Poster: Visualising and communicating data from non-destructive testing using extended reality technology for infrastructure and environmental asset monitoring.

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Abstract

Built infrastructures including road, buildings and airport terrains are critical to sustaining societal functionality and safety. Despite their importance, these structures inevitably degrade over time. Remote non-destructive testing (NDT) technologies, such as Ground Penetrating Radar (GPR) and Light Detection and Ranging (LiDAR), employ sensors to inspect the condition of these assets, generating large volumes of data (e.g., position, deformation, velocity, displacement). These datasets are essential for identifying cracks, structural weaknesses, and variations in electromagnetic or thermal properties.

Traditionally, data visualisation has been limited to two-dimensions (2D) screens, which inherently lack true depth perception, restrict viewing angles, and reduce interactivity challenges that affect the accurate interpretation of subtle defects or complex information.

To address these limitations, this project explores the design of effective three-dimensional (3D) Extended Reality (XR) environments for visualising and communicating NDT sensor data. A systematic review of existing approaches to XR-based visualisation is being conducted, with a focus on three key domains: civil infrastructure, green infrastructure and heritage assets. Relevant stakeholder groups are being identified and engaged throughout the process.

The project follows an agile design science research methodology, enabling an iterative development of XR artefacts based on continuous stakeholder interaction and feedback. Early prototypes, including a visualisation of runway deformation data through a 3D runway model overlaid with sensor outputs, are informing the evolving design. Artefacts are progressively evaluated to ensure their effectiveness and usability, with refinements being incorporated as the research advances.

The findings of this study are expected to contribute to the maintenance of the civil, green and heritage infrastructures. Furthermore, the project aims to deliver practical and theoretical guidelines on how to integrate sensor data into XR environments and to demonstrate how 3D data visualisation can enhance the interpretation and communication of detected degradation and displacement in infrastructures.

Keywords

Non-destructive testing, Extended reality technology