Geometric and Model Updating of a Railway Bridge Pier through 3D Reconstruction

MA RAN

Keywords: 3D reconstruction, geometric updating, model updating

【Background】

Structural Health Monitoring (SHM) systems can integrate diverse data sources, including 1D, 2D, and 3D data. While 1D and 2D data are commonly used, 3D point cloud data captures comprehensive 3D geometric and spatial features of structures, facilitating detailed analysis of structural response. However, the application of 3D point cloud data is constrained by several challenges, including high acquisition costs, irregular meshing of derived FE models, and insufficient consideration of environmental impacts on boundary conditions. Addressing these limitations is crucial for advancing the practical implementation of 3D data in SHM.

【Objective】

This study investigates the potential of geometric and model updating techniques using multi-view images, with a focus on a real-world pier structure. The research aims to enhance the accuracy and reliability of geometric representations by leveraging image data. By integrating structural responses, the geometrically updated finite element model is further updated to achieve as-built structural conditions, enabling more precise assessments of structural integrity and degradation

【Approach】

1. Structure from motion
2. Topology optimization
3. PSO optimization

【Publication plan】

・IABSE 2025
・A journey paper after combining sensor data for scour assessment

【Results】

The geometrically updated model achieved centimeter-level accuracy, and the updated finite element model demonstrated a high degree of agreement with the rocking modes obtained from impact vibration tests.

Point cloud from image

Reprojection error of point cloud
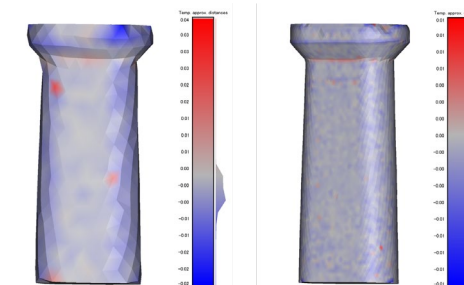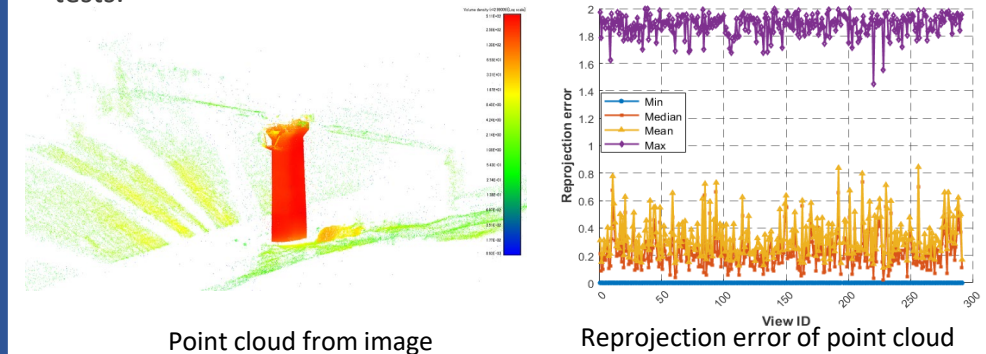
Geometry updating results using different levels of seeds density
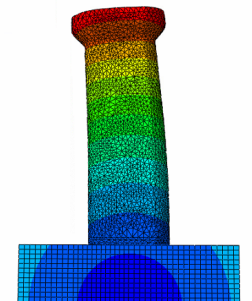
Identified rocking mode (9.15Hz) after model updating