

# TACK – Tunnel Automatic Crack Detection

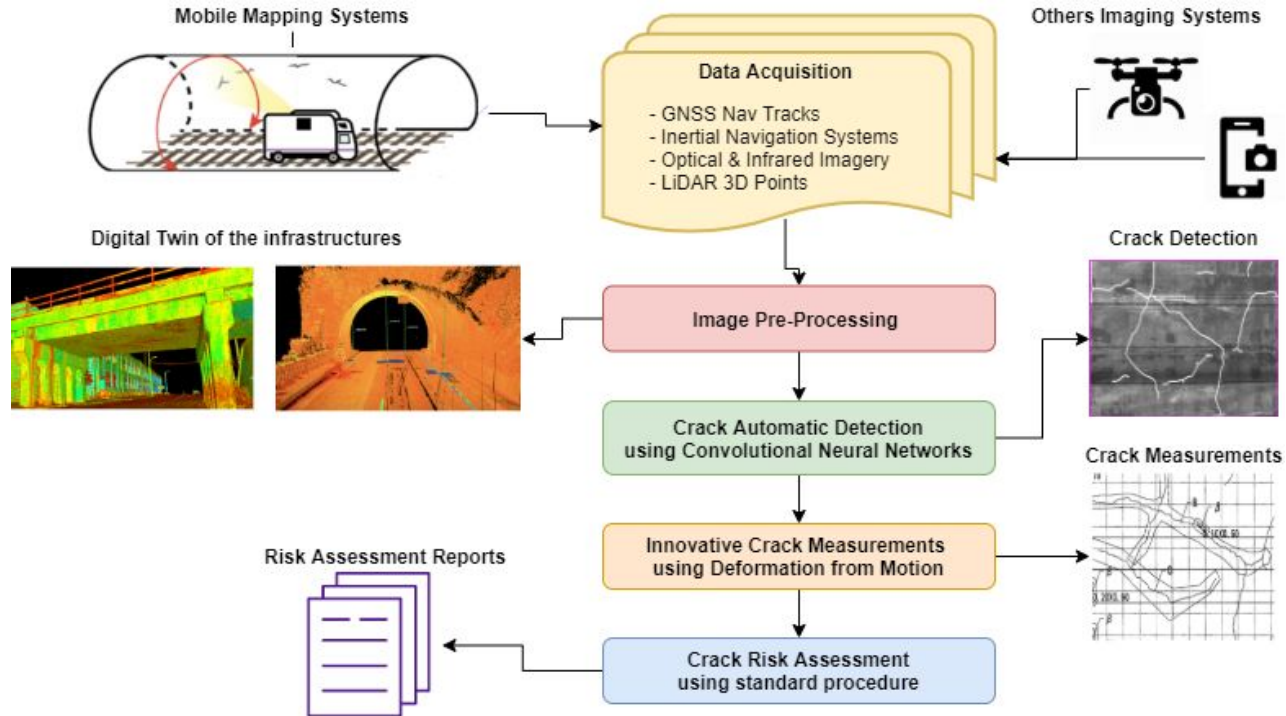
October 28, 2021



SAPIENZA  
UNIVERSITÀ DI ROMA



# The TACK project



# Deep-Learning

- **Convolutional Neural Networks (CNN)** are powerful deep-learning techniques for automatic feature extraction and classification problems
- CNN use annotated datasets to learn how to recognise specific patterns in new unseen images

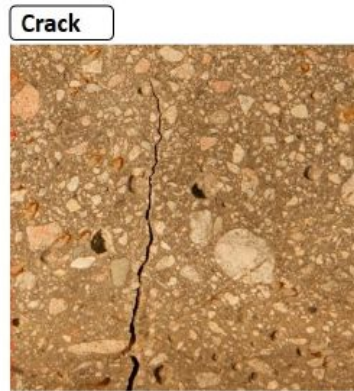
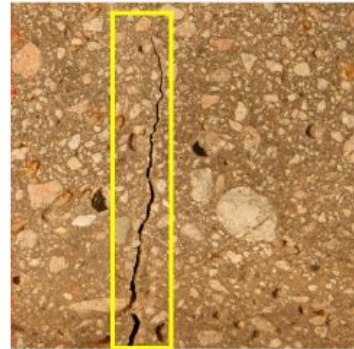
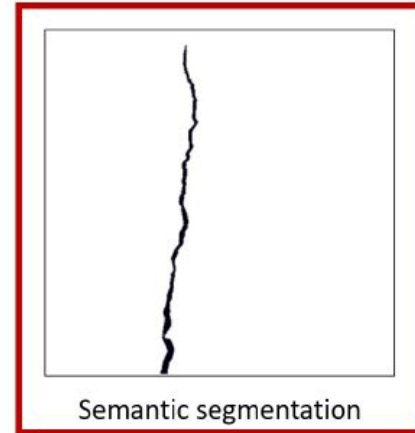


Image classification

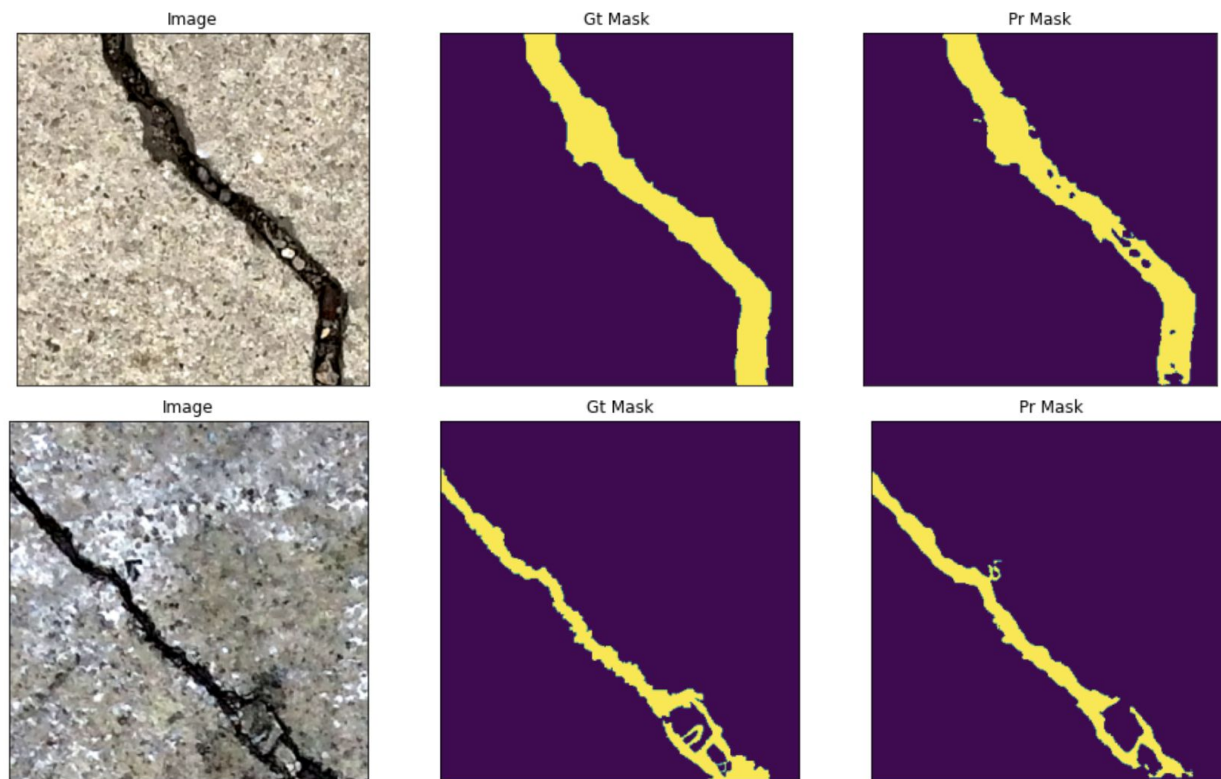


Object detection



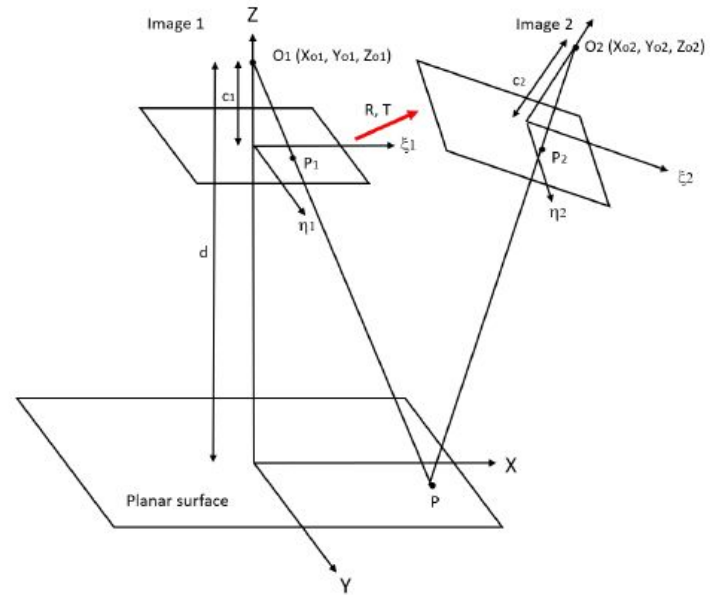
Semantic segmentation

# CNN performance on the test set

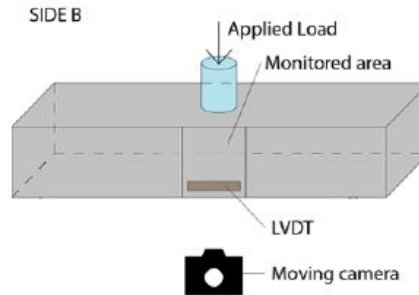
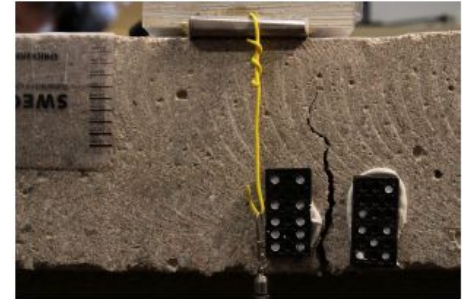
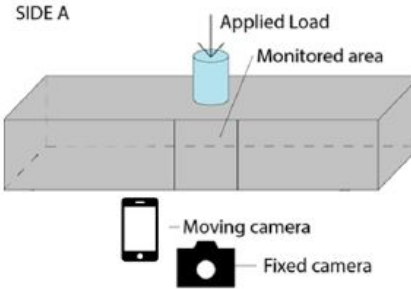


# Photogrammetry - Deformation from Motion

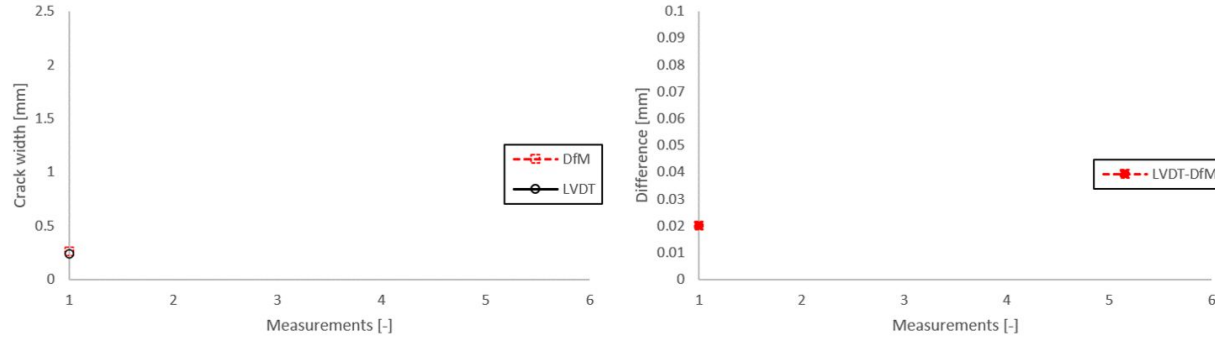
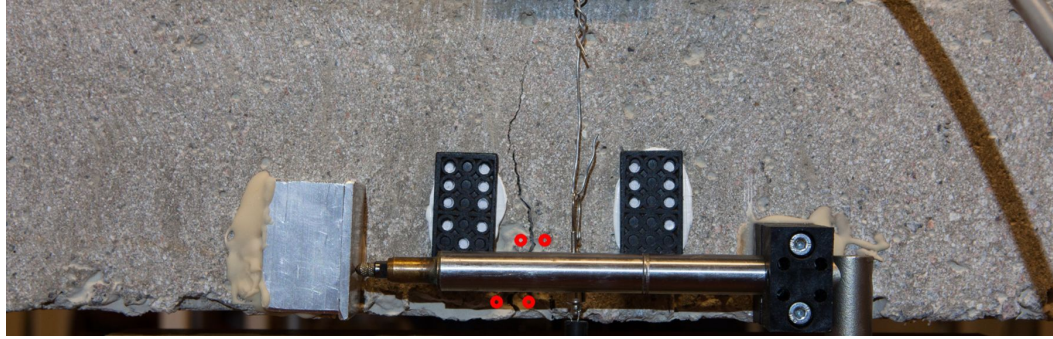
- How to measure the damage using images acquired from **different positions?**



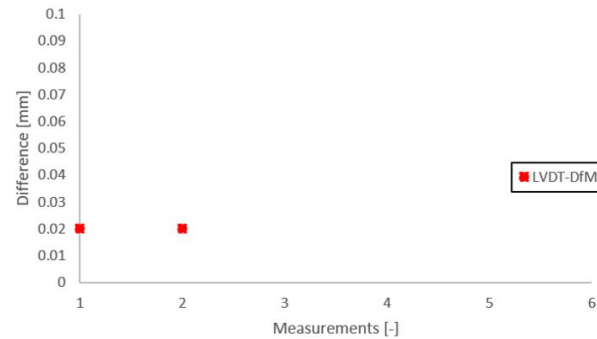
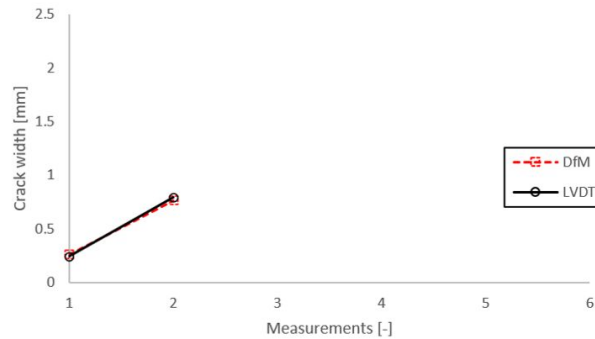
# Laboratory test



# Results assessment

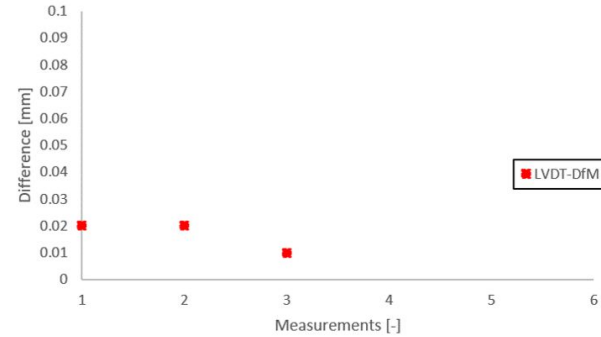
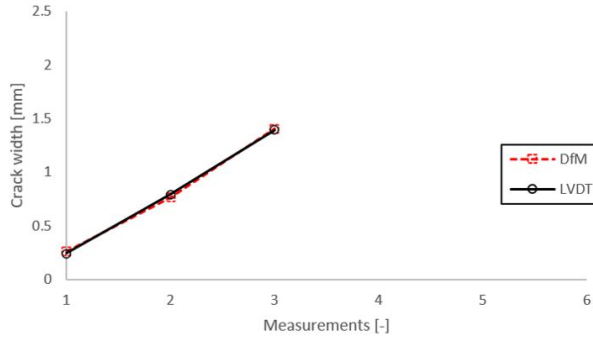


# Results assessment

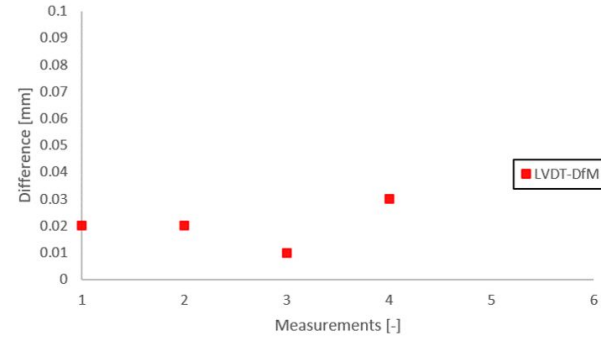
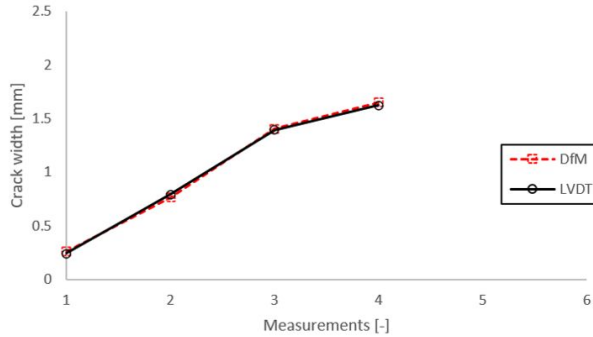




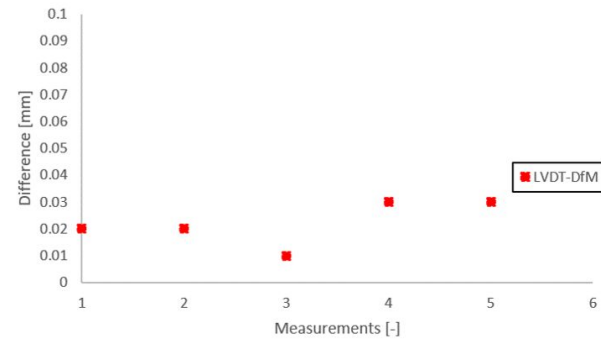
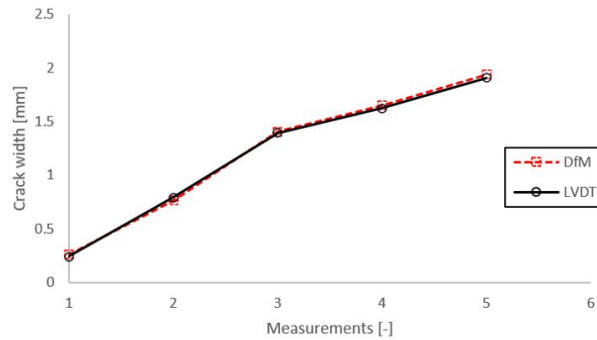
# Results assessment



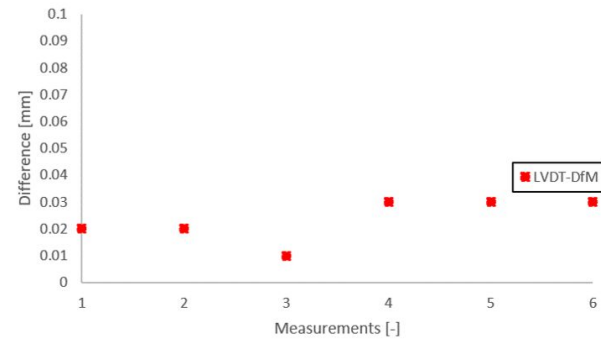
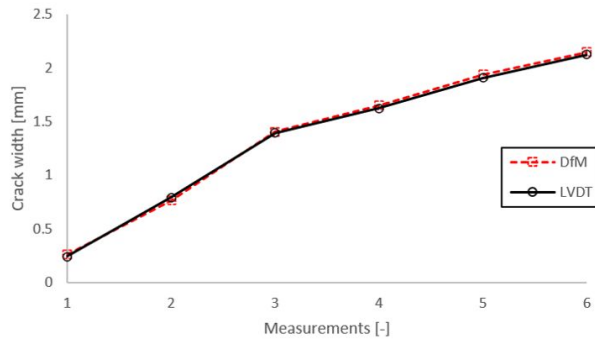
# Results assessment



# Results assessment



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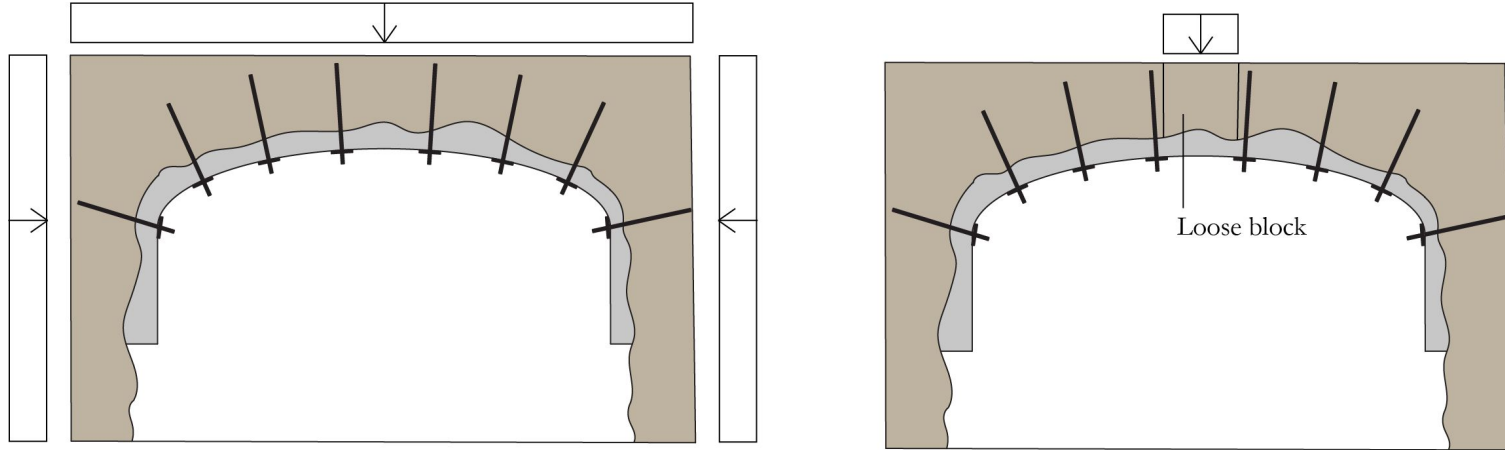


# Risk Assessment

- Assess the risk associated with cracks in the shotcrete
- Today, cracks are assessed based on a combination of metrics, location, cause and description
- To automate, cracks must be assessed based on measurable parameters, e.g. metrics and location



# Load Cases



Settlement of rock mass and gravity load from a loose block

Structural capacity is compared between uncracked state and several different cracked states to assess the impact of single and multiple cracks with different metrics

# Implementation

Small scale implementation:

Support from KTH Innovation with marker survey and development of prototype.

Development of a mock-up of a cloud based SaaS solution for high-accuracy measurements.

Based on technology from project.



# Steps for Implementation

1. Proof of Concept



5. Implementation



# Steps for Implementation

1. Proof of Concept
2. Validation of accuracy



5. Implementation

# Steps for Implementation

1. Proof of Concept
2. Validation of accuracy
3. Data management



# Steps for Implementation

1. Proof of Concept
2. Validation of accuracy
3. Data management
4. Time and Funding



5. Implementation