ISSN:2790-1688 DOI: 10.56028/aetr.3.1.283

Research on Motion Target Detection Method Based on Machine Learning

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Abstract: In the development of modern science and technology, due to the small size, low cost, practical operation is very flexible, so the UAV has been fully used in environmental monitoring, geological survey, military exploration, agricultural plant protection and other fields. Among them, as one of the basic contents of UAV aerial photography research, moving target detection directly affects the quality and efficiency of UAV work. On the basis of understanding the research status of moving target detection methods, I choose random forest and kernel correlation filtering algorithms for experimental analysis, focusing on the application value of the algorithm in moving target detection. Finally, the experimental results show that the proposed algorithm is effective.

Keywords: Machine learning; Movement target; Object detection; drone

1. Introduction

Moving target detection is the hot topic of machine vision research, although in recent years, mastered a number of technical theory, but practice research face bigger challenges, such as in the case of a moving target for shade, if the tracker is unable to accurately identify obstructions, as is tracking the target, then the follow-up tracking a moving target will be an error. According to the accumulated experience of moving target detection in recent years, shape change is the most common problem in target tracking. If the posture of moving target changes, the corresponding appearance model should be updated. Since the actual situation of moving object detection and tracking is relatively complex, scholars from all over the world have been constantly improving the performance of algorithms when studying related problems. However, there are still many problems in practical application and theoretical research. At present, researchers mainly discuss how to create a tracker with high robustness and precision. Nowadays, there are many algorithms for studying moving object detection, such as optical flow method, inter-frame difference method, background difference method and so on. From the Angle of practice research, optical flow method is trust phase moving target detection is one of the most common content, make use of optical flow constraint equation of motion target speed calculation, will be combined with the velocity vector determine whether belong to the movement as a whole, usually belong to the same overall movement target, have the same velocity vector, to detect moving targets seriously; [1.2.3]The inter-frame difference method can obtain moving objects by subtraction of two or more adjacent frames. Background difference method is to obtain the feature information of the image, implement modeling analysis in the known background, and use the current image and background model subtraction to obtain moving objects.

After scientific research on moving object detection algorithms, scholars at home and abroad will apply machine learning algorithms to moving object detection and obtain excellent results. For example, some scholars proposed technical algorithms of Boosting weak classifier group and boosting strong classifier. Although the operation is very simple, it can achieve pioneering application of machine learning algorithm for target detection. Some scholars have proposed a fast HOG feature extraction algorithm, which is mainly used to extract target features. Some scholars used structural random forest algorithm to detect the boundary of moving targets, fast regional convolutional neural network and deep feature and convolution learning algorithm to extract and analyze the features of moving targets using neural network. From the perspective of overall development, moving object detection algorithm has developed from object matching and region

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matching algorithm to the coexistence of feature extraction improvement, structured classifier and deep learning multiple algorithms. As long as there are practical needs, it can continue to develop.

At the same time, researchers also discussed the application of correlation filtering algorithms, in order to improve the tracking accuracy and tracking speed of single feature integration analysis, multi-feature fusion has become the main problem of target tracking. For example, Li et al. proposed SAMF algorithm in their research, which fully integrated CN, gray features and HOG features, and updated the target scale size by using scale pool, so as to further improve the accuracy of moving target tracking, but the overall tracking speed decreased significantly. Martin et al. also proposed a tracking algorithm of continuous domain convolution. On the basis of obtaining multi-resolution depth features and features, the feature maps of different resolutions were interpolated into the continuous spatial domain by cubic interpolation, and the target location of sub-pixels was obtained by matrix. Nowadays, with the wide application of deep learning methods, convolutional features extracted by deep learning are applied to target tracking, and a variety of effective features or feature fusion methods are obtained.

Foreign countries have been studying unmanned aerial systems for a longer time, while domestic research on unmanned aerial systems is getting faster and faster under the guidance of relevant policies and technological theories. Among them, DJI Innovation Co., Ltd. has launched a series of drones with rich functions, which play an important role in film and television, military, agriculture and other fields. The International Air Robot Competition was first started in the early 1890s, and eight missions have been released so far, among which the first four generations of missions are mainly outdoor autonomous flight. The fifth generation is changed to indoor environment and cannot rely on any external auxiliary positioning equipment; The sixth task is to propose the requirement of interacting with the environment on the basis of fully autonomous flight. The seventh generation mission is called Operation Air Shepherd, and the aerial robot will rely entirely on its own indoor navigation and control technology to contain and control the designated area of the competition field with 10 ground moving objects; In THE eighth GENERATION of MISSIONS, the first remote non-electronic interaction between human and machine is performed by four aerial robots and a human working together to accomplish TASKS that cannot be accomplished by a single human. On the basis of understanding the current research status of machine learning algorithms, this paper focuses on the object detection method in UAV operation.[4.5.6]

2. Method

2.1 Random Forest algorithm

In this paper, the Gini index is used to construct multiple binary decision trees, and the voting mechanism is used to integrate random forest. The application of this kind of algorithm in moving object boundary detection usually consists of two steps: on the one hand, it refers to the model training, which needs to be studied by using the characteristic attributes of index splitting; On the other hand, it refers to boundary detection, which determines the boundary according to the threshold value of the feature value of the split attribute and the relationship between the feature attribute at the current node.

The single-family decision tree is used to detect feature samples step by step, and then the minority follows the majority voting mechanism is used to judge the final boundary results. The binary segmentation function is shown as follows:

$$h(x,\theta_j)=\begin{cases}0, & \text{left}\\ 1, & \text{right}\end{cases}$$

$$\theta=(k,\ \tau),\ h_1(x,\ \theta)=[x(k)<\tau]$$

$$\theta=(k_1,\ k_2,\ \tau),\ h_2(x,\ \theta)=[x(k_1)-x(k_2)<\tau]$$

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In the above formula, $h(x,\theta_j)$ represents the ¥2 segmentation function of the current node, x represents a sample of the current node, θj represents the characteristic attribute and corresponding threshold of sample x stored at node j, k represents the characteristic attribute of sample x, and τ represents the threshold of attribute k of sample x at node j.

2.2 Structured random forest algorithm

Here, the algorithm uses the inherent structure of the moving target boundary to detect and analyze the target boundary, which usually consists of three steps: firstly, the feature extraction, secondly, the training model construction, and finally, the boundary detection. Combination are shown in figure 1 below process on the structure of the random forest algorithm analysis, and the traditional random forest algorithm is one of the biggest difference is that different feature extraction algorithm, using the K - means to generate structured tagging, training the decision tree based on the Gini index, to obtain the resolution of the different characteristics of property value, the final boundary of moving targets using the threshold value judgment, This provides an effective basis for subsequent research.[7.8.9]

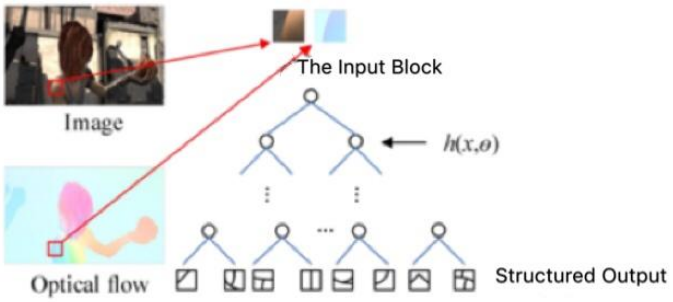

FIG. 1 Detection flow chart of structured random forest algorithm

2.3 Improved algorithm

Although the feature extraction algorithm of structured random forest can obtain features and reduce the dimension, the speed of obtaining features is still very slow. In this paper, in order to optimize the application algorithm, simplify the processing of the feature extraction algorithm, so as to control the feature extraction time. The similarity of decision trees is calculated by using the interval decayed mean, and the decision trees with higher similarity and lower importance are removed, so as to improve the accuracy of the algorithm and improve the detection speed of the algorithm. Random forest algorithm is one of the most critical contents of machine learning algorithm. This paper studies and improves the integration algorithm of random forest, which can effectively deal with the information redundancy between decision trees in random forest. According to the analysis of the flow chart shown in Figure 2 below, the algorithm execution steps involve the following points:[10.11.12]

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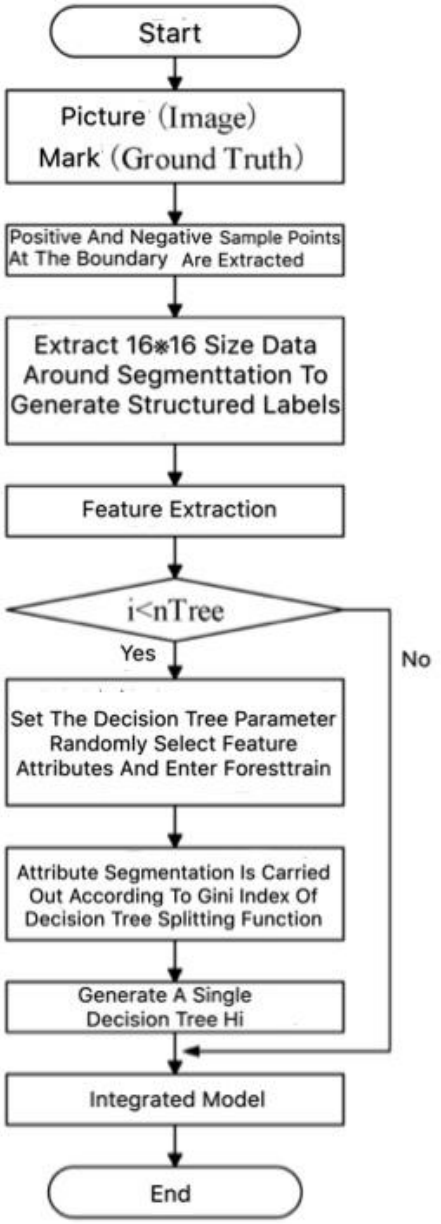

FIG. 2 Flowchart of the improved algorithm

First, initialize the processing. The image samples were segmented into 35×35 image blocks, and the manually labeled samples were segmented into 16×16 binary boundary blocks.

Second, extract feature information. The acquired feature information includes 3-dimensional color information, gradient channel, 7-dimensional forward optical flow, image error, etc., and multiple sample subsets are generated by randomly selecting samples from the current samples.

Third, the structured labels were generated, and the binary bounding box was mapped in two steps. The k-means algorithm was used for cluster analysis, and the structured labels were mapped to the discrete space to obtain the binary classification labels.

Fourth, the feature information of the sample is randomly selected. After constructing the sample features of the current node, the Gini index of the analyzed sample is calculated to accurately record the features and relevant values of the current node, so as to facilitate subsequent detection and analysis.

Fifthly, the termination condition of a single decision tree is clarified. If the number of samples is less than 8 and the depth of decision tree is more than 32, the classification corresponding to the sample features is single, and the splitting can be stopped if one of the three conditions is met. Sixth, determine whether the current generation of nTrees decision trees, if so can proceed to the next step,

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using the voting mechanism to generate a random forest. On the contrary, decision number training should be carried out from the second step;

Seventh, the integration model. The mean value of interval decrement is used to judge the redundancy state of the current decision tree. After generating a subset of random forest, the boundary of moving object is detected and the corresponding result is output.

3. Result analysis

On the one hand, qualitative analysis. In order to verify the effectiveness of the random forest algorithm shown in Figure 3 below, the experiment should be conducted in MATLAB software for comparative analysis. The final results show that the background difference only obtains one target, and the actual detection results are not perfect. This kind of algorithm has high requirements on the motion background, and it needs to update the motion background in real time. The detection results of the algorithm studied in this paper are basically complete and have certain anti-interference and robustness. Although the video frame image is blurred, resulting in multiple palm-shaped boundaries in the blurred area, the structured random forest detection obtains the complete moving target boundary.[13.14.15]

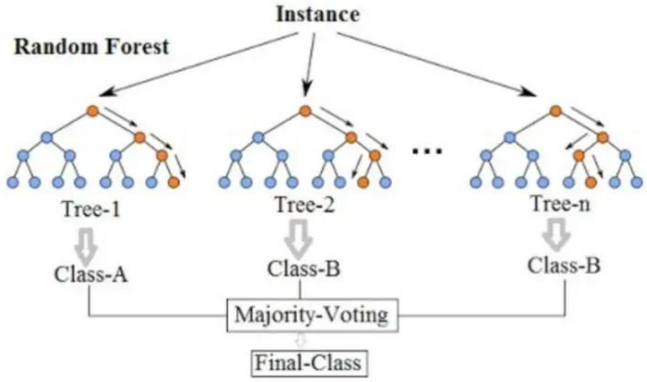

Figure 3 Structure diagram of random forest algorithm

On the other hand, quantitative analysis. According to the evaluation results of different parameter values shown in Table 1 below, it can be seen that in the research experiment of this paper, maxDepth value is set to 32, imWidth value is set to 35, which is higher than the original design accuracy, and can reduce the number of image blocks extracted and speed up the speed of feature extraction.

Table 1 Evaluation results of different parameter values

Precision	0.7288	0.7286	0.7284	0.7284
maxDepth	32	40	48	64
Precision	0.718	0.730	0.732	0.734
inWidth	8	24	32	35
Precision	0.731	0.734	0.738	0.736
aTrees	2	4	8	16

By comparing and analyzing the results of different algorithms under different indicators, it can be seen that the details are shown in Table 2 below:

Table 2 Analysis of algorithm results under different indicators

Compare the algorithm	Recall	Precision	PCC	F_1
In this paper, algorithm	0.9157	0.4297	0.0445	0.5849
Background difference method	0.1182	0.9695	0.0493	0.2107
Vibe	0.6327	0.5149	0.0342	0.5678
HS-flow	0.6984	0.4217	0.1492	0.5259

Combined with the above analysis, it is found that the algorithm studied in this paper has the highest recall rate, the lowest accuracy and the lowest error rate. From the perspective of overall

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application, the improved structured random forest algorithm is more in line with the needs of moving target detection, and has strong anti-interference and robustness.

4. Conclusion

To sum up, according to the uav motion target detection method in recent years research perspective, research the most valuable machine learning algorithms, so countries scholars to strengthen the practice to explore, pay attention to the development of professional and technical personnel optimization efforts, learning from the experience of countries practice explore gain attention enriched the contents of the moving target detection method, It provides new ideas for feature extraction, boundary detection and detection mechanism by changing the traditional simple technology theory. Therefore, after mastering the existing theory of moving target detection methods in China, an all-round study is made from the perspective of machine learning algorithms, and more research results and outstanding talents are discovered. The development of American UAV technology provides the basic guarantee.

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