Robotic and Sensing Systems for Automated Visual Inspections of Infrastructures

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The aging UK rail Infrastructures are subject to regular condition assessment. In particular, the structural maintenance works are often required to mitigate the deterioration due to age and severe weather condition. However, the current structure examination practices are facing three major challenges:

1. There are very limited experienced engineers for assessing a large stock of structures in the UK. For example, only 100 inspectors who are subcontracted by Network Rail from the company Amey are doing the visual inspection of 40,000 railway structures in the UK. These structures need to be inspected at least once a year.
2. The inspection of many infrastructure sites like railway bridges often requires carrying out difficult access works. Working at height is one of the major safety concern. In addition, the inspection usually requires line blockages to avoid working at live track.
3. Most inspection results are recorded in the form of reports. The photos of defects and associated text descriptions in the reports only provide a limited context of the sites. There is a gap between the quality of data collected on site and the information needed for the efficient and reliable structural assessment.

In order to address the challenges, the development of an efficient, safe and high-quality structure examination regime is urgently needed to ensure 4.5 million railway passengers travelling safely every day.

This research aims to revolutionise the current regime of infrastructure structural inspections with latest digital data capture and computer vision technology. In the traditional practice, two or more inspectors are required on site to take pictures and notes of the identified defects. In the new process, only one inspector is needed to use a laser scanner on the ground and remotely controls a customised drone to capture the 'as-is' state of the structures. Figure 1 (a) and (b) show these two ways to collect the spatial data of railway bridges. The data collected terrestrially and aerially will provide a holistic view of the structure including the area that is not accessible by the traditional inspection method. An intelligent system will then generate 3D models of the structures and identify and classify the structural defects automatically. The system will also produce quantified assessment result, and semantically rich models of the structures can be visualised in a customised Augmented Reality (AR) device for on-site and off-site detailed assessment and maintenance planning, as is shown in Figure 1 (c).

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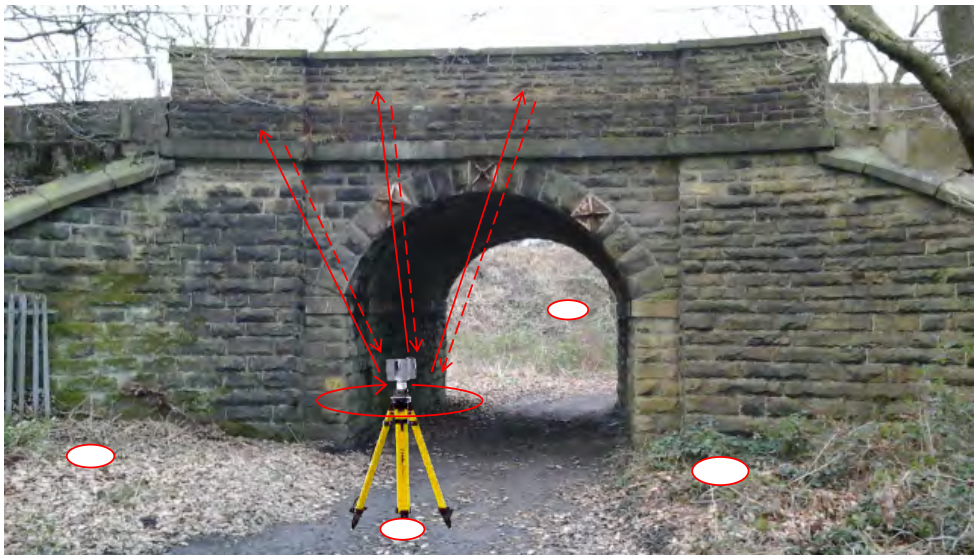
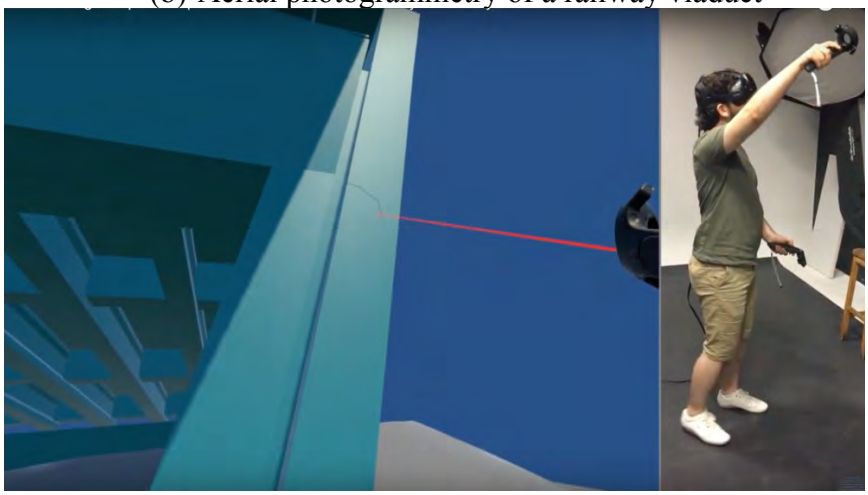


(a) Terrestrial laser scanning of an underline rail bridge

(b) Aerial photogrammetry of a railway viaduct



(c) Examination of the bridge defects

Figure 1 Remote sensing and visualisation of infrastructures