Computer vision beyond black boxes – all eyes on infrastructure and construction

Key benefits
- Understanding the benefits and risks of computer vision (CV) applications for civil engineering
- Identifying suitable CV solutions specific for infrastructure and construction use cases

The field of computer science that is computer vision (CV) brings focus to the creation of digital systems capable of processing, analysing, and making sense of visual data. Computers are programmed to process an image at a pixel level and understand it. Visual information can be retrieved and interpreted through special software algorithms.

Demystifying CV in infrastructure and construction to maximise value

This project applies CV algorithms such as object tracking, data segmentation and image matching to solve specific challenges on civil engineering projects to benefit engineers and ultimately all stakeholders. Potential use cases will be considered in order to assess the specific insights required by an organisation to ensure that CV is a suitable solution. Cost-effective solutions can deliver insights gained from using low-cost cameras and poor-quality images which, in some situations, may provide adequate data. This approach demonstrates the application of CV in infrastructure and construction without over-burdening budgets.

A rigorous assessment of the context for a CV solution and realistic expectation of capability is key to securing value from investment. There is a tendency for some CV projects to make assumptions such as overestimating the accuracy capability of artificial intelligence (AI) and expecting added value from a reduction in error and need for human intervention. In reality, AI relies heavily on labelling and data training which requires a lot of human resource.

Feedback from industry partners to CSIC researchers about experiences applying CV solutions to civil engineering projects has highlighted results falling short of expectations. This project considers the development of standardised descriptions and explanations of CV technology for the sector in order to; enhance understanding and support use of CV in infrastructure and construction, identify when use of CV is appropriate and better manage risk and expectation when planning a new CV approach. For this project CSIC researchers aim to; provide guidelines and a framework for using CV in civil engineering, and gather information from industry practitioners about what the real-world need is for CV and why it has not always worked well in the past.

Infrastructure and construction

The adaptability and wide range of applications for CV makes it potentially very well suited to a variety of civil engineering applications where different structures and sites present challenges for asset managers and developers. These challenges include: identifying people or hazards on a railway line; keeping track of site progress; making sure construction workers operate in a safe environment; supporting autonomous operations; and tracking defects in structures as part of a monitoring system. CV for infrastructure and construction is attracting a number of start-ups developing solutions for the sector.

Other useful applications of CV involve monitoring to assess the best locations for a construction site by analysis of the surrounding environment, the maximum output of renewable energy by measuring shade exposure or dirt collected on solar panels, the heat profile of a house or building to optimise energy use, and the risk of environmental events, such as flooding and landslides, allowing asset managers and local authorities to better prepare themselves.

Opportunities and limitations

The full potential for CV in civil engineering is currently underexploited. CV-based technologies are often limited to capture, such as CCTV, recording a condition or generating a 3D model, without further processing to assess quality and produce additional value. CV is an adaptable and cost-effective approach and there may be lessons learned from CV solutions applied to other sectors useful to infrastructure and construction organisations. As a relatively new field of technology within infrastructure and construction, some organisations rely on short term projects to test a CV solution. However, without an adequate understanding of both the opportunities and limitations of these technologies, they risk a disappointing return on investment.

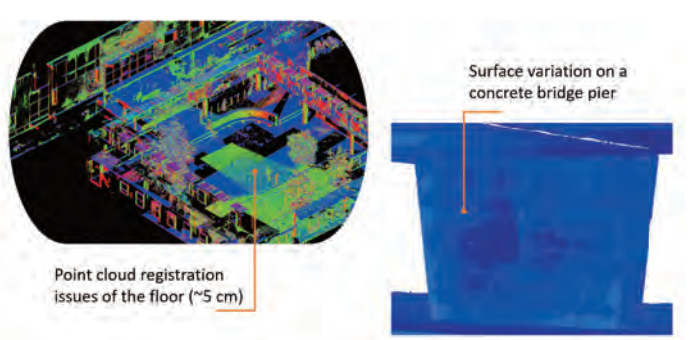

Figure 1. The point cloud on the left shows local irregularities in geometry pointing out data preparation errors such as misalignment. The one on the right shows surface variation of a bridge pier that can be monitored over time to spot abnormal behaviour.

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