Moving Target Detection and Tracking Based on Improved FCM Algorithm

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ABSTRACT

With the rapid development of computer intelligence technology, the majority of scholars have a great interest in the detection and tracking of moving targets in the field of video surveillance and have been involved in its research. Moving target detection and tracking has also been widely used in military, industrial control, and intelligent transportation. With the rapid progress of the social economy, the supervision of traffic has become more and more complicated. How to detect the vehicles on the road in real time, monitor the illegal vehicles, and control the illegal vehicles effectively has become a hot issue. In view of the complex situation of moving vehicles in various traffic videos, the authors propose an improved algorithm for effective detection and tracking of moving vehicles, namely improved FCM algorithm. It combines traditional FCM algorithm with genetic algorithm and Kalman filter algorithm to track and detect moving targets. Experiments show that this improved clustering algorithm has certain advantages over other clustering algorithms.

KEYWORDS

Genetic Algorithm, Improved FCM, Kalman Filter, Moving Target Detection and Tracking

1. INTRODUCTION

Today, vision-based moving target detection and tracking has been widely used in video surveillance, virtual reality, human-computer interaction, planet detection, behavior understanding and other fields. It has realized the functions of public safety monitoring and management, accident prevention, detection and processing, emergency deduction, monitoring of the elderly, children and disabled, and self- navigation. Visual-based moving target detection and tracking has gradually penetrated into all aspects of people's lives, and its importance has become increasingly prominent, it attracts more and more scholars and research institutions at home and abroad to participate in this field[YIN,2016].

At present, some conventional moving target detection methods include: (1) Target detection based on background modeling includes initialization of background model, model maintenance, and foreground detection and segmentation. For example, Wang et al. proposed to improve the initialization background model Median, and proposed a robust initialization model that can accommodate more than 50% of the foreground targets or noise. Its disadvantage is that it can only be used in a fixed scene environment, and it changes constantly due to changes in illumination and the changing factors of the target in the scene. Accurate and various background models need to be established, so they usually cannot meet the real-time performance request well. (2) Target detection based on foreground object modeling, the foreground object and background in training samples are respectively expressed by features, the object or background appearance model is established, and then the classifier model is obtained by classifier training. For example, the DPM target detection algorithm proposed by

Felzenszwalb is a target shape description model trained by combining gradient histogram (HOG) features with Latent SVM. Its disadvantage is that the accuracy and robustness of the algorithm are not high under the conditions of large occlusion, small inter-class difference and large intra-class difference, large target deformation and scale change, and low image resolution [Li,2010; Wang,2019].

This paper is mainly described the target detection algorithm based on feature optical flow. The core idea of the algorithm is to calculate the optical flow of all feature points in each frame image by using feature matching of a series of adjacent images, and then perform an improved clustering algorithm on the optical flow to separate the moving target from the background, and last track the target in combination with Kalman filter. The innovation of this paper is to propose an algorithm that can automatically give the number of clusters, which is a simple and fast improved FCM algorithm, and several sets of experiments are carried out for comparative analysis. The results show that the algorithm is adaptive. And the number of moving targets is given at each moment, successfully separating the target and background.

2. FCM CLUSTERING ALGORITHM

The fuzzy C-means clustering algorithm (FCM) is simple in principle, easy to be operated and widely used. The core idea is to minimize the objective function, and to find the final class center and membership matrix. A given data set $X = \left\{ x_1, x_2, \cdots, x_N \right\}$, which contains N samples, the number of clusters is C, u_{ij} is the degree of membership for the first j sample $x_j \left(j = 1, 2, \cdots, N \right)$ which belong to the Ith category $v_i \left(i = 1, 2, \cdots, C \right)$, the objective function of FCM is as follows[Gao, 2016]:

$$
\begin{cases}
\min & J\left(U, C\right) = \sum_{i=1}^{C} \sum_{j=1}^{N} u_{ij}^{m} \left(x_j - v_i \right)^2 \\
s.t & \sum_{i=1}^{C} u_{ij} = 1
\end{cases}
\tag{1}
$$

Among them, M is the fuzzy coefficient, usually m is taken 2. According to the Lagrange multiplier method we obtain the clustering centers and membership degree expressions as follows [Tang, 2014]:

$$
v_i = \frac{\sum_{j=1}^{N} u_{ij}^{m} x_j}{\sum_{j=1}^{N} u_{ij}^{m}}
\tag{2}
$$

$$
u_{ij} = \frac{1}{\sum_{k=1}^{C} \left(\frac{\left(x_j - v_i \right)^{\frac{2}{m-1}}}{\left(x_j - v_k \right)^{\frac{2}{m-1}}} \right)}
\tag{3}
$$

The steps of the algorithm are as follows:

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