Paper Title:
YOLO-Based multi-model ensemble for plastic waste detection along railway lines

Paper Link:

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1 Summary

1.1 Motivation

Plastic waste causes environmental issues and threatens rail transportation by hanging on overhead power lines for trains. Remote sensing has been used to detect marine and agricultural plastic waste, but little research exists on monitoring plastic intrusions along railways.

1.2 Contribution

This paper proposes detecting railway plastic waste using You Only Look Once version 5 (YOLOv5), an object detection algorithm that divides images into grids with cells responsible for detecting objects. Experiments compare YOLOv5 model sizes and ensemble strategies.

1.3 Methodology

The paper uses the You Only Look Once-v5 (YOLO-v5) algorithm and experiments with different sizes of YOLO-v5 models to find the optimal size for detecting plastics. The algorithm divides images into a grid system, with each grid cell responsible for detecting objects within itself. Two ensemble modeling strategies are implemented, considering different size combinations of YOLO-v5 models. Dataset split randomly as 80%, 10% and 10%. The first part is used for training and the rest are for validation and test. Models were trained and tested on a high performance workstation with NVIDIA GPU.

1.4 Conclusion

The YOLO-based ensemble model achieves an overall accuracy of 85.4% and a mean Average Precision of 0.834, outperforming the individual YOLO-v5 models. The results indicate that the ensemble model effectively improves the performance of plastic waste detection using surveillance cameras.

2_Limitations

2.1 First Limitation

The study primarily focuses on using data from surveillance cameras along railway lines, and the accuracy of the YOLO-based ensemble model is better for images acquired in the daytime condition compared to nighttime condition.

2.2 Second Limitation

The YOLO algorithm tends to perform poorly on small targets, as there can be multiple targets in the same grid without detailed grid division. The lack of detailed grid division in the YOLO algorithm can result in lower performance and accuracy.

3 Synthesis

The ensemble modeling strategy, which combines multiple YOLO-v5 models of different sizes, improved the overall performance of plastic waste detection. In terms of future work, the acquired knowledge from surveillance cameras can be applied to UAV and satellite-based high-resolution imagery for plastic waste detection.