

CASE STUDY

AUTOMATED PRECISION 3D SURFACE INSPECTION

FOR DRUMS CONTAINING RADIOACTIVE WASTE



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ResearchProjects_4703.php](https://www.tmb.kit.edu/english/ResearchProjects_4703.php)

The Karlsruhe Institute of Technology (KIT) is a public research university in Karlsruhe, Germany. The research project presented here is carried out at the Institute of Technology and Management in Construction, department of Deconstruction and Decommissioning of Conventional and Nuclear Buildings at KIT. The project is called EMOS, which is a German acronym for “Development of a Mobile and Automated Optical System for the Inspection of Radioactive Waste Drums.”

The Application

The challenge of this application is to provide automated inspection of drums filled with low-level radioactive waste in order to identify a range of potential defects and damage. Currently, approximately 120.000 m³ of low- and intermediate level radioactive waste is stored at interim storage sites in Germany. The safe storage of these drums must be guaranteed for an indefinite period of time until they are brought to a final repository.





The Challenge

In order to maximize inspection accuracy and minimize inspection time and thereby limit the exposure of personnel to radiation, the EMOS project at KIT aims to automate the complete process of inspection and data evaluation. This is required to detect the smallest visible optical and geometrical defects, particularly caused by corrosion, on the drum surface by the EMOS inspection system.

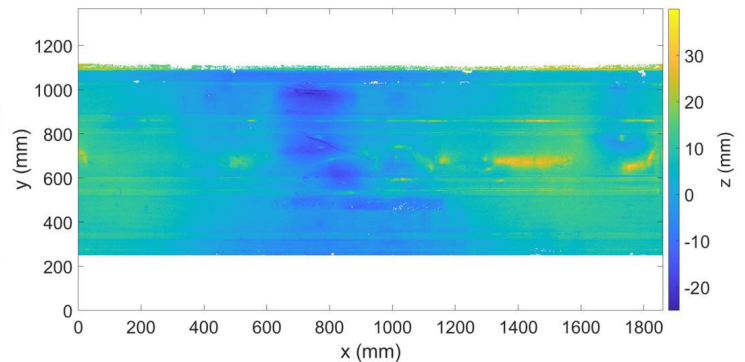
The Solution

Radioactive drums with an object height of ~93 cm have to be inspected. The LMI Gocator 2380 laser line profile sensor was selected because of its wide field of view and a required spatial resolution of no more than 1 mm at a distance of about 1 m from the object surface. The handling of this smart device is quite simple and can be controlled both manually, which is necessary for test cases and automatically in the final inspection system. For manual control, KIT used the web browser-based interface, which is quite simple and easy-to-use. In case of automation, they use the Gocator API to connect to the sensor and read the profiles automatically during the inspection process.

A requirement of the mobile EMOS inspection system is the capture of the entire drum surface, including shell, lid, and bottom. Laser scanning is done profile by profile at 250 Hz while the drum is standing and rotating on a turntable or lying in the drum tipping system.

THE GOCATOR® ADVANTAGE

- Laser profiling at 250 Hz
- Generates high-resolution 3D shape data (width, height, volume, offset)
- High repeatability for reliable measurement over time
- Factory pre-calibrated, ready to measure out-of-the-box
- Simple integration with existing inline and robotic systems
- Easy web based interface for maximum ease of use and operations efficiency
- Onboard software with built-in measurement tools (e.g. Surface Track Tool), no third party software required



Height map created from the unwound laser profiles of the drum shell

“Gocator allows the EMOS mobile and automated inspection unit to remotely scan the entire drum surface optically, including the shell, lid and bottom. The precision profile data gathered with Gocator is then used to evaluate drum surface integrity and output the results in an inspection report. Besides the increase in occupational safety, due to standardization and reproducibility of the inspection process, our system leads to a huge time gain and the exposure to radiation of the personnel can be reduced.”

— **Melanie Müßle, Research Associate, Institute of Technology and Management in Construction at KIT**

The Result

The LMI Gocator enables us to detect all types of geometric deformation on the drum surface, such as bumps, dents or cracks. During the evaluation step, KIT compiles the profiles to create 3D height maps of the whole drum surface, and combine them with camera recordings in order to detect and classify the damages automatically.

Next Steps

KIT also plans to use the profiles to create 3D-models of the drums for the purpose of 360° visualization. They have already done this for test purposes, but plan to automate the procedure in the future.