62. AI-assisted 2D-to-3D crack mapping for structural assessment and planned maintenance across underground, infrastructure and Cultural Heritage assets

Alessandra Spadaro

1 Department of Environment, Land and Infrastructure Engineering (DIATI), Politecnico di Torino, 10129 Turin, Italy

Reliable crack mapping is essential for structural assessment and planned maintenance, yet image-based detections remain difficult to interpret metrically when assets present complex geometries, heterogeneous materials and variable acquisition conditions. This study presents a prompt-based multi-view workflow that transfers crack detections from an oriented photogrammetric image block onto the reconstructed surface. Text-prompted masks generated with Segment Anything Model 3 are projected through the calibrated camera geometry and integrated into a surface-constrained automatic 3D crack support. Recovery, metric correspondence and continuity are assessed against manually traced 3D references. The workflow was evaluated on an underground calcarenite chamber, a masonry bridge and a decorated heritage vault. All references in the underground and masonry datasets were substantially recovered. In the more demanding decorated-vault dataset, characterized by millimeter-scale cracks and a radiometrically complex surface, six of thirteen traces were substantially recovered, including three completely recovered within 10 mm. The results demonstrate the potential of combining complementary observations from the complete image block to generate metrically assessable 3D crack representations for documentation, targeted inspection and maintenance planning.