Place

Seminar Room: 4.521
Aalborg University,
Rendsburggade 14
9000 Aalborg, Denmark.
Online: Zoom

Date

Wednesday June 15, 2022

Program

13:00 – 13:05
Moderator Rikke Gade
welcomes the guests

13:05 - 13:50
Presentation by Joakim
Bruslund Haurum

13:50 – 14:05
Break

14:05 – 16:00 (latest)
Questions

16:00 – 16:30
Assessment and
announcement for the
committee

16:30
Reception

Invitation to PhD Defense

By Joakim Bruslund Haurum

Title

A Deep Dive into Computer Vision Aided Sewer Inspections

Assessment committee

Associate Professor Georgios A. Triantafyllidis
Department of Architecture, Design & Media Technology, Aalborg
University, Denmark

Professor Serge Belongie
Department of Computer Science (DIKU), University of Copenhagen,
Denmark

Professor Graham W. Taylor
School of Engineering, University of Guelph, Canada

Supervisors

Professor Thomas B. Moeslund
Department of Architecture, Design & Media Technology, Aalborg
University, Denmark

Host

Department of Architecture, Design & Media Technology, Aalborg
University, Denmark

Information

The defense will be conducted in-person and via Zoom. For participating
in the Zoom meting use the following link and information:

https://aaudk.zoom.us/j/67276100441

Meeting ID: 672 7610 0441

Passcode: 218782

If you wish to participate in the reception, please sign up via Google
Forms: https://forms.gle/uWsjWbmLWX1Yt3Hp8

Abstract

The sewerage infrastructure is a critical infrastructure of modern society, which requires regular inspections. However, due to the large extent of the infrastructure it is infeasible to inspect all parts regularly through manual inspections. This Ph.D. thesis addresses the topic of computer vision aided automation of sewer inspections through two input modalities: images and point clouds.

Within image-based automation of sewer inspection, we investigated the fundamental historic hindrances of the research field, and how the field can be advanced. Through a survey covering nearly three decades, we found that the research field was lagging behind the general computer vision field by several years and pinpointed three major hindrances: A lack of public data, open-source code, and a common evaluation protocol. Using data from three Danish water utility companies, we released the world's first publicly available sewer multi-label defect classification dataset: Sewer-ML. Using Sewer-ML we benchmarked 12 state-of-the-art algorithms implemented in an open-source codebase, evaluated using two domain-influenced evaluation metrics. Through this analysis, we documented the need for further research in the field.

We advanced the image-based automation of sewer inspections field by first considering the equally important tasks of water level, pipe material, and pipe shape classification. An initial investigation using a subset of Sewer-ML and common computer vision models found that the water level in sewer pipes is better classified when using water level labels based on visual appearances compared to exact quantities. Building upon this result, we demonstrated the effectiveness of a multi-task classification approach for classifying all four tasks at once and presented a method to improve performance by incorporating known relationships between classes across tasks. We also extended the recent Hybrid Vision Transformer with multi-scale features and a clustering-based tokenizer in order to capture the spatial semantics of sewer defects, achieving significant improvements within sewer defect classification.

Within the point cloud-based automation of sewer inspections field we presented a synthetic sewer point cloud generator to circumvent the lack of real life data. Using the synthetic data generator and data recorded from a laboratory setup, we released the world's first point cloud-based dataset for sewer defect classification and compared performance of the PointNet and DGCNN models. Through this analysis, we verified the usefulness of synthetic point clouds for training sewer defect classification models.