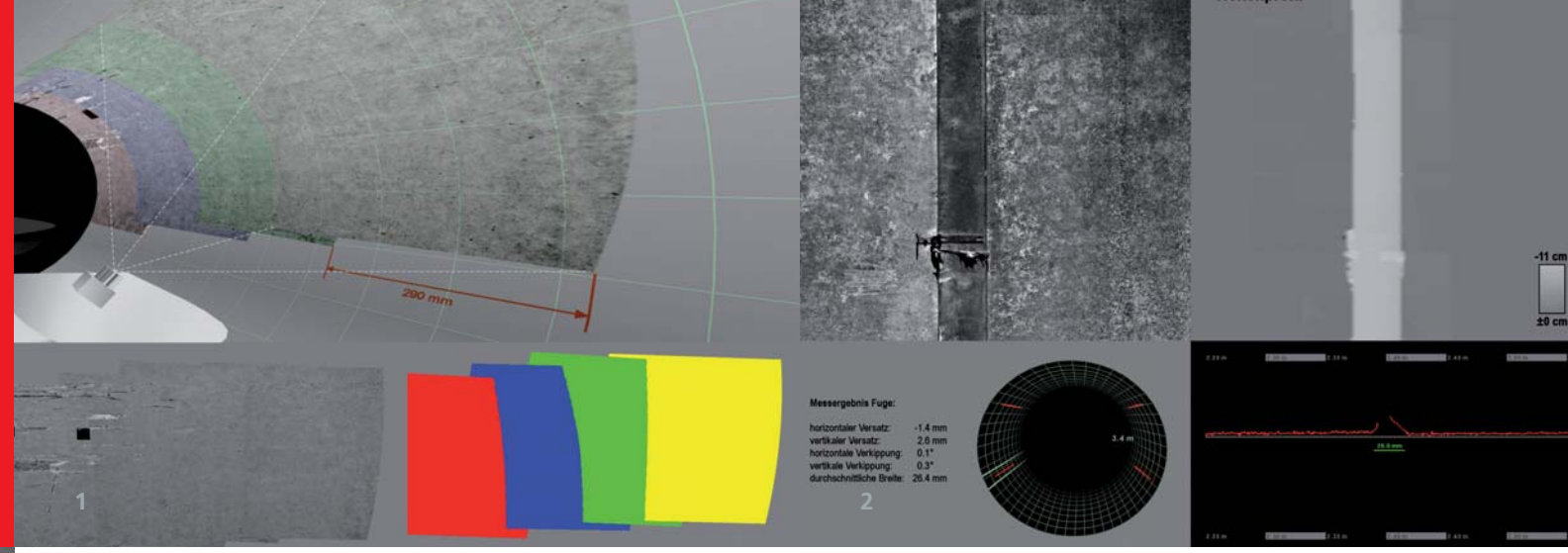

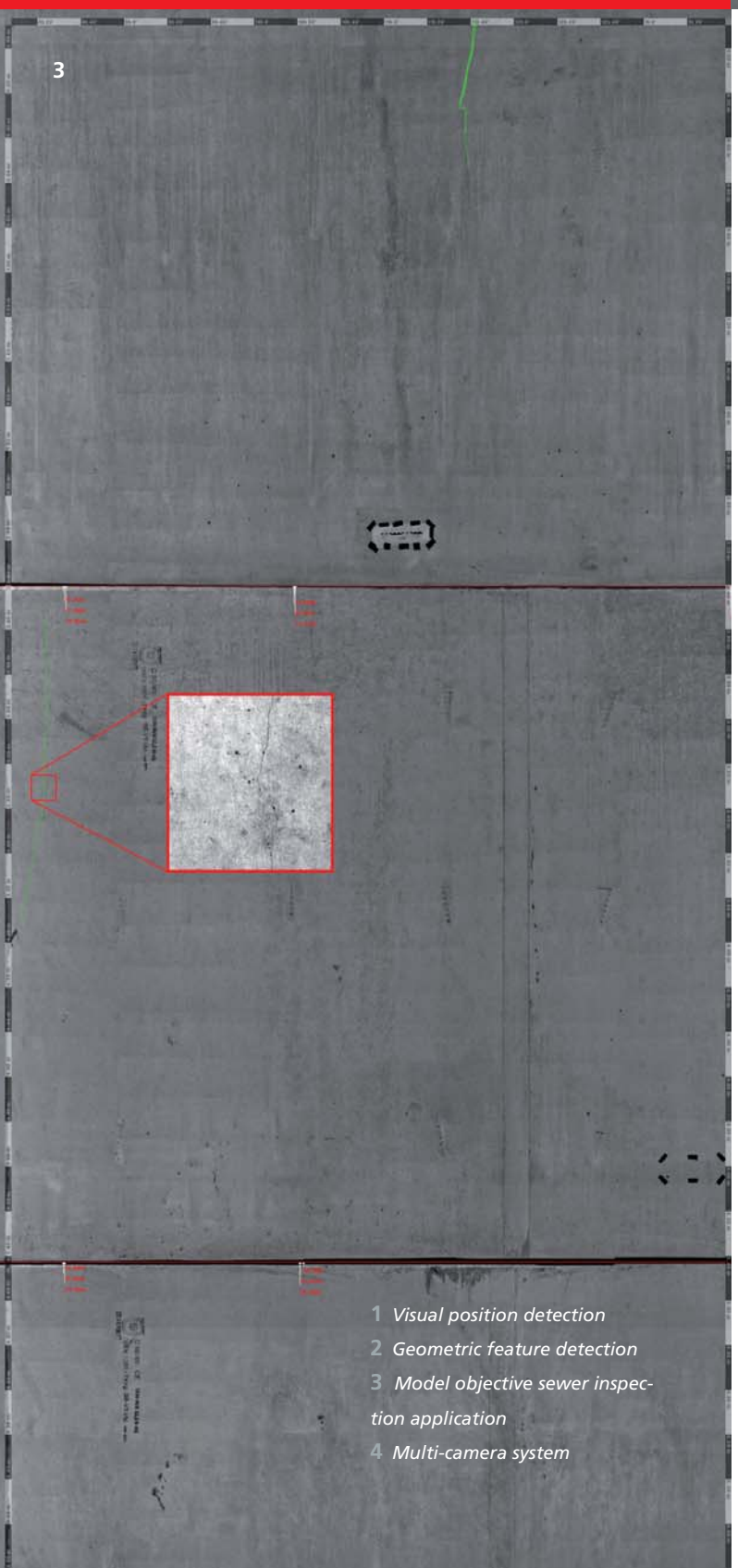

1 *Visual position detection*
2 *Geometric feature detection*
3 *Model objective sewer inspection application*
4 *Multi-camera system*

APPLICATION: OBJECTIVE SEWER INSPECTION

The Emschergenossenschaft and the Fraunhofer IFF have developed novel inspection equipment to map the condition of the future Emscher sewer system. The integration of systems and current findings from image processing research play an important role. The following results reveal the potentials and challenges on the path to objective and reliable fully automatic condition mapping for this application.

DETECTION OF CRACKS ON CONCRETE SURFACES

Detection of even the minutest cracks is an essential part of inspection and serves to detect damage at an early stage. At the same time, personnel is unable to expediently analyze the large quantity of picture material necessary cost effectively or practically.

Automatic systems that visually detect cracks on concrete surface run up against the challenge of handling different surface characteristics. The development of new algorithms and a broad base of training datasets have now made it possible to employ automatic crack detection for specific inspection tasks. This achievement has been enhanced further by linking it with other data sources such as joint and waterline detection.

Automatic crack detection for user support makes it possible to detect even cracks starting with widths of 0.5 mm.

VISUAL POSITION DETECTION

Visual position detection systems are based on the observation of fixed points in the world. A change of the camera's position can be determined based on changes of the positions of the observed structures over time. Simultaneous mapping makes it possible to find them again. Precise tracking of the system position is essential when registering datasets.

The special system developed for use with mobile and floating inspection robots in large, partially filled concrete pipes includes visual position tracking and determination. The system is able to precisely track the robot's forward movement. Thus the robot can be reliably retrieved anywhere with a tolerance of less than 2 mm.

DETECTION OF GEOMETRIC FEATURES

Joint Detection and Measurement

A combined system that scans images and geometry was designed to precisely detect specific geometric features. Image-based recognition of joints between pipe segments and subsequent scanning on the basis of light-sectioning make it possible to detect features such as joint width, axial displacement and pipe offset reliably and with high precision.

Geometry Reconstruction

Building upon the extremely precise visual position tracking, geometry can be reconstructed on the basis of a stereo analysis of temporally consecutive camera images. This makes it possible to cost effectively quantify structures projecting into the pipe for example.