

## **Enhancing Cavity Detection in Tunnel Linings Using Electromagnetic Simulation and Machine Learning**

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### **ABSTRACT**

The cavities found inside aged tunnel linings and in the surrounding ground are caused by various factors and are often located in places that are difficult to visually inspect. Recently, efforts have been made to assess the condition of tunnel linings and the underlying ground using non-destructive investigation methods such as ground-penetrating radar (GPR). However, cavity detection using GPR has limitations in accuracy and reliability. To overcome these issues, this study conducts electromagnetic simulations and develops a new Cavity Detection Model based on machine learning. The program creates training datasets for the Cavity Detection Model. Furthermore, the Fully Convolutional Network (FCN) technique is used in the Cavity Detection Model, with B-scan data as input and the permittivity map as the target. The FCN-based Cavity Detection Model significantly enhances practical applicability in tunnel lining inspection and safety assessments, providing a reliable tool for engineers and researchers in the field.

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