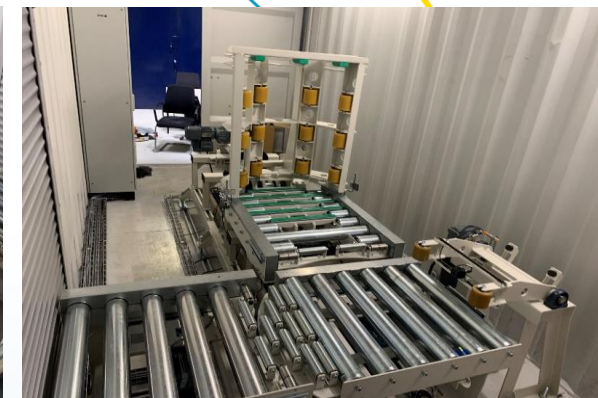



EMOS: Development of a mobile, automated, optical inspection system for radioactive drums

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The research project - EMOS

- **EMOS** - Development of a mobile, automated, optical inspection system for radioactive drums
- Sponsored by:  Federal Ministry of Education and Research
 - BMBF Sponsoring Programme „Research for the dismantling of nuclear facilities” (FORKA)
- Research cooperation within the KIT
 - Institute of Technology and Management in Construction (**TMB**)
 - Institute of Photogrammetry and Remote Sensing (**IPF**)

Field of application - EMOS

■ Starting position

- Currently, approximately **125.000 m³** of treated and conditioned low- and intermediate-level **radioactive waste** is stored in Germany.
- The waste is filled in containers, mostly **200 L steel drums** and is stored at the interim storage sites until a final repository is found.
- Their **safekeeping** must be ensured for an indefinite period of interim storage.



→ **Recurrent inspection of the drums is required to detect corrosion and other damages and, if necessary, to be able to initiate consequences to minimize damage**

Goals of the research project

- **Automation and standardization of the inspection process of the drums**
 - Automatical detection of damage to new and stored drums
 - Categorization of damages
 - Detection of changes of damages over time
 - Indicate, when consequences have to be taken to minimize damage
- **Advantages**
 - Increase in **Safety** during interim storage of nuclear waste
 - Increase in **occupational safety**: Staff is less exposed to radiation
 - **Time Gain** in the inspection process of the drums



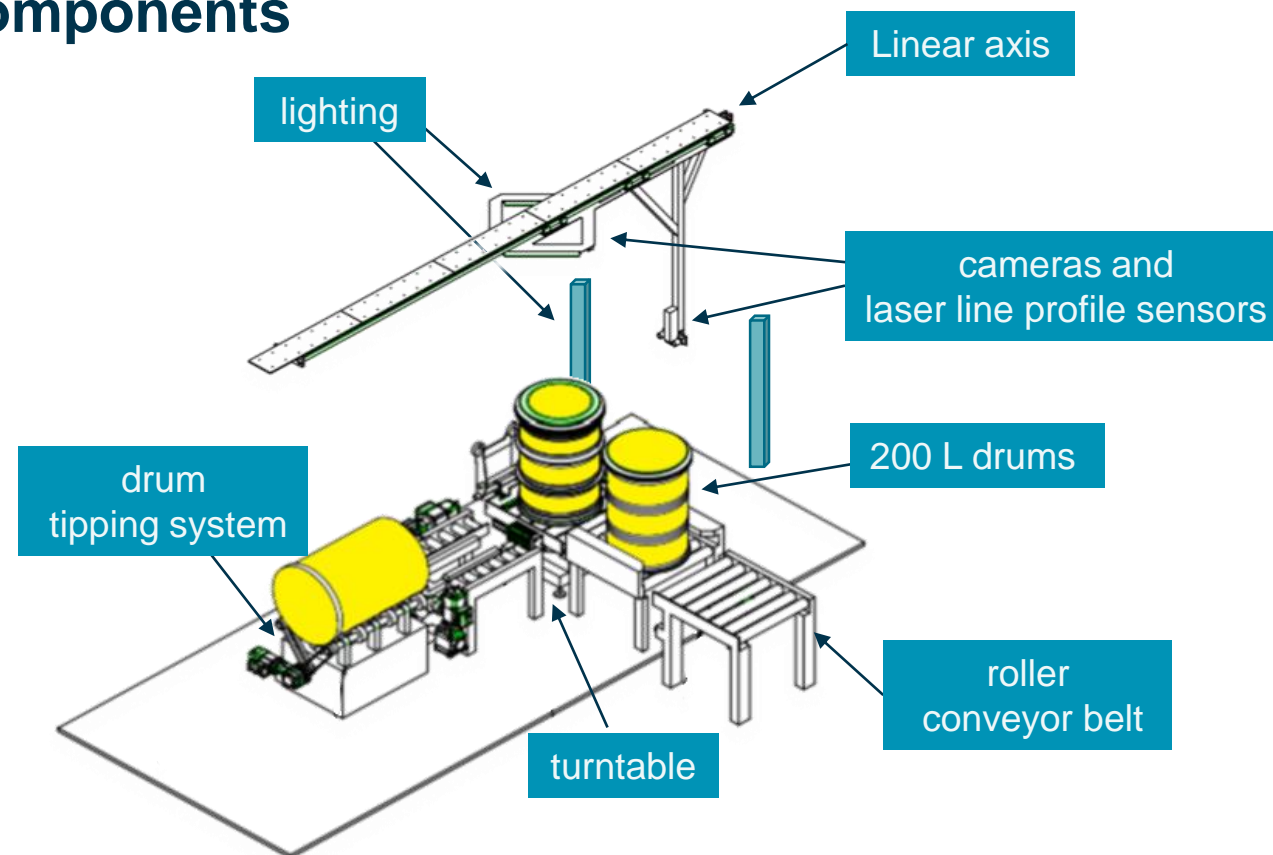
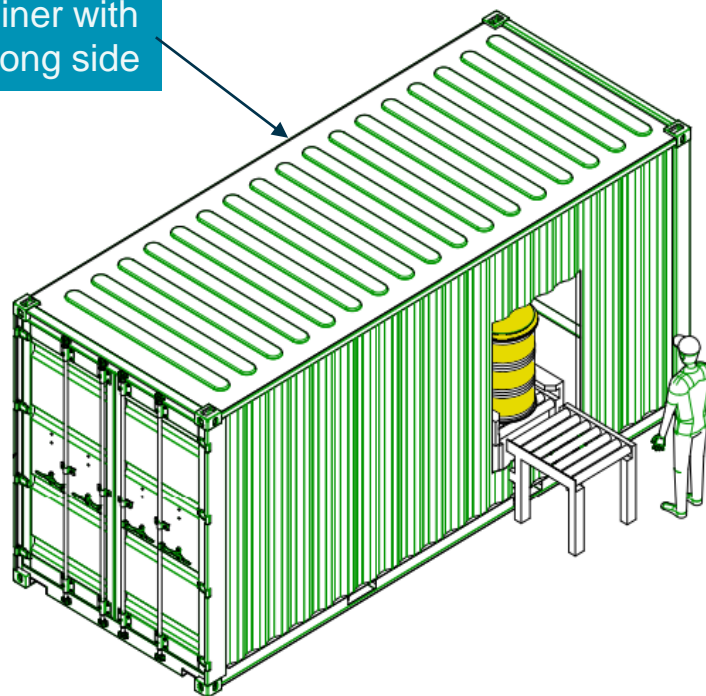
Concept

- **Requirements**
 - **Mobile** inspection unit
 - Optical and geometrical **recording of the whole drum surface** to detect damage like:
 - Corrosion
 - Bumps / dents
 - Scratches / cracks
 - Collected data will be **automatically** analyzed by a software developed in this project, digitally saved and an inspection report will be generated
- **Boundary conditions of the research project**
 - 200 L– steel drums (A200, R200, RRF200)
 - Low active waste

Concept

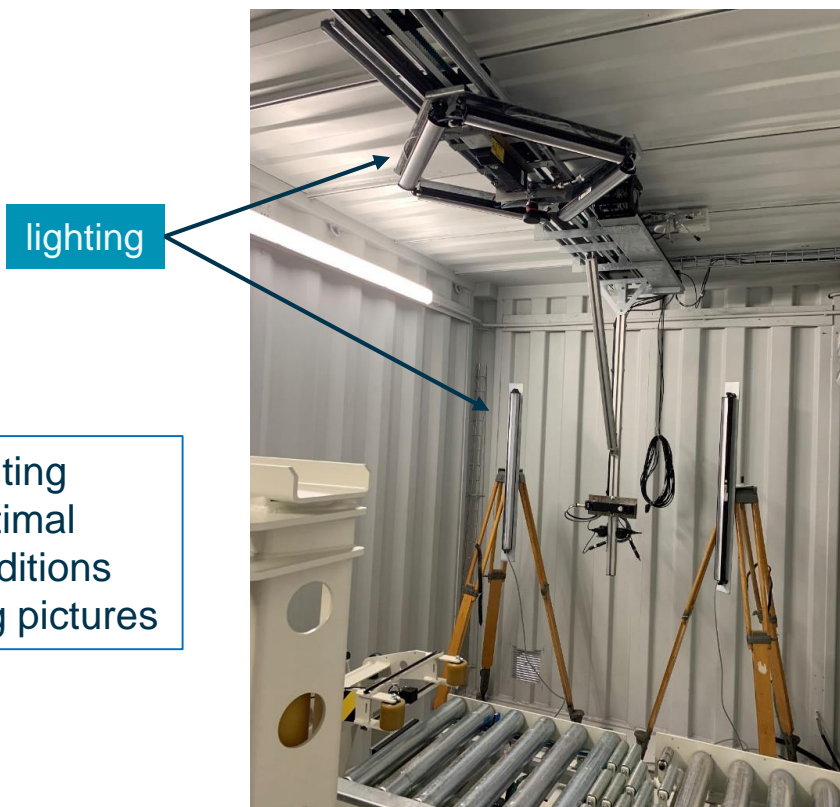
- Setting of inspection unit and components

20ft high cube container with a rolling gate at the long side



Concept

■ Setup of lighting and sensors



lighting

➤ artificial lighting ensures optimal lighting conditions when taking pictures



camera

Laser line profile sensor



Laser line profile sensor

2 cameras

Inspection process

- Remote operation of the system via control panel



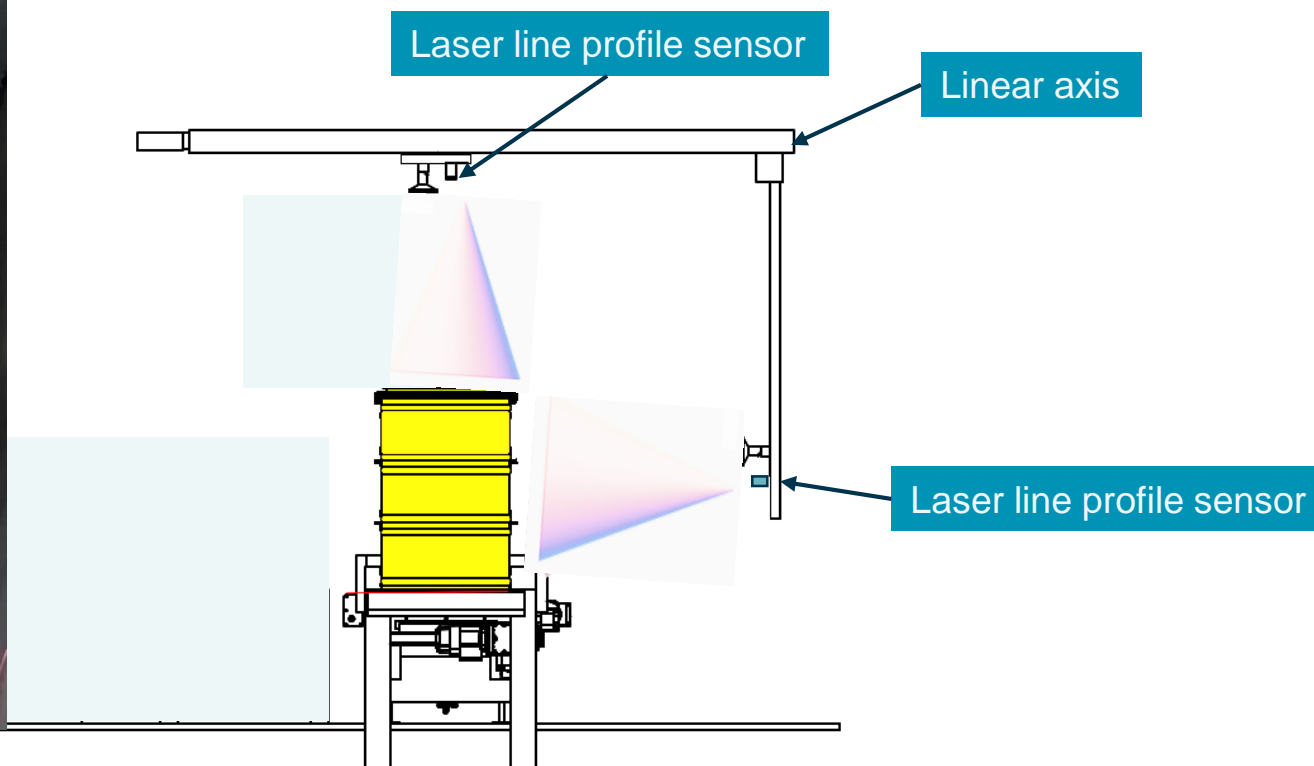
Inspection process

- **Drum on turntable** – Drum gets carried to the **turntable** and gets centered



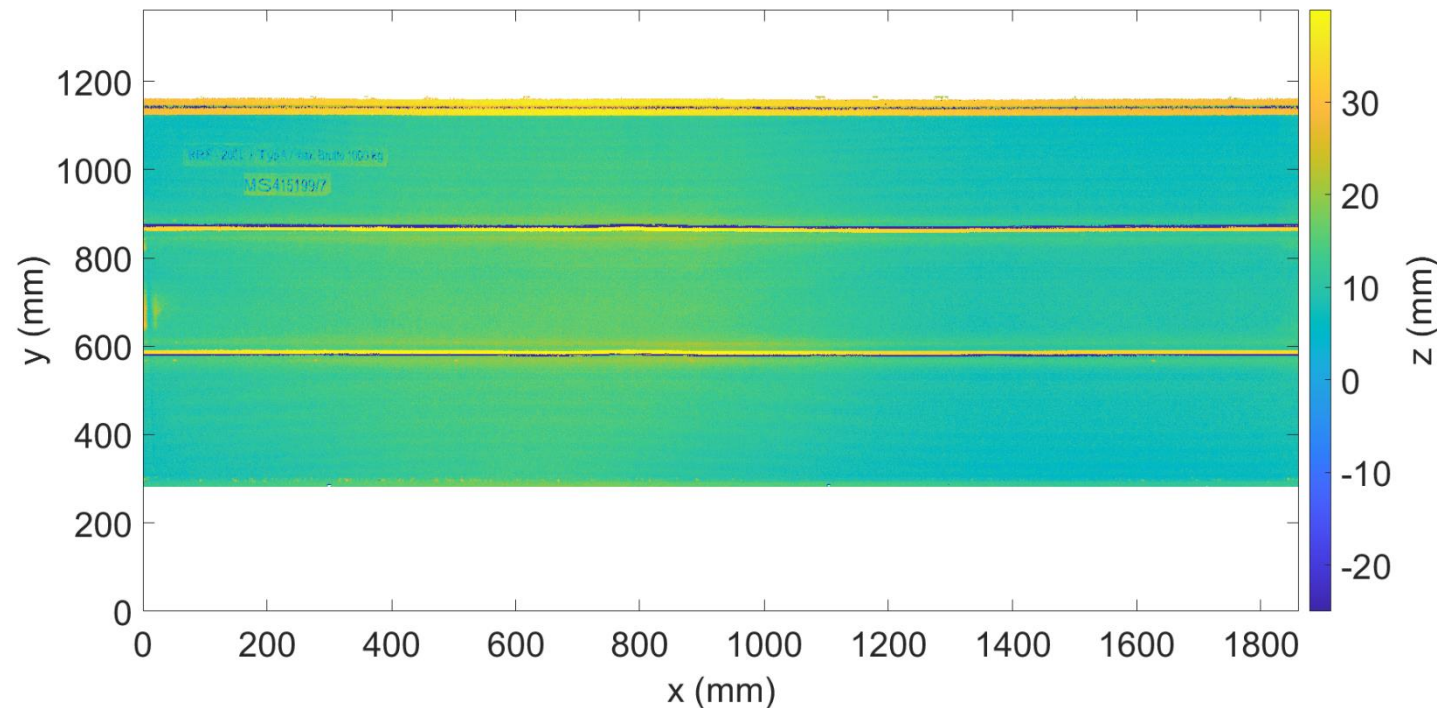
Inspection process: Laser line profile sensor

- Drum shell and drum lid scan



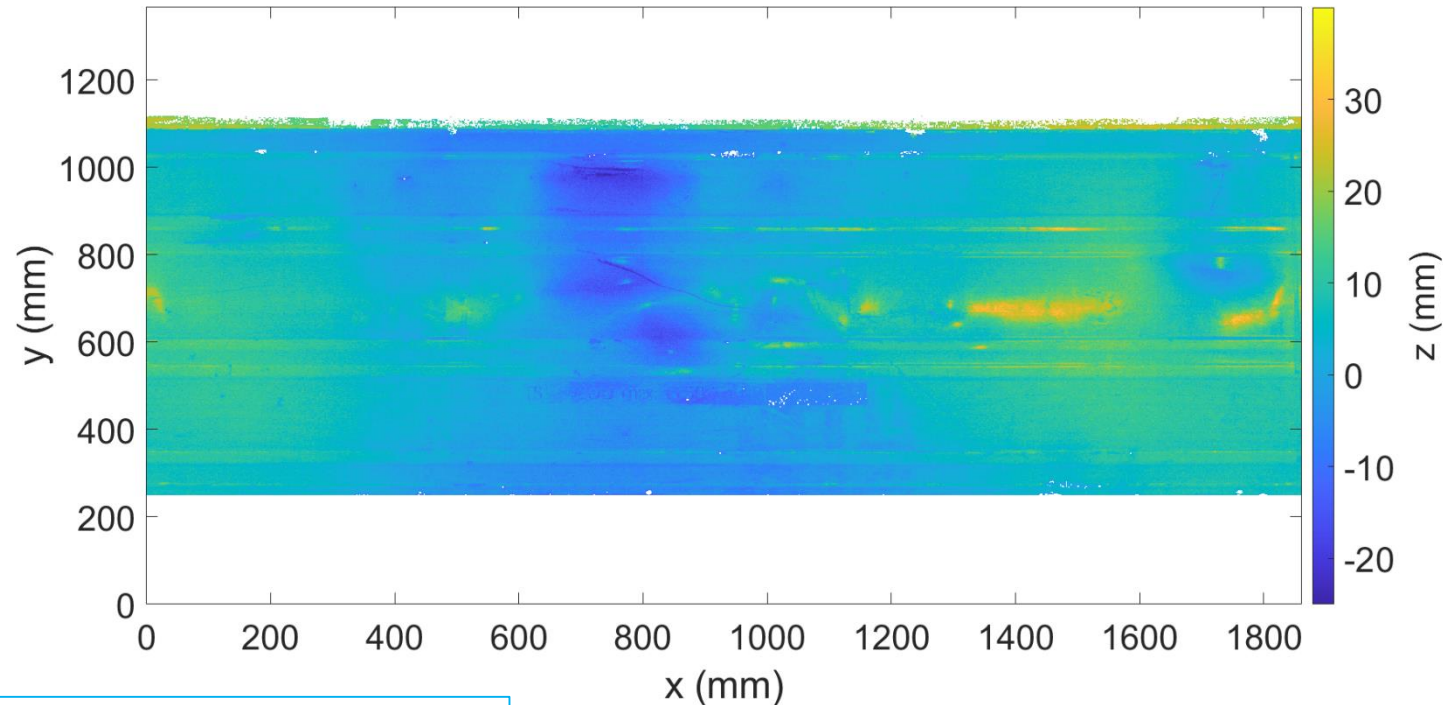
Results: Laser line profile sensor

- Height map of the unwound drum shell – new drum



Results: Laser line profile sensor

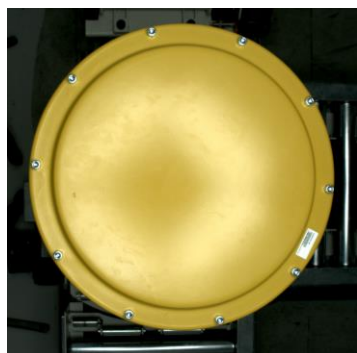
- Height map of the unwound drum shell – damaged drum



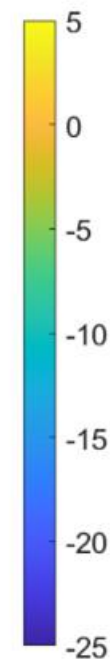
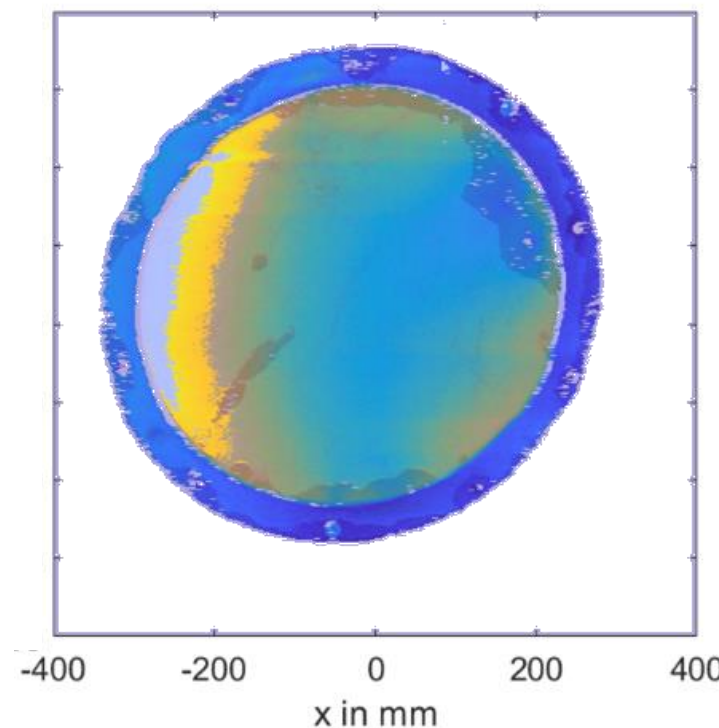
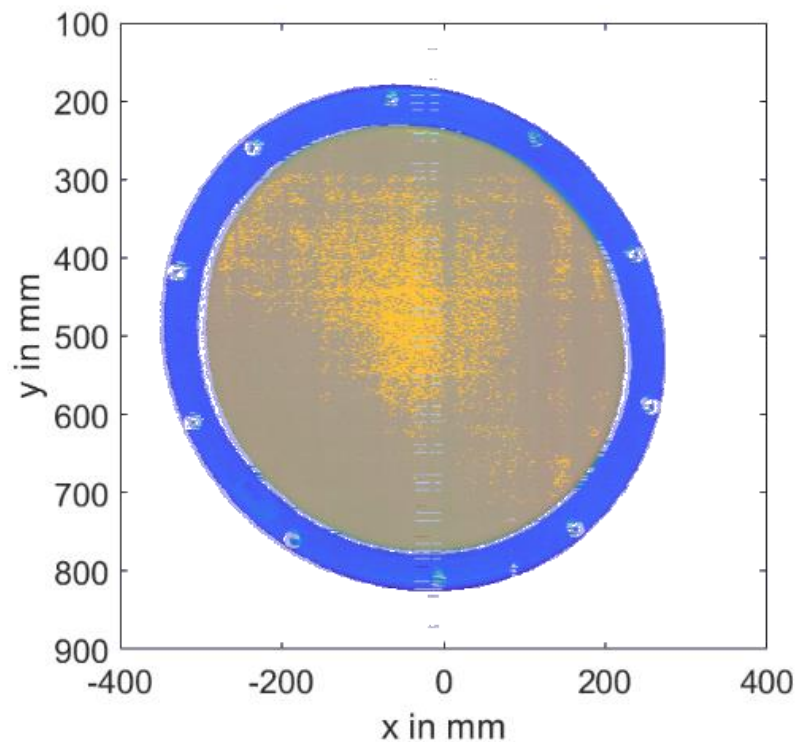
➤ Detection of geometric damage, such as bumps and dents

Results: Laser line profile sensor

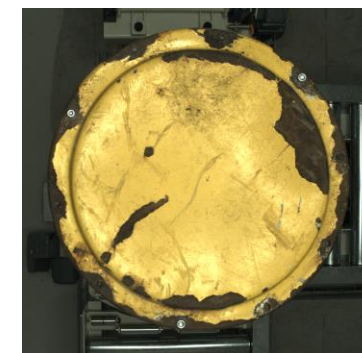
- Height maps of the drum lid – new and damaged drum in comparison



new drum



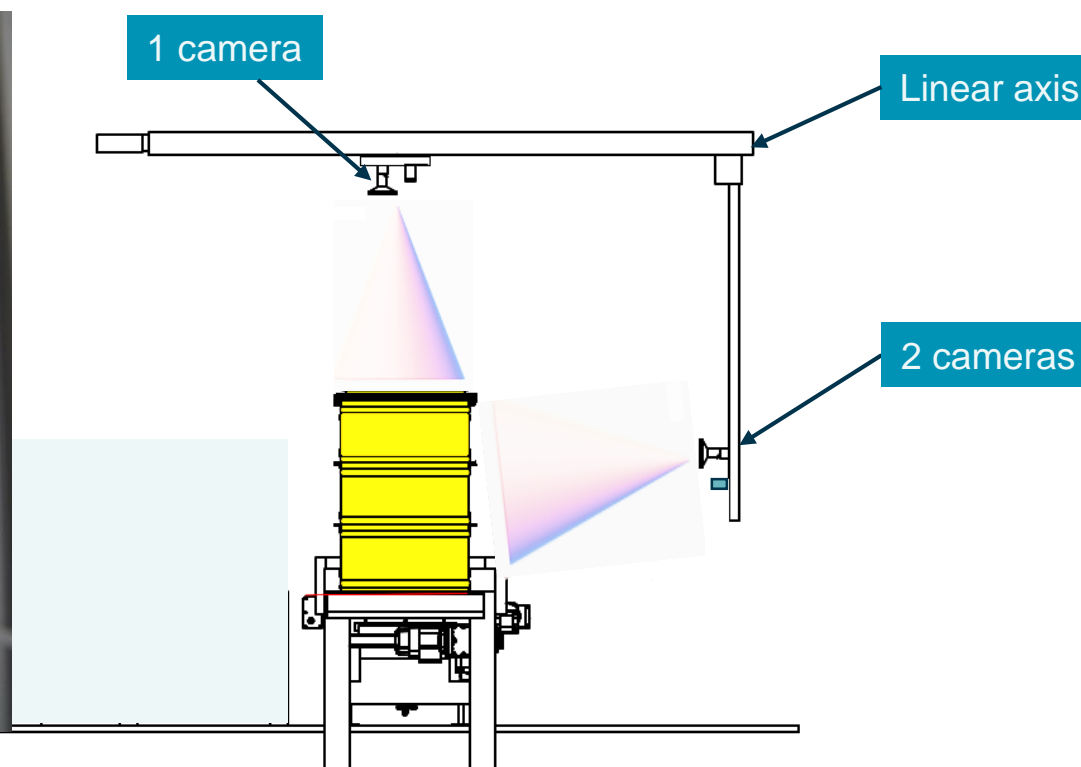
z in mm



damaged drum

Inspection process: Camera

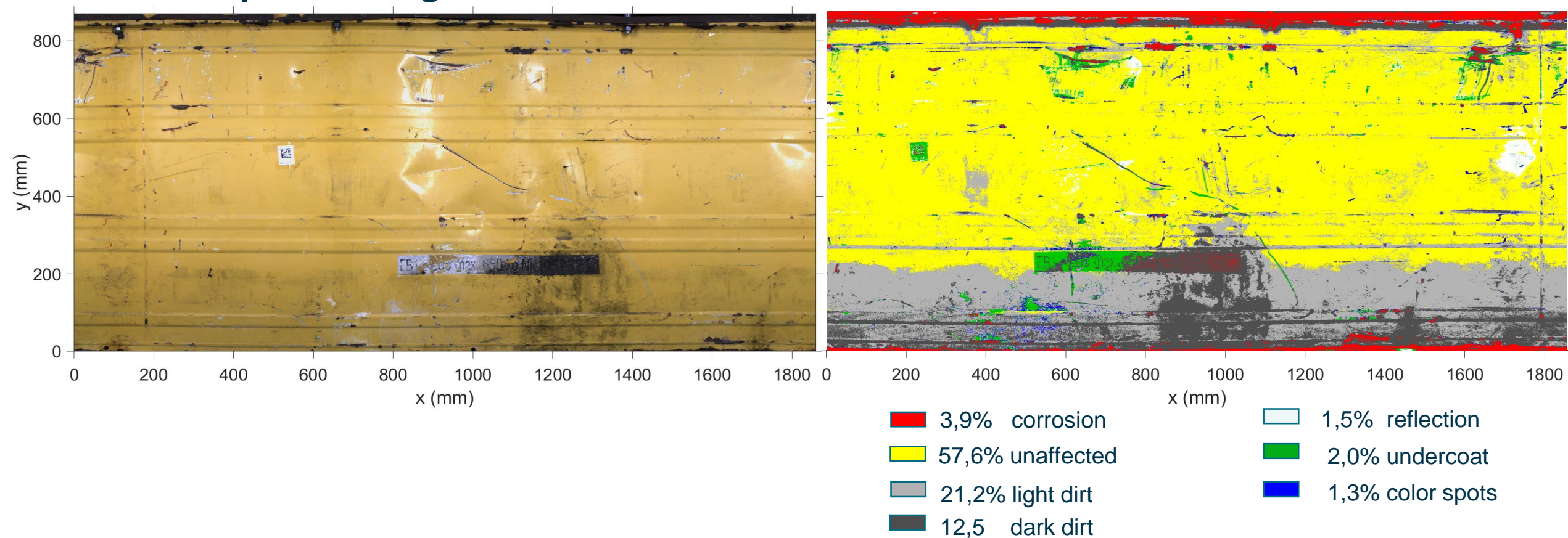
- Drum shell and drum lid photograph



➤ Detection of the smallest, visual changes in the surface structure → corrosion

Results: Camera

Composite image of the unwound drum shell and classification



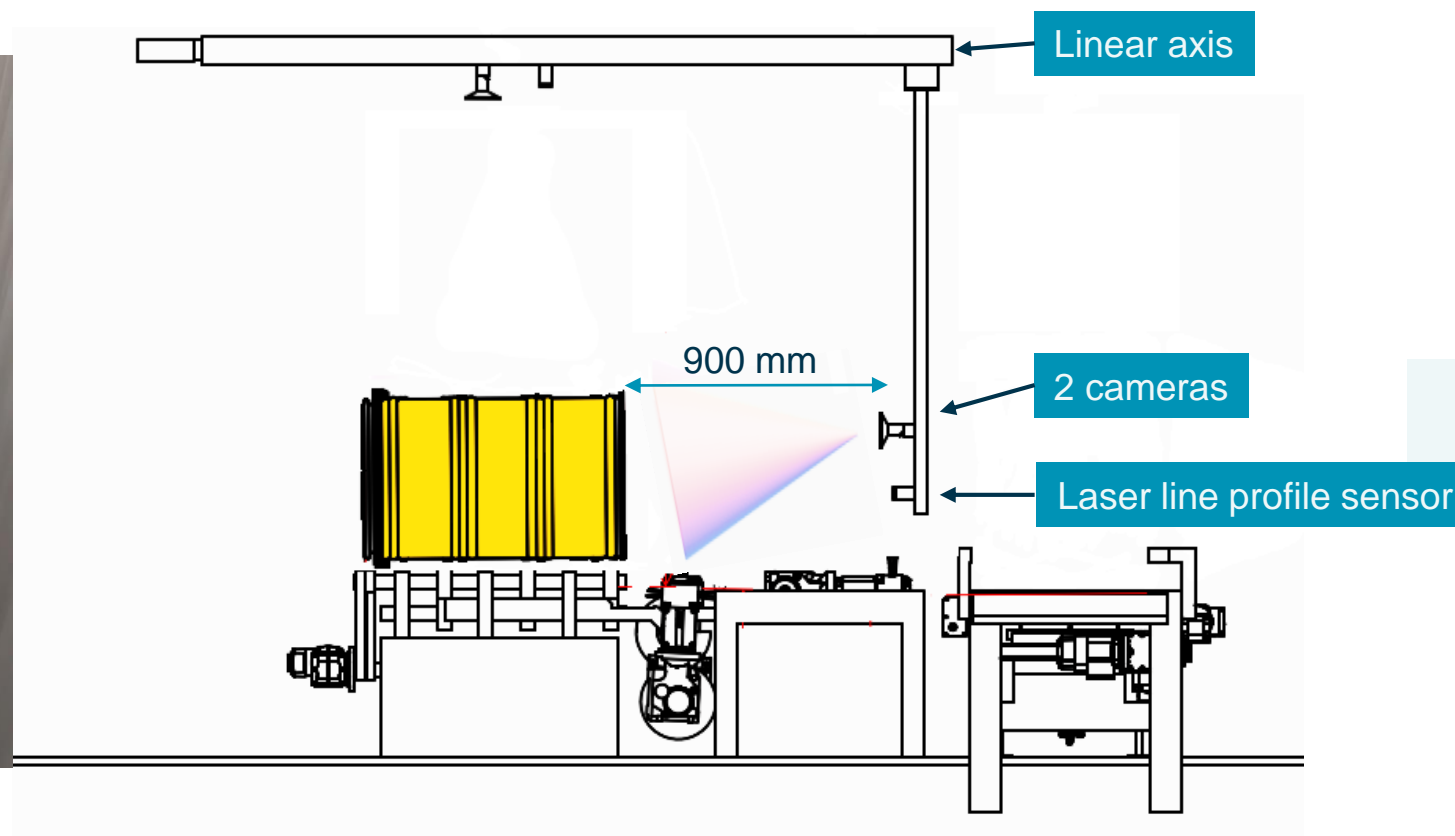
Inspection process

- **Drum on tipping system** - Drum is carried to the **tipping system** and gets tipped

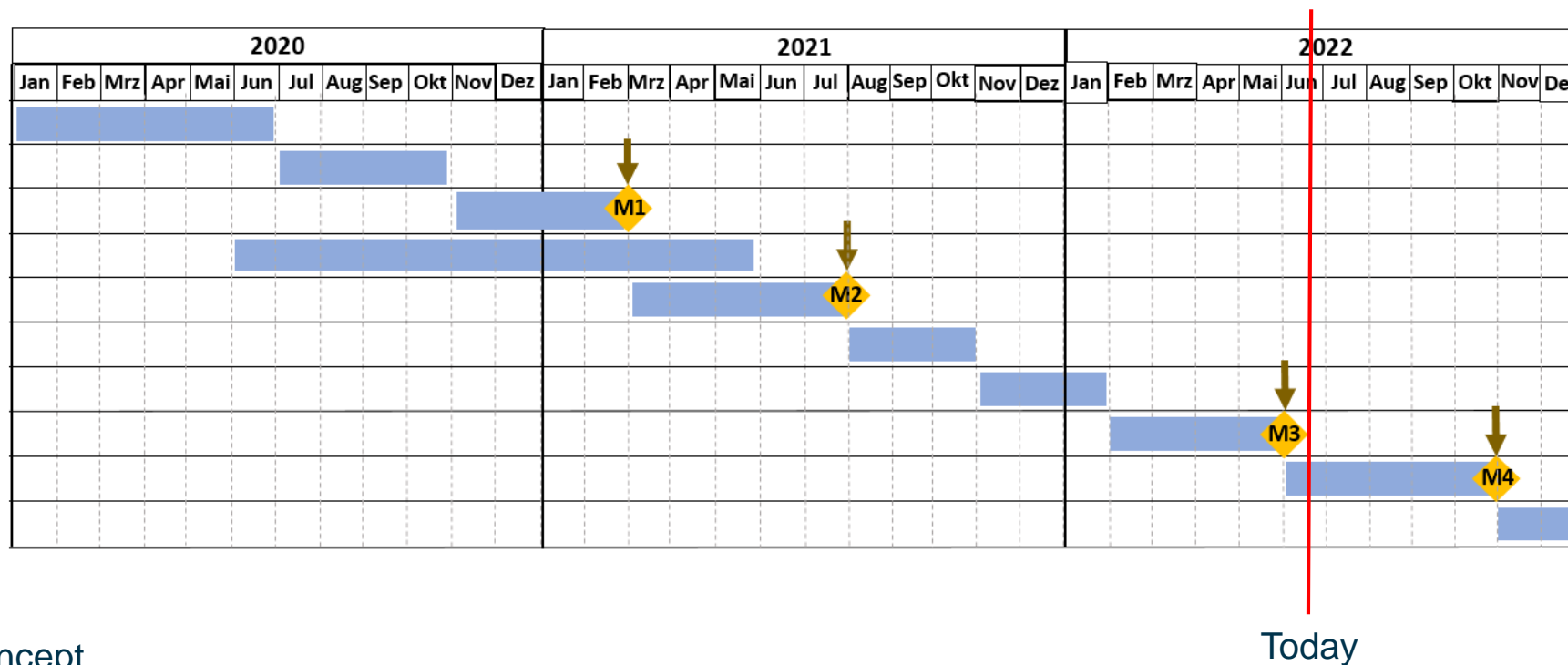


Inspection process

- Drum bottom scan and photograph



Timeline



Milestones

M1 Finished Concept

M2 Demonstrator 1.0

M3 Final maturity Demonstrator 1.0

M4 Final maturity Demonstrator 2.0

Today

Thank you very much for your attention!