



HUMBOLDT-UNIVERSITÄT ZU BERLIN



# Identification of sewer damages using intelligent image analysis - project AUZUKA

BLUE PLANET - Berlin Water Dialogues, 25 February 2021

Daniel Sauter (Berliner Wasserbetriebe)

GEFÖRDERT VOM



Bundesministerium  
für Bildung  
und Forschung



PHOTONIK  
FORSCHUNG  
DEUTSCHLAND

# Project goals

AUZUKA



## Assistance system for productivity and quality enhancement based on...

... existing 2D camera technology

- AI-based damage detection tool
- Damage measurement tool

lessons  
learned

... novel 3D camera technology

- Development of 3D-camera system including carrier vehicle
- AI-based damage detection tool
- Damage measurement tool

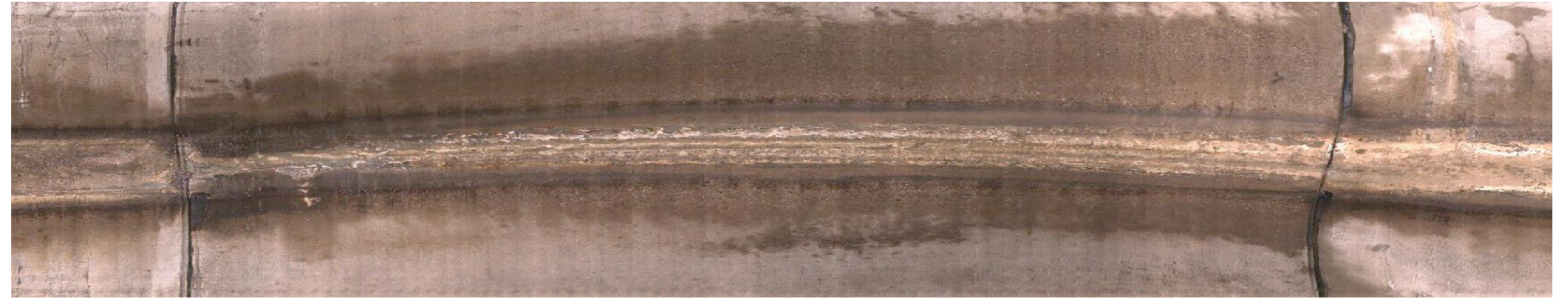
# Assistance system for damage analysis



- Basis: Images from digital fisheye cameras

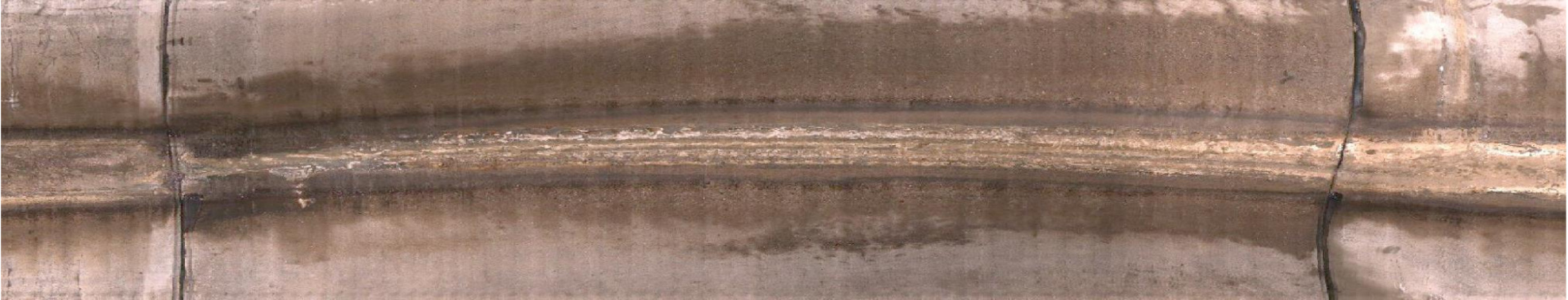


Perspective from inside the pipe

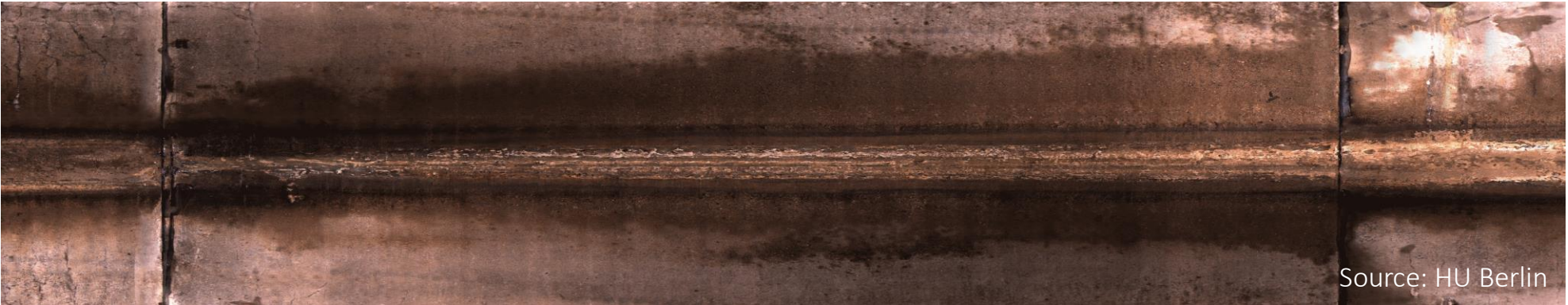


Unwrapped inner surface of the pipe

# Assistance system for damage analysis



Original



After Re-engineering

Source: HU Berlin

# Assistance system for damage analysis



- Convolutional Neural Network architecture:
  - RetinaNet (results on following slide)
  - recently replaced by EfficientDet
- Training data set: 90 sewer reaches
- Damage Labelling with bounding boxes
- Discrimination of different 10 damage types (according to the BWB catalogue)

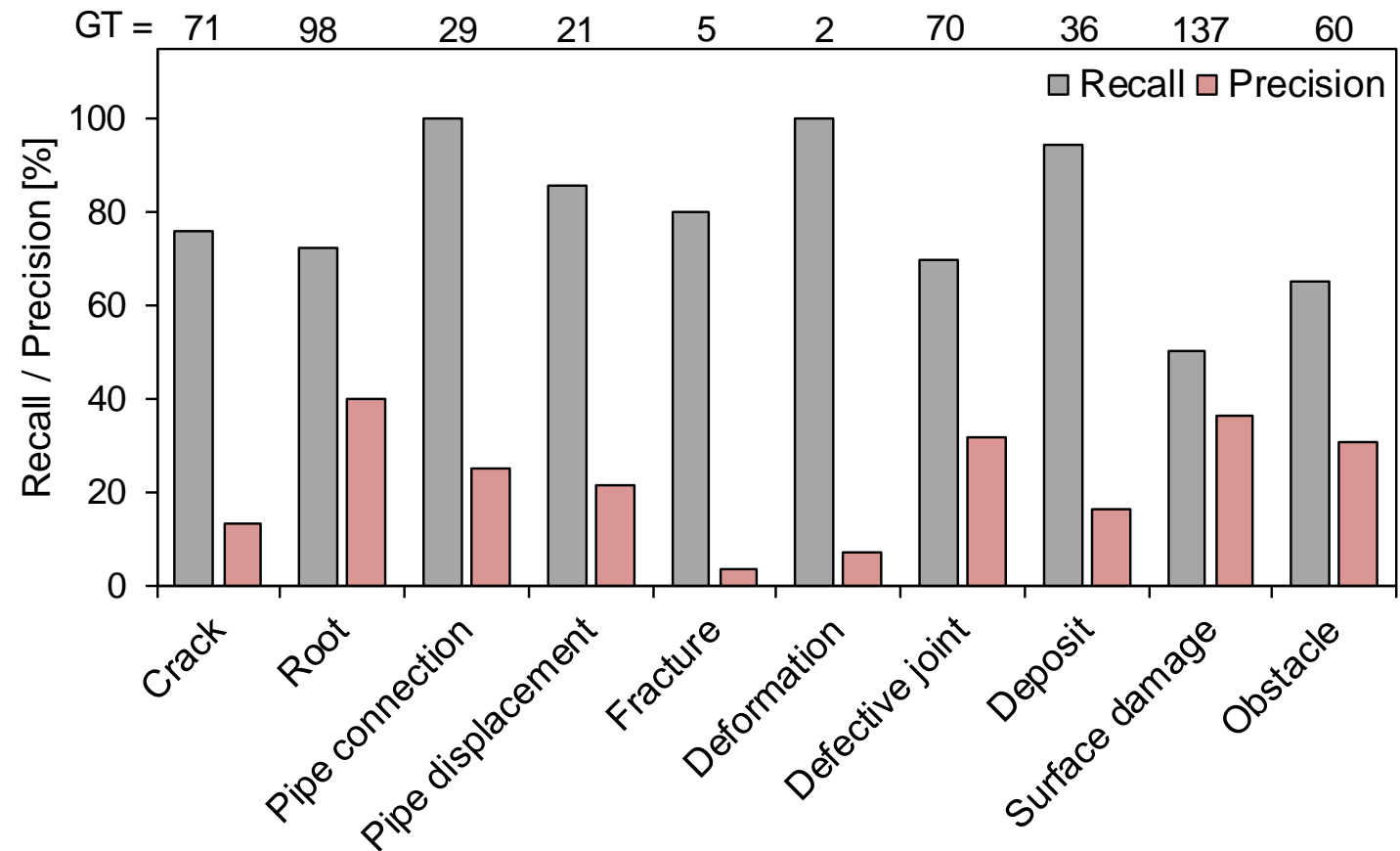


Source: e.sigma

# Assistance system for damage analysis



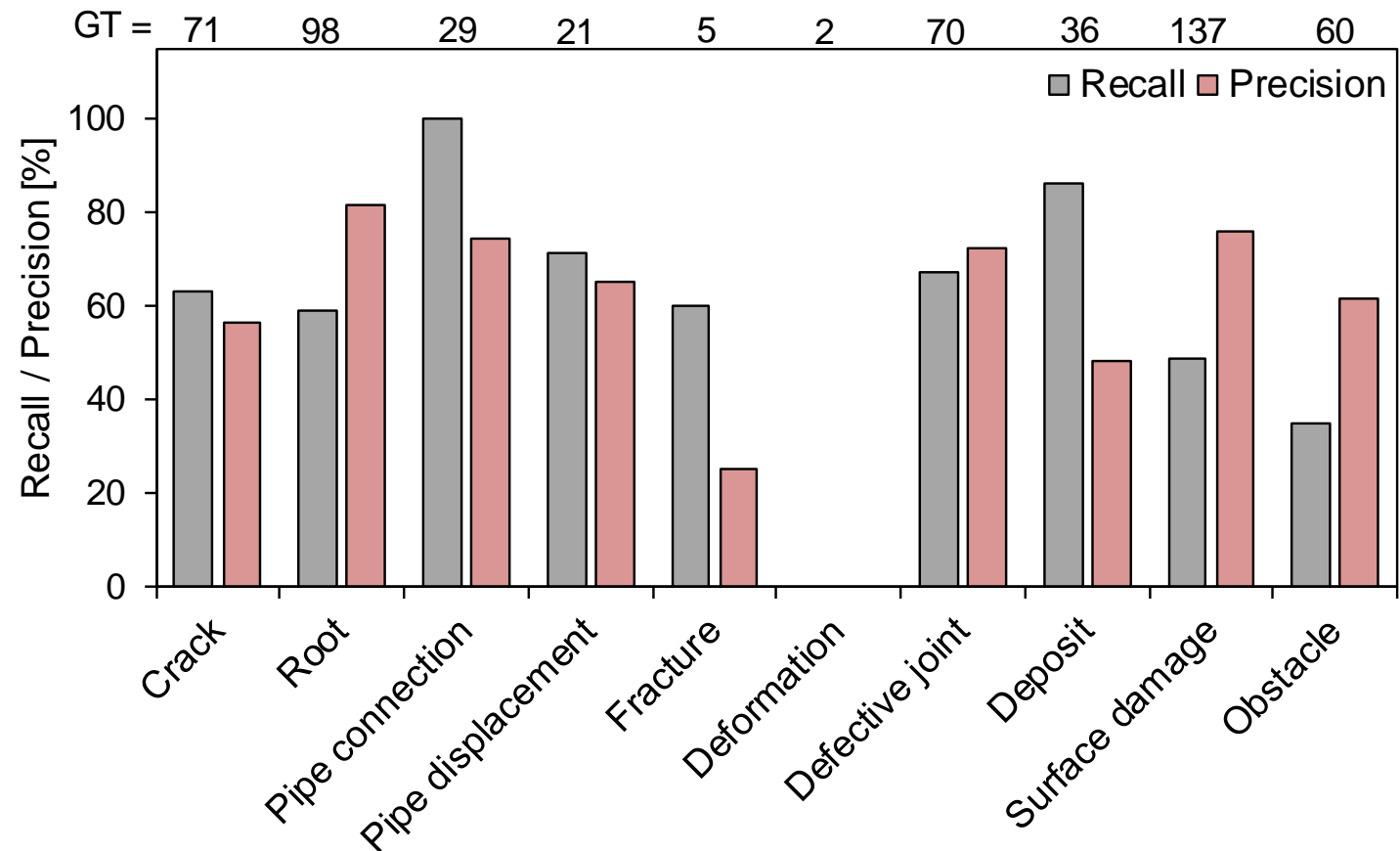
- **Recall:** Percentage of real damages that were detected by AI
- **Precision:** Percentage of AI-detected damages that are real damages
- **Ground truth (GT):** number of real damages
- Results for **all** detected damages:
  - 79 % Recall on average
  - 23 % Precision on average



# Assistance system for damage analysis



- **Recall:** Percentage of real damages that were detected by AI
- **Precision:** Percentage of AI-detected damages that are actual damages
- **Ground truth (GT):** number of real damages
- Results for damages detected with confidence score  $\geq 0.25$ :
  - 59 % Recall on average
  - 62 % Precision on average

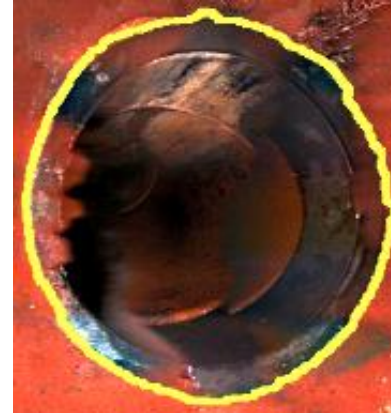


# Assistance system for damage analysis



- Automatic recognition of damage boundaries
- Pixel-based calculation of length, width, area etc. of the damage
- Realised for cracks, fractures and pipe connections
- Tool is currently integrated into inspection software

Pipe Connection



Fracture



Crack



Source: ZBS

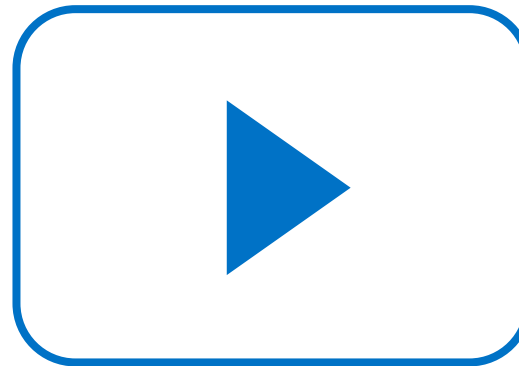


# Assistance system for damage analysis



- Integration of all components in one user-friendly software
- Control of automatically annotated damages by sewer inspection experts
- Operational test at Berliner Wasserbetriebe in 2021 → processing of several thousand sewer reaches

## Demonstration video



Source: e.sigma

# References



- Künzel, J., Werner, T., Möller R., Hilpert, R., Waschnewski, J., Eisert, P., 2018. Automatic Analysis of Sewer Pipes Based on Unrolled Monocular Fisheye Images. IEEE Winter Conference on Applications of Computer Vision. Lake Tahoe, NV/CA.
- Waschnewski, J., Hilpert, R., Sauter, D., Eisert, P., Künzel, J., Schalter, B., Sympher, K.-J., Jöckel, U., Kresin, K., Franke, K.-H., Kapusi, D., Döhring, R., Woock, P., Zimmermann, F., 2020. Kanalzustandserfassung: Perspektiven mit neuartigen 3D-Bilddaten und mit KI in der 2D- und 3D-Bildauswertung am Beispiel des BMBF-Projekts AUZUKA. Korrespondenz Abwasser, Abfall 4/2020.



# Thank you for your attention!

Daniel Sauter  
Berliner Wasserbetriebe, Neue Jüdenstraße 1, 10179 Berlin  
daniel.sauter@bwb.de • berlinerwasser.de

GEFÖRDERT VOM



Bundesministerium  
für Bildung  
und Forschung



PHOTONIK  
FORSCHUNG  
DEUTSCHLAND



HUMBOLDT-UNIVERSITÄT ZU BERLIN

