A Multi Target Algorithm for Image Target Tracking

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Abstract. As technology advances, improving the accuracy of image target tracking is extremely important for medicine, aerospace and military, industry and agriculture. Image target tracking usually apply the method of manual extraction, which is not only a waste of time and power, but also has many difficulties in extraction. However, multi target algorithm can make up for its shortcomings, and multi target algorithm develops from underlying characteristics to multi-level, abstract features in the form of data. This paper, proposed a novel multi target algorithm for image target tracking for solving the above shortcomings. In the multi-target tracking problem, the random set is actually the number of elements and a set of random variables. When the number of targets is unknown or changing, the number of targets is a discrete random variable, the dimension of the state space will be different with the target value of the number of changes, so the multi target state model and observation model can be expressed as random finite sets form. Simulation results show that compared with traditional method, this method has higher accuracy and low loss rate.

Keywords: Image Target Tracking, Multi Target Algorithm, Fingerprint Image, Data Communication Module

1. Introduction
In recent years, the application of multi target algorithm in image target tracking field has become the focus of research [1-2], which has huge development space. Measurement of monocular vision and its tracking prediction of a moving object mean that a vision sensor such as a video camera or digital camera is used to shoot single images for purposeful measurement [3]. The measured data are reasonably analyzed to achieve the trajectory of the moving object, thus its moving orientation can be predicted at the next moment according to the movement trend [4].

Sequential images of a moving object shot by a digital camera or video camera are classified into two types: First of all, the background of sequential image of the moving object is relatively static [5]. This is a common situation, because the monocular vision measuring system is usually used for measurement when it is static, the background of sequential images to be shot is static under normal circumstances. For instance, the background of sequential images at the crossroads which are shot by the fixed video camera.

Secondly, the background of sequential images to be shot is relatively static, because the monocular vision measurement system moves regularly when measuring. On this occasion, the background of the obtained sequential images is constantly changing [6]. For example, driving status
in front of the vehicle which is shot by the on-board camera. Based on the above-mentioned different situations, the available algorithms to predict the moving objects are as follows: the method of background removal, the method of adjacent frame difference, the method of optical flow and so on[7].

2. Image Target Tracking based on Multi Target Algorithm

The dynamic model and observation model of multi-objective system are described below. Assuming that the \( t-1 \) time RFS \( \Xi_{t-1} \) has been obtained, the multi-objective system state at \( t \) time can be expressed as follows [8],

\[
\Xi_t = S_t(X_{t-1}) \cup N_t(X_{t-1})
\]

\[1\]

\[
N_t(X_{t-1}) = B_t(X_{t-1}) \cup \Gamma_t
\]

\[2\]

Among them, \( S_t(X_{t-1}) \) represents a random finite set of targets that continue to appear at the \( t \) moment, and \( N_t(X_{t-1}) \) represents a random finite set of new targets at the \( t \) time.

The above stochastic finite set includes all kinds of behaviors of targets in multi-objective systems [9], for example, the number of targets changes with time, the emergence and splitting of single targets, and the interaction between targets. The observational model of the time is as follows

\[
\sum_i \Theta_i(X_t) \cup C_t(X_t)
\]

\[3\]

Among them, \( \Theta_i(X_t) \) is the RFS produced by \( X_t \), and \( C_t(X_t) \) is the RFS of the observed clutter.

It is assumed that the change of the target state between each frame of the video is small, and the motion of each target is independent. The state transfer equation of a single target is

\[
x_k = x_{k-1} + v_k + w_k
\]

\[4\]

Background subtraction or target detection algorithm, such as Adaboost algorithm can be used to get the target's background to detect the target, and the centroid is as the observation value to update the PHD filter. Its likelihood function is set as

\[
p(y | x_t) = \frac{1}{2\pi |M|^{1/2}} \exp[-\frac{1}{2} (y - x_t)^T M^{-1}(y - x_t)]
\]

\[5\]

The implementation of the target association is as follows

Step 1. Initialization of the set of particles, weight and the number of initial targets

Step 2. Forecast. Prediction markers for particle distribution is

\[
L_t^p(\tilde{x}_t^i) = L_{t-1}(x_{t-1}^{i\text{-NEW}})
\]

\[6\]

Definition of prediction division is

\[
\{P_{t, \tilde{x}_{t-1}}^p, ..., P_{t, \tilde{x}_{t-1}}^p\} = \{P_{t-1, \tilde{x}_{t-1}}^p, ..., P_{t-1, \tilde{x}_{t-1}}^p\}
\]

\[7\]

New particle distribution markers is

\[
L_t^p(\tilde{x}_t^i) = L_{\text{NEW}}
\]

\[8\]

Step 3. Update and define repartition

\[
\{P_{t, \tilde{x}_{t-1}}^{\tilde{x}_t^i}, ..., P_{t, \tilde{x}_{t-1}}^{\tilde{x}_t^i}\} = \{P_{t, \tilde{x}_{t-1}}^p, ..., P_{t, \tilde{x}_{t-1}}^p\} \cup P_{t, \tilde{x}_{t-1}}^p
\]

\[9\]
Step 4. Resampling. If \( x_i^{(j)} \in \text{child}(x_t) \), its corresponding mark is

\[
L_t^R(x_i^{(j)}) = L_t^R(x_t)
\]

The definition is based on the division of the resampling.

Step 5. State estimation. State estimation \( \{S_{t-1}, S_{t-2}, \ldots, S_{t-1}, S_{t-1}\} \) marks the new division \( \{P_{t,1}, \ldots, P_{t,1}\} \).

Step 6. Data Association. Create matrix A and matrix C, if

\[
C_{j,k} = \{ i : x_i^{(j)} \in P_{t,j} \cap P_{t,k} \} \geq \epsilon_i N, A_{j,k} = 1.
\]

If \( \sum_k A_{j,k} = 0 \), \( L_{t,j} \) is deleted and the declared goal disappears.

If \( \sum_k A_{j,k} = 1 \), associate \( P_{t,j} \) with \( L_{t,k} \).

If \( \sum_k A_{j,k} > 1 \), let \( k = \arg \max_k C_{j,k} \) and associate \( P_{t,j} \) with \( L_{t,k} \).

This paper constructs the architecture of block diagram of image target tracking, as is shown in Figure 1.

![Figure 1. Block diagram of image target tracking](image)

The architecture of block diagram of image target tracking is divided into seven layers. In order to obtain pre-selected region with higher quality and higher recall rate, selective search algorithm is applied, and the output layer is whole connection layer.

3. Experimental Results and Analysis

Actual prediction of a moving object is to determine the specific location of the moving object in the space at its corresponding time, which can be obtained through the image matching algorithm according to the monocular vision measuring system. The image matching algorithm refers to an algorithm where a series of template images containing target images is used for image matching according to the relevant similarity principle so as to achieve the trajectory of the research object and its status at the next moment, as is the basic principle of the image matching algorithm [10].

The tracking algorithm only needs matching the original data of grey level of related images, no feature extraction or division is required for images. In this case, all information of this series of images can be kept, and the tracking algorithm also has many advantages, for example, no complex preprocessing of the original images is required, and the grey level of images can be used to directly matching key points, so the possibility of implementation is greatly increased. Moreover, under the condition of low noise, matching also can be carried out, and there is no high demand for the quality...
of sequential images. In such an approach, its local anti-interference ability is very strong. The correlation tracking algorithm can be used to predict the trajectory of a moving object in real life.

In the scene, there are vehicles and pedestrians as experimental targets. The background subtraction is used to get the moving target area as the observation value, as shown in Figure 2.

![Figure 2. The background subtraction detection results](image)

All the above experimental schemes utilize quantitative analysis to conduct performance evaluation, and in the following parts, we will provide several examples of the object recognition results by proposed method in Figure 3.

![Figure 3. Examples of the object recognition results by proposed method](image)
4. Conclusion

In recent years, the application of multi target algorithm in image target tracking field has become the focus of research, which has huge development space. Measurement of monocular vision and its tracking prediction of a moving object mean that a vision sensor such as a video camera or digital camera is used to shoot single images for purposeful measurement. The measured data are reasonably analyzed to achieve the trajectory of the moving object, thus its moving orientation can be predicted at the next moment according to the movement trend. The multi target algorithm has the ability to extract image features independently, and also can extract abstract features. On the basis of the analysis on in-depth architecture error transmission, it proposes parameter tracking method of image features. Simulation results show that compared with traditional method, this method has higher accuracy and low loss rate.

Acknowledgments

This work was financially supported by Science and Technology Research Project of Jiangxi Provincial Education Department "Face recognition based on Embedded Zerotree Wavelet" (Grant No. J61635).

References

[1] Chen G, Hong L. A genetic algorithm based multi-dimensional data association algorithm for multi-sensor-multi-target tracking. Mathematical & Computer Modelling, 26(1997) 57-69.
[2] Biao Sun, Moving target tracking based on monocular vision, Acta Armamentarii, 4(2010) 85-89.
[3] Guohu Feng, Dayong Zhang. Determination of the moving target position based on dual four elements in monocular vision. Journal of Wuhan University, 10(2010) 1147-1150.
[4] Pengcheng Xie, Research on moving target tracking and locating technology based on single camera, Computer Optical Disc Software and Application, 18(2012) 82-84.
[5] B Shen, C Jiang, M Sun, P Liang, The 3D reconstruction technology for shaft parts based on monocular vision, Machine Design & Manufacturing Engineering, 2(2015) 55-63.
[6] H Hassannejad, P Medici, E Cardarelli, P Cerri, Detection of moving objects in roundabouts based on a monocular system, Expert Systems with Applications, 42(2015) 4167-4176.
[7] Cunxiao Miao, Autonomous landing of small unmanned aerial rotorcraft based on monocular vision in GPS-denied area, Automatica Sinica, 2(2015) 109-114.
[8] A Alamoodi, O Balfaqih, ZZ Htike, Road lane tracking based on monocular vision, International Journal of Applied Engineering Research, 16(2015) 221-235.
[9] Xu Yiming, Liu Xiaoli, Liu Yixin, A Correlation Tracking Algorithm Based on Template Partition Motion Estimation, Journal of China Ordnance, 11(2019) 72-78.
[10] Tiancheng W. Unsupervised video multi-target tracking based on fast resampling particle filter. Journal of Supercomputing, 76(2020) 1293-1304.