Development of a 3D point cloud-based tunnel cross-sectional parameter measurement technology

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ABSTRACT

3D point cloud–based management plays a crucial role in the accurate condition assessment and safety monitoring of large-scale structures, such as railway tunnels. Nevertheless, the processing and analysis of large volumes of collected data incur considerable time and cost. Manual extraction of essential information and parameters from 3D data is labor-intensive and inefficient, and the consistency and accuracy of the results largely depend on the expertise of operators. To overcome these limitations, the development of automated parameter extraction techniques is imperative. This study presents a computer vision–based method for automatic extraction of key parameters related to railway tunnel facilities. The proposed method includes noise filtering, tunnel circularity estimation, rail detection and measurement, vehicle clearance measurement, and radius measurement across lateral angles. The method was developed as a GUI-based software application and validated through field tests conducted on railway tunnels.

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