

# Cross-modal Data Integration: Digital Twins for Bridge Maintenance

## Description

SwissInspect utilizes advanced drone technology and AI structural analysis to provide innovative maintenance solutions for bridge infrastructure. This project builds on those capabilities by integrating diverse data artifacts, such as 3D mesh reconstructions and AI damage reports, into a unified structural model representation. The resulting integration will enable users to seamlessly visualize and access this cross-modal information through a user-friendly frontend.

## Task

- **Data Exploration:** Familiarize yourself with the available data representations and formats
- **BIM Development:** Create a simplified BIM model of a bridge to complete the missing data modality
- **Alignment:** Develop a method for automated spatial registration to sync data across different modalities.
- **Interactive Visualization:** Build a web-based viewer to make the aggregated data in this “Digital Twin” accessible and interactive for users.

References: <https://xeokit.io/> <https://thatopen.com/> <https://open3d.org/>

- Context:
  - Pantoja Rosero, Bryan & Chassignet, Adrien & Rezaie, Amir & Kozinski, Mateusz & Achanta, Radhakrishna & Beyer, Katrin. (2024). Partial annotations in active learning for semantic segmentation. *Automation in Construction*. 168. 105828. 10.1016/j.autcon.2024.105828.
  - Binni, Leonardo, et al. "An Automatic Registration System Based on Augmented Reality to Enhance Civil Infrastructure Inspections." *Buildings* (2075-5309) 15.7 (2025).

## Project Characteristics

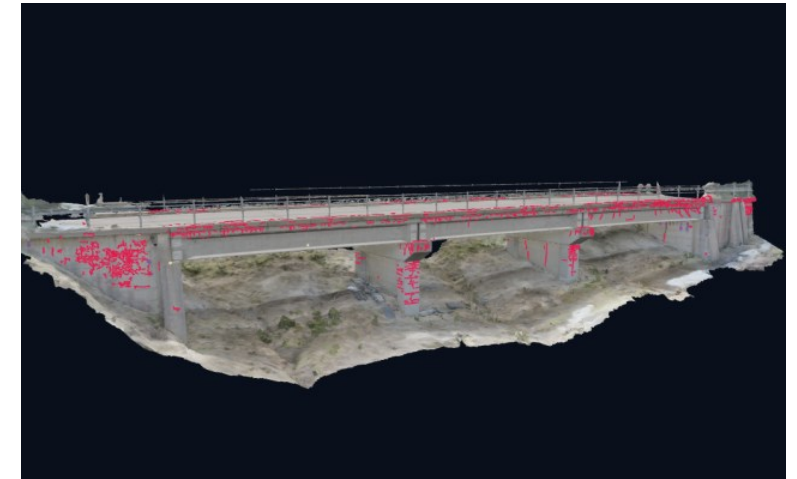
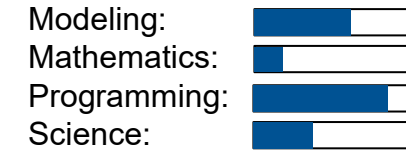


Figure 1: Reconstructed textured mesh model with highlighted damages (adapted from <https://swissinspect.io/>)