Research on Ocean Garbage Target Detection Algorithm Based on Improved YOLOv5s

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ACSE 2023

A101

Introduction

In order to reduce the harm of marine garbage to biological and water resources, this paper proposes a marine garbage target detection algorithm based on improved YOLOv5s. Regarding the issues of false detection, and inadequate feature extraction ability for small targets in object detection algorithms, this paper adds a new module based on large kernel attention (LKA) mechanism into the backbone network part to extract critical targets in the feature layer. Additionally, it modifies the original network structure in the Neck part by incorporating the shallow feature map of the backbone network into the feature pyramid (FPN) structure. The aim is to enhance the location information and semantic information of the large-scale feather map. The experimental results show that the mean precision (mAP) of the improved YOLOv5s target detection model is increased by 8.8%, and the precision (P) and recall (R) are also increased by 2.9% and 6%, respectively indicating that the improved algorithm is effective and feasible in the application of marine garbage target detection.

Methods

First, add an Attention-L structure after each CSP module of the backbone network. Secondly, in the Neck network, the CBS module, CSP2_1 module and upsampling module are added after the second CSP2_1 module of the FPN network, and the output of the first CBS+CSP1_1+A in the backbone network is connected with the third CSP module in the FPN network. The output of the first upsampling module is connected (Concat) in the channel dimension, and then the output of the second CBS module in the FPN network and the output of the second CBS module in the PAN network are also concatenated in the channel dimension, which ensures that network channel before and after the introduction of these models have the same number. Finally, input the result of the first CSP2_1 module in the PAN network to the first Detect. The improved model structure is shown in Figure 3, where A is the Attention-L structure in Figure 2.

The LKA module not only can reduce the parameters of the network model, but also decreases the computational cost. Moreover it can evaluate the importance of each point in the image and allocate limited information processing resources to important parts of the image. The large-kernel attention mechanism combines the advantages of self-attention and convolutional neural networks, taking into account local contextual information, large receptive fields, and dynamic processes. In addition, it also realizes the adaptability of spatial dimension and channel dimension. The LKA module structure is shown in Figure 1:

This paper uses a new module based on a large-core attention mechanism, the Attention-L network, to allocate limited information processing resources to important parts of the image. Although the Attention-L structure is simple, it is found through experiments that adding an Attention-L structure after each CSP structure of the backbone network can greatly improve the accuracy of the network model.

Attention-L has a simple hierarchical structure. A 1×1 convolution is added before and after the LKA module. The purpose is to ensure that the number of channels before and after the network model is the same, and can reduce the number of parameters of the network model, which is conducive to speeding up model training. At the same time, a Gelu activation function is added after the first 1×1 convolution. The Attention-L structure is shown in Figure 2.

Graphics

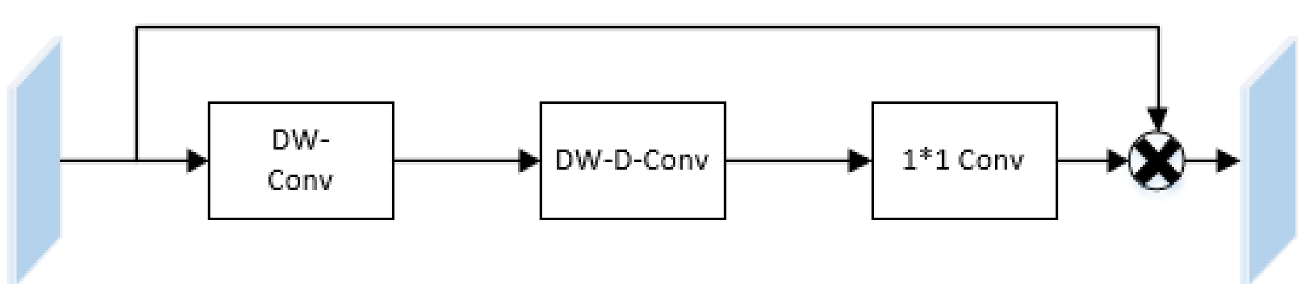

Fig. 1 LKA module structure

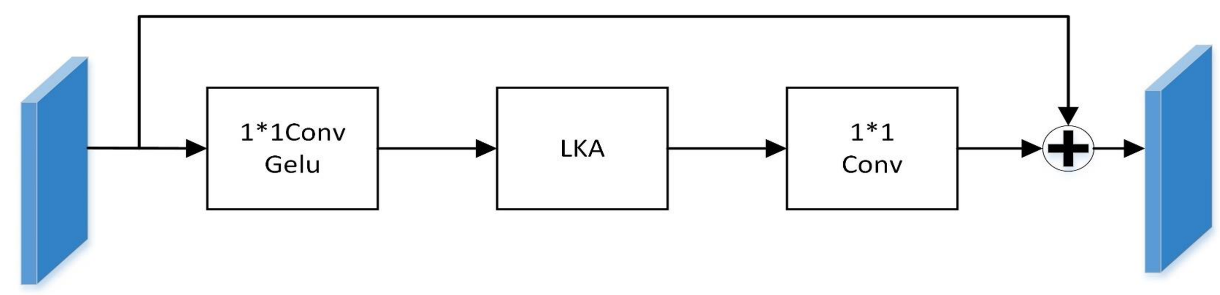

Fig. 2 Structure of Attention-L

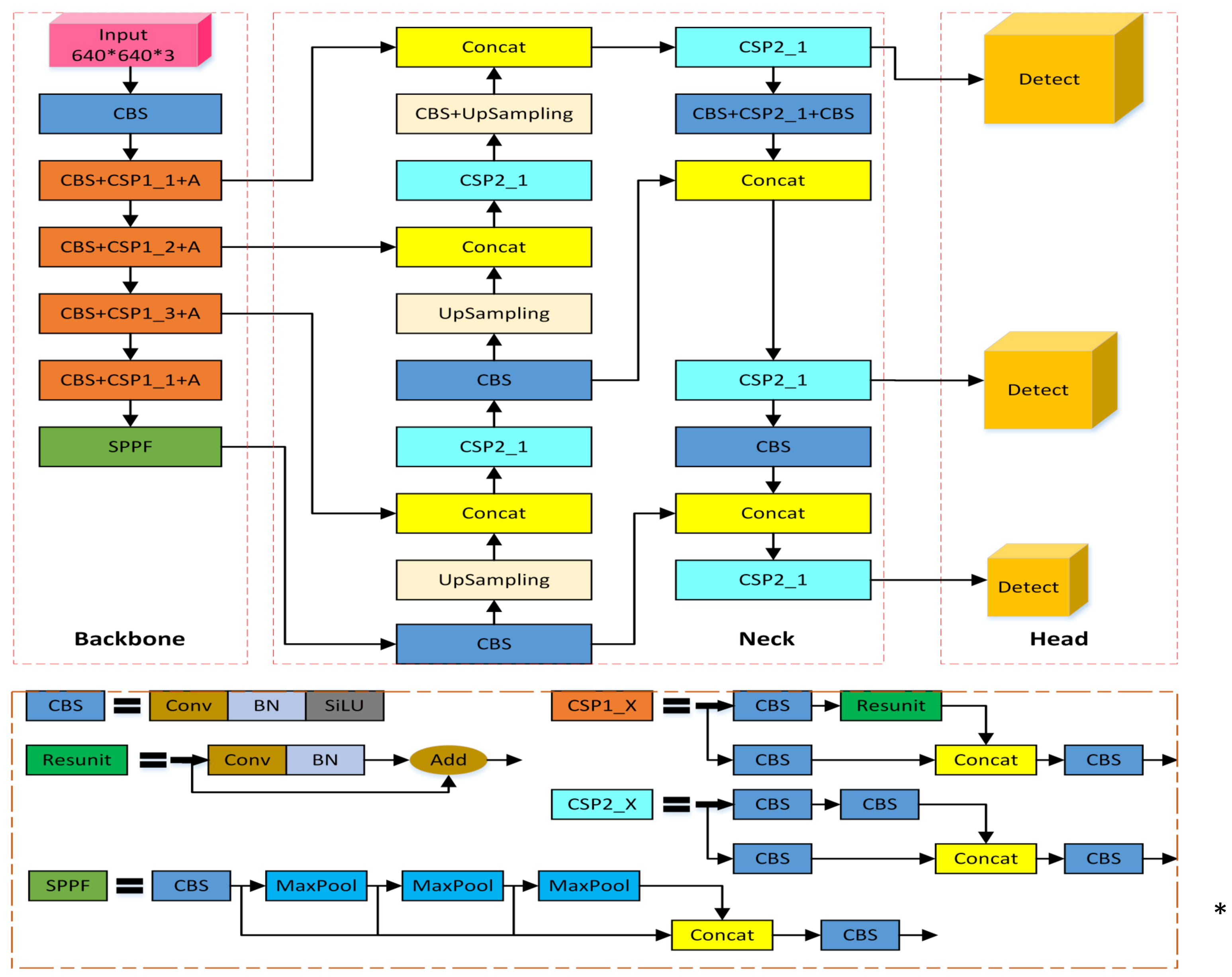

Fig. 3 Improved model structure

Conclusions

This paper analyzes the difficulties and requirements of marine debris target detection, and finds that the current algorithm has some problems such as missed detection of small targets, false detection and insufficient feature extraction capabilities. Therefore, this paper proposes a marine debris target detection algorithm based on improved YOLOv5s. First, the Attention-L module is added to the backbone network part of the original model to allocate limited information processing resources to important parts of the image, thereby improving the feature extraction capability of the network. Secondly, in order to solve the problems of missed detection and false detection of small objects, the original Neck network structure is changed, purposing to make the large-scale feature map have better position information and semantic information. Finally, training and testing are carried out on the J-EDI marine debris dataset. The experimental results show that the improved model in this paper can effectively improve the recall rate and precision rate of small target detection. This algorithm can be deployed in marine garbage cleaning robots, which can avoid manual fishing of garbage in dangerous sea areas. This method can eliminate water pollution and restore marine ecosystems, which is of great significance to the protection of marine resources and the environment.

References

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