The moving target tracking algorithm based on optical flow consistency

Zhongwu Sun [a], Fuqing Wang [b], Sishu Han [c]

School of Computer and Software Engineering, Xihua University, Chengdu 610039, China

[a]sunzw314@163.com, [b]wangfu_qing@126.com, [c]hansishu1990@163.com

Abstract

Multiple target tracking algorithm is a hot research topic in recent years. In view of the multiple target tracking, this paper use the light flow the movement characteristics significantly. Using forward and backword flow calculation method, light filter matching error is within the scope of the optical flow effectively, and the target movement further filter out the main direction with the direction of optical flow.To filter out the characteristics of the optical flow as the target characteristics of the movement, and in the event of a shade of light flow forecast the location of the object to target tracking.Validation of the experimental data, the algorithm in solving multi-object tracking effectiveness.

Keywords

Multiple target tracking, forward-backward optical flow, consistency, occlusion, optical flow predicition.

1. Introduction

In recent years, with the development of economy and society, in public places, frequent emergencies and abnormal situations to Skynet monitor screen focused more and more people's attention. Most screen monitor and moving target tracking is based, plus a limited number of staff and energy, how to make the computer instead of the people were efficient object tracking and motion analysis in recent years become a hot topic. Y.Yang [2], who used the chain as the matching corner point, a characteristic optical flow and optical flow chain between two consecutive frames, optical flow in the feature clustering obtain several candidate class, calculate the parameter value for each class Finally, based on similar criteria to find the target class in the candidate class, the final goal of using active contour obtain precise outer contour tracking goals;T.T.Chen[3], who proposed the motion body tracking feature points method Lucas-Kanade (LK) pyramid optical flow algorithm, the method of feature point tracking large scale movements have a good effect; Y.P.Li[5] et al proposed based on scale Invariant Feature Transform (SIFT) feature points and Kalman filter optical Organization of the Text flow tracking algorithm. These methods are to some extent to achieve good tracking effect, due to the presence among the target occlusion, these methods can not estimate correctly the blocked area of the optical flow tracking algorithm may fail.

Since the multi-objective mutual occlusion occurs when existing optical flow calculation method will block out the failure of the target, which has brought a new focus - Improved optical flow algorithm. J.Liu[4], who can not be effectively detected by the interruption, errors caused by such factors blocking the light flow component defects for varying spectral flow method is proposed based on PSO (Particle Swarm Optimization) optical flow algorithm, and Classic + NL algorithm based on the model, the consistency before and after the introduction of the optical flow motion judge blocked and partially blocked by PSO repair achieve light calculation error, so as to achieve good tracking results. A.M.Zhu[6] and others by considering the consistency of the feature points in the speed and direction, learning stability characteristics of the target, to achieve the local non-rigid object and variable motion robust and real-time target tracking algorithm. In this article, the first reverse flow through to light[8] calculations exclude LK optical flow calculation error itself, and through the target motion characteristics, statistical consistency and motion main direction of the light stream in occlusion time

by learning objective Before the motion characteristics of the estimated position of the target in order to achieve multi-target occlusion motion tracking.

2. Motion consistency model

2.1 Forward and reverse optical flow selection model

Among the many feature point tracking algorithm, LK optical flow method is the most typical feature point tracking method is relatively easy to implement, low computational complexity, high precision tracking, so it has been widely used. However, according to the consistency assumption graphics, optical flow method applies only to target small-scale movements, prone to the phenomenon of missing feature point tracking. To reduce the effects of noise and stable outlook extract the full optical flow, we use Gaussian mixture background modeling, and moving foreground region mark, then optical flow characteristic movement within the region analyzed. Specifically divided into the following steps: 1) reverse the recent match to optical flow field; 2) the feature point motion main direction consistency constraints and statistics;

Forward and reverse nearest neighbor matching optical flow

Forward and reverse optical flow computation ideas [8] is set I_1 and I_2 are on screen sequence two adjacent frames color images, x = (x, y), and f (x) = [u(x), v(x)] is a reflection of the correspondence between the two images pixel optical flow positive, and the reverse optical flow b(x) = [bu(x), bv(x)] will I_2 pixel corresponds to I_1 pixel. In the forward and reverse optical flow reversible case, there is a relationship between f(x) and b(x): f(x) = - b[x + f (x)], or b(x) = - f[x + b(x)]. This relationship can be seen from Fig.1 in the image.

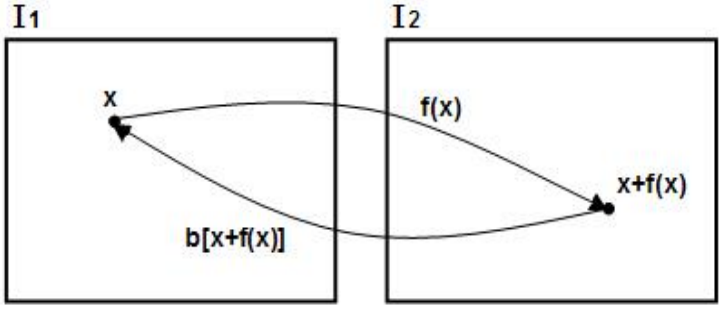

Fig. 1 Forward optical flow and reverse flow of light

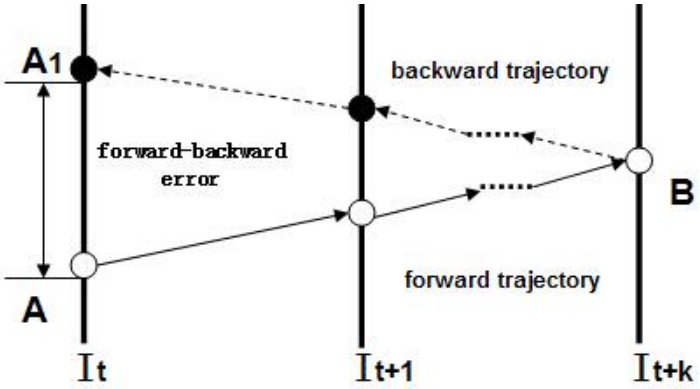

Fig. 2 Feature points before and after the error calculation schematic

However, in most natural image sequences, f(x) are not satisfied in the case of reversible. In [8] positive target tracking - Reverse consistency assumption: the right target tracking locus sequence-independent front and rear frame, a frame that is a feature of the current point A, trace to the next frame corresponding feature point B, if point B the correct match the target, then it's backtracking points A_1 and a point should coincide. Forward and reverse feature point tracking error schematic diagram shown in Fig.3.

According to this hypothesis, we use the nearest neighbor method in the effective optical flow feature point selection [9] to select the correct match point set. But the goal is for the flexible pedestrian tracking objects in this category, corner feature to be bound by the background and clothing, limited extracted feature points, and deformation occurs when the moving target, extracting feature points is extremely difficult there. There are optical flow is based on the brightness constant, time-continuous, uniform space three assumptions, in order to avoid aperture problem, this paper uses the size of 9*9 features window computing Gaussian mixture background modeling extracted foreground region dense optical flow (u, v). It current frame optical flow point set $P = \{P_1, P_2, ..., P_n\}$, forward optical flow calculation corresponding to the next frame I_{t+1} optical flow point set is $P_{t\_a} = \{P_{1\_a}, P_{2\_a}, ... P_{n\_a}\}$; in image I_{t+1} to P_{i_a} (where i = 1,2, ..., n) as the center of the neighborhood set of points $x = \{x_1, x_2, x_3, x_4\}$ within the scope of the search, the nearest neighbor point set x seek take x_i (i = 1,2,3,4) and Pi_a area constituted $w_i = \max \{w_1, w_2, w_3, w_4\}$ (where i = 1,2,3,4), constituting the obtained wi n optical flow to match point set $P_{t\_f} = \{P_{1\_f}, P_{2\_f}, ..., P_{n\_f}\}$, shown in Fig.3.

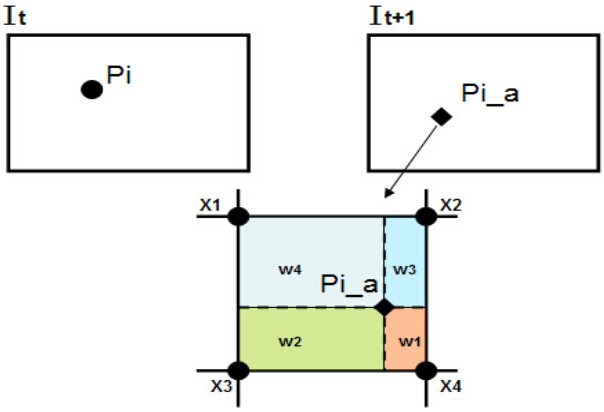

Fig. 3 Forward optical flow Nearest Neighbor Search Match schematic

Set point P_{t_f} as the initial point, I_{t+1} frame tracing back to the previous one I_t, get the reverse optical flow approximate location $P_{t\_b} = \{P_{1\_b}, P_{2\_b}, ... P_{n\_b}\}$. Similarly, in the image in the center of the field to P_{i_b} point set light to meet reverse flow matching point set constraints $P_{t\_b} = \{P_{1\_b}, P_{2\_b}, ..., P_{n\_b}\}$.

Feature point consistency constraints

Feature points as part of a dynamic consistency constraints selection model, the velocity and direction of motion analysis target tracking conducive to the realization of robustness, particularly in the target into the shelter and shelter separation process.Feature point consistency constraint algorithm steps: ①from positive - get match point set matching algorithm reverse optical flow error, statistical I_t previous frame to the current direction of the feature point in the frame I_{t+1} optical flow motion, the direction is divided into 16 non-overlapping areas, each of 22.5 degrees;②Statistica 16 directions in each direction of energyD_k:$E_D(D_k)=n_k$,k=0,1,2,…,15,Among them,nk is the number of pixels for the D_k direction, k is the pixel possible direction. Consistency constraints target feature point shown in Fig.4.

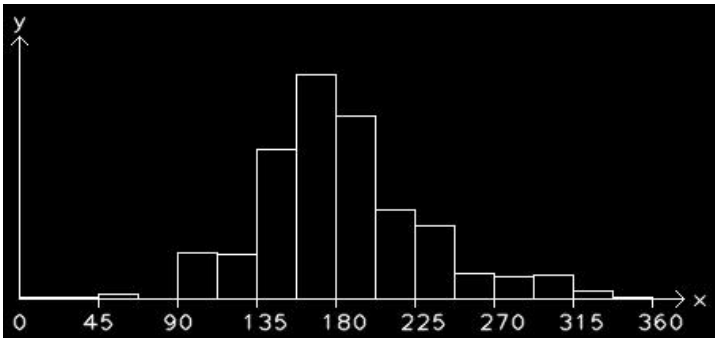

Fig. 4 Target feature point consistency constraints histogram (x denotes angle section 16, y represents a feature point statistics)

3. Target tracking and match

Based on the above dynamic motion consistency model, in order to solve the tracking problem, first by Gaussian mixture model to detect motion prospects, get about regional targets, provide a reference for tracking. Then establish a correspondence between the test results with the existing target before, in order to determine whether the occurrence of occlusion and the target appears and disappears. When you trace match, by the Euclidean distance to rough match, then the goal of the rough matching an exact match and then the motion information. When occlusion occurs, the use of optical flow forecast possible target location information, the occurrence of partial occlusion on the use of the active portion of the optical flow unobstructed continue to follow.

For mutual occlusion, optical flow forecasting through analysis feature screened valid information when the target is blocked. Then the area will be expanded to predict the horizontal and vertical directions of the original 10% target as the search area for the search to match. Optical flow within the search area for statistical information to determine the best match location information campaign as a tracking position of the target. Euclidean distance as shown in equation (1):

$$dis\tan ce = \sqrt{(A.Gray - B.Gray)^2 + (A.Edge - B.Edge)^2} \quad (1)$$

4. Experimental results and analysis

In order to verify the effectiveness of the proposed method, the self-timer data size is 432*240 and PETS2009 data size is conducted experiments on 768*576, experiments were among mutual occlusion did not occur between the target block and multi-objective test. Experiments show that the algorithm has some validity, the experimental results in the settlement block and tracking see Fig.5.

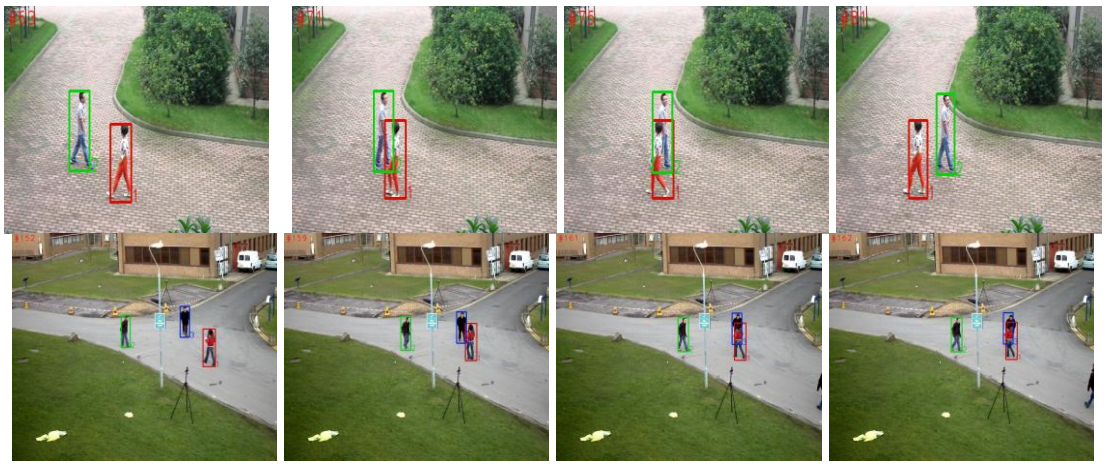

Fig. 5 Self-data results and the experimental results PETS2009

But in between multi-objective severe occlusion and occlusion in the case of mutual goals static color characteristics similar to, yet to be further improved and perfected.

References

[1] J.Zhang,X.B.Mao,T,J,Chen: Summary of moving target tracking algorithm, Application Research of Computers, Vol. 26 (2009) No. 12, p. 4407-4410.
[2] Y.Yang,T.W.Zhang: A moving target based on characteristics of optical flow tracking algorithm, Jouranal of Astron Autics, Vol. 21 (2000) No. 2, p.8-15.
[3] T.T.Chen,Q.Q.Ruan: Large-scale movement of the human body feature point tracking algorithm under, Journal of signal Processing, Vol. 30 (2014) No. 7, p.797-803.
[4] J.Liu,F.Li,S.R.Zhou,L.Huang: Improved PSO based optical flow algorithm, Computing Technology and Automation, Vol. 33 (2014) No. 4, p.68-73.
[5] Y.P.Li,J,H,Ling,N.X.Yang: A moving target based on SIFT feature optical flow tracking algorithm, Computer Science, Vol. 42 (2015) No. 11, p.305-309.

[6] A.M.Zhu,Y.M.Chen: Real-time target tracking algorithm based on the feature point of consistency constraints, Journal of ShenZhen University Science and Enginering, Vol. 30 (2013) No. 3, p.228-234.
[7] L.Z.Yan,J.L.Lu: Optical flow computation based on a normalized matching area, Journal of HeBei Normal University Natural Science Edition, Vol. 32 (2008) No. 6, p.730-733.
[8] Z. Kalal,K. Mikolajczyk,J. Matas: Forward-Backward Error: Automatic Detection of Tracking Failures, *International Conference on Pattern Recognition*(Istanbul, Turkey, August23-26,2010).
[9] J.Sánchez,A.Salgado,N.Monzón: Computing inverse optical flow, Pattern Recognition Letters, Vol. 52 (2015), p.32-39.
[10] M.H.Yang,J.H.Tao,J.T.Ye,Y.S.Wang: Robust exclude optical flow error tracking point, Journal of Compute- Aided Design & Computer Graphics, Vol. 24 (2012) No. 1, p.76-82.
[11] G.J.Wei, Z.Q.Hou, W.Li, W.S.Yu: Motion coherence image seglIIentation fused with multi-feature, Joumal of Image and Graphics, Vol. 19 (2014) No. 5, p.701-707.
[12] C.S.Chen, J.Zhang, Z.Xie, J.Gao: Multi-cues object tracking based on motion consistence in random field, Journal of Image and Graphics, Vol. 20 (2015) No. 1, p.0059-0071.