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Enhancement of Road Defect Detection Using First-Level Algorithm Based on Channel Shuffling and Multi-Scale Feature Fusion

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Abstract : Road defect detection is crucial for modern urban management and infrastructure maintenance. Traditional road defect detection methods mostly rely on manual labor, which is not only inefficient but also difficult to ensure their reliability. However, existing deep learning-based road defect detection models have poor detection performance in complex environments and lack robustness to multi-scale targets. To address this challenge, this paper proposes a distinct detection framework based on the one stage algorithm network structure. This article designs a deep feature extraction network based on RCSDarknet, which applies channel shuffling to enhance information fusion between tensors. Through repeated stacking of RCS modules, the information flow between different channels of adjacent layer features is enhanced to improve the model's ability to capture target spatial features. In addition, a multi-scale feature fusion mechanism with weighted dual flow paths was adopted to fuse spatial features of different scales, thereby further improving the detection performance of the model at different scales. To validate the performance of the proposed algorithm, we tested it using the RDD2022 dataset. The experimental results show that the enhancement algorithm achieved 84.14% mAP, which is 1.06% higher than the currently advanced YOLOv8 algorithm. Through visualization analysis of the results, it can also be seen that our proposed algorithm has good performance in detecting targets of different scales in complex scenes. The above experimental results demonstrate the effectiveness and superiority of the proposed algorithm, providing valuable insights for advancing real-time road defect detection methods.

Keywords : roads, defect detection, visualization, deep learning
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