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Research on multi-target detection and tracking algorithm based on improved YOLOv5

Qian ZHOU[a], Fuxin SUN[b], Junyou ZHANG[a,*]

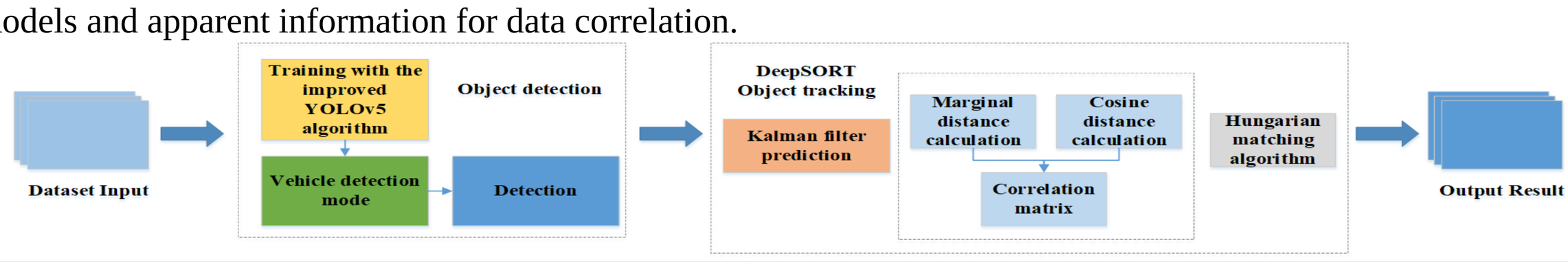
[a]Shandong University of Science and Technology, Qingdao, China

[b]Shandong Port Qingdao Port Group Limited, Qingdao, China

*Corresponding author's e-mail: junyouzhang@sdust.edu.cn

Introduction

To further improve the robustness and accuracy of detection and tracking, the YOLOv5 detection algorithm is combined with the DeepSORT tracking algorithm for multi-target detection and tracking of traffic scenes. Firstly, YOLOv5 is optimised and improved for the target occlusion and small size target problems that occur during detection. Secondly, the combination with DeepSORT enables end-to-end multi-target vision tracking using motion models and apparent information for data correlation.



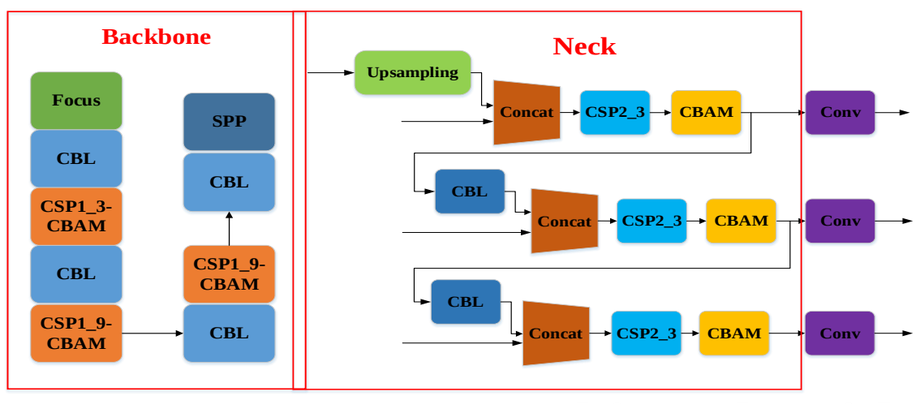
Methods

- **YOLOv5 algorithm optimization**
  - Optimized acquisition of Anchor based on driving scenarios.
  - Loss function and Non-maximum suppression optimization.

$$CIOU\_Loss = 1 - CIOU = 1 - \left(\left| \frac{A \cap B}{A \cup B} \right| - \frac{d^2}{c^2} - \alpha\tau \right)$$

$$s_i = \begin{cases} s_i, & IOU\text{-}R_{CIOU}(M, B_i) < \varepsilon \\ 0, & IOU\text{-}R_{CIOU}(M, B_i) \geq \varepsilon \end{cases}$$

  - Embedded attention mechanism.

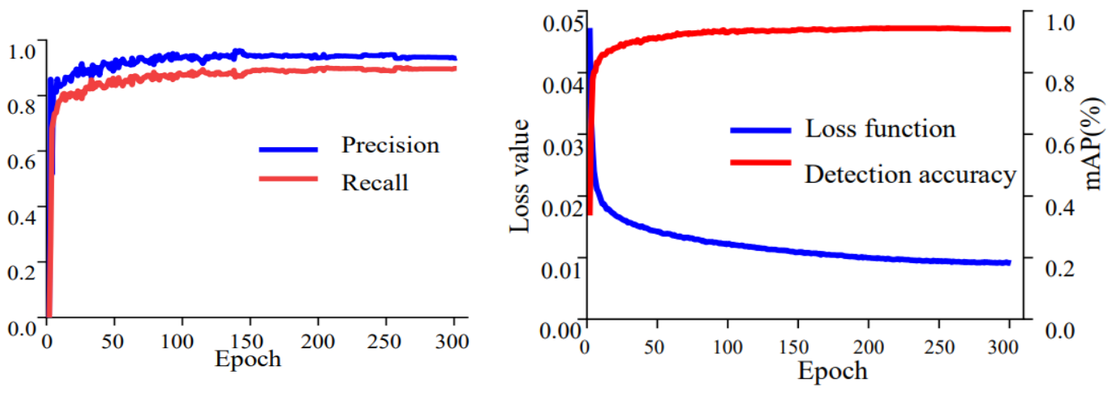


- **DeepSORT target tracking algorithm**
  - Use a combination of motion and appearance information to improve the accuracy of the association.

Results

- Object Detection

After 200 iterations, the model reaches the optimal state
P remains at around 93%
R is maintained about 90%.



The improved algorithm has a higher accuracy and provides better improvement in the obscuration of obscured vehicles and small vehicles.

Models	Faster RCNN	YOLOv4-Tiny	YOLOv4 Mobilenet	YOLOv5	Ours method
fps(f/s)	12.57	88.48	41.35	35.30	32.32
mAP(%)	81.0%	72.2%	74.5%	93.3%	95.4%

Results

- Object Tracking

The target can be detected earlier in the tracking process and the count can be resumed earlier after occlusion

before after

before after

Conclusion

- This paper proposes an efficient multi-objective detection and tracking algorithm by combining YOLOv5 with DeepSORT algorithm, targeting vehicles and pedestrians in traffic scenes.
- The improved algorithm achieves a 2.1% improvement in mAP on the KITTI dataset, while ensuring real-time detection speed.
- During the tracking process, the algorithm is able to detect the targets in advance, recover the counts of the occluded targets in time, and show better results for vehicle and pedestrian multi-target tracking