

RESEARCH ARTICLE

Siamese Neural Networks in Unmanned Aerial Vehicle Target Tracking Process

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ABSTRACT With the continuous maturity of unmanned aerial vehicle (UAV) technology, its application is more and more extensive. At the same time, the problem of UAV target tracking has also been widely concerned. Aiming at the problem of low recognition accuracy of small target, a target tracking model of UAV based on siamese neural network (SNN) is studied. Firstly, based on the YOLOv5 recognition model, convolutional attention module and multi-scale feature fusion network are introduced. On the basis of the intersection over union loss, the effective intersection over union loss is proposed to improve the loss function, and an improved YOLOv5 target recognition model is established. Then, a fine-grained classification regression network is proposed, which uses per-pixel classification regression to train the tracker. A target tracking model based on SNN is established by adjusting the results with a fine-tuning module. The results showed that the improved YOLOv5 model combined with the optimized loss function had the highest average accuracy of 47.84% and a frame rate of 28.34fps, which was better than the traditional YOLOv5 model. The recognition accuracy in the fused dataset is 93.12%, with a loss value of less than 0.01, which is superior to YOLOv3, YOLOv4, and traditional YOLOv5 models. The method has strong anti-jamming ability in the acceptable range. The target tracking model based on SNN has the highest tracking accuracy and still has good tracking performance in color image environment, which shows certain feasibility and superiority. To sum up, the model built in this study has good application effects and plays a certain role in promoting the development of the UAV industry.

INDEX TERMS Siamese neural network, target tracking, target recognition, unmanned aerial vehicle, deep learning.

I. INTRODUCTION

With the development of science and technology, unmanned aerial vehicle (UAV) technology has made rapid progress, which is widely used in civil and military fields. UAV target tracking receives widespread attention in academia, which uses UAVs and related technologies to track and monitor the position and movement of ground targets. UAV target tracking is widely used in monitoring, emergency response, military reconnaissance, and autonomous driving [1]. More accurate and real-time target tracking can be achieved by

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combining advanced sensor technology, real-time data processing, and machine learning algorithms [2]. The application of siamese neural network (SNN) in target tracking receives increasing attention. SNN can effectively learn the features of the targets and track them by comparing the feature similarity between the input target and the candidate target [3]. SNN can be combined with other deep learning models to demonstrate better robustness in handling appearance changes and covering of targets compared to traditional target tracking methods [4]. However, SNN also has issues such as requiring a large amount of training data and long training time, which is sensitive to the selection of hyper-parameters. Therefore, SNN needs to be improved. Target recognition serves as the