New Methods and Algorithms of Search, Detection and Tracking of Moving Point Targets along a Complex Path on a Complex Background

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Keywords: Search and recognition, image and pattern recognition, complex background, video sequence handling.

Abstract. The article is devoted to solving the fundamental scientific problems of developing universal methods of video sequence processing for the detection and tracking of objects of interest. During work on the subject, authors designed new methods and algorithms for universal monitoring systems for wide range of objects in the video sequences which could be implemented at miniaturized data processing systems. In this paper we describe a new method of search and recognition of point objects on a complex background, a new algorithm for the analysis of the found set of descriptors of local features to filter false positives filter local features, object detection criterion in the image, a new algorithm for the analysis of the trajectory of a point object on the basis of a recursive Kalman filter to predict the trajectory the movement of point objects.

Method of Search and Recognition of Point Objects on a Complex Background

Developed method of search and recognition of point targets based on an analysis of a series of noisy images of a video sequence. The novelty of the method lies in the combination approach analysis descriptors local image features, data mining techniques and algorithms of graph based parallel computing technology. Search method point object consists of 3 stages:

- preprocessing the video sequence image (a monochrome image conversion, noise smoothing median filtering, improving image contrast selection scope);
- detection of point targets (Harris corner detector, the analysis of the "good" tracking points for the image);
- analysis of the data of point objects to isolate moving objects (filtering areas based on graph algorithms, the analysis of the speed and distance traveled by the object, the averaging motion path based on the Kalman algorithm) [1].

The inputs to the algorithm search and recognition point objects on a complex background are another frame of the video sequence frame, optical flow vector of parameters $opt_flow$. The algorithm starts with calculating $vec\_points$ image descriptor frame $c$ using the graphics subsystem. Next is the start of the algorithm remove connected groups $vec\_points$ vector. The remaining elements of the vector are entered into a vector $vec\_points vPoints$ algorithm using the addition point into the vector $vPoints$. Is launched update algorithm based on vector $vPoints$ added points. At the final stage of the algorithm is performed conclusion intended purposes on the basis of analysis $vPoints$ vector.
Figure 1. The integrated search algorithm and recognition of point objects on a complex background.
Algorithm Analysis Found a Plurality of Local Descriptors Features to Filter False Positives Filter Local Features

The main task of the algorithm deleting connected groups - vec_points reduce the length of the vector. The input to the algorithm is applied and the vector vec_points v_acc. Vector elements v_acc
recorded in vec_points. A search of connected groups of pixels is equal to the maximum distance MAX_DIST_EL. The points which correspond to the condition entered in the connected battery v_acc vector and excluded from the input vector vec_points, the remaining points form the desired vector result v_out.

Figure 4. The algorithm of adding the new terms to the vector vPoints.
The essence of the algorithm is to verify the minimum distance \( \text{dist} \) added from the point defined by point coordinates \( X, Y \) to existing points, stored in the vector \( vPoints \). If the distance is less than a predetermined value \( usRadius \) - radius overlapping points, then the existing point is updated (changed its position, velocity, time, activity, and the following calculation is made on the basis of the coordinates of the Kalman filter). Otherwise, the point is made to add a new point in the vector \( vPoints \) (speed and activity of the new point initialized to zero).

The input data vector \( vPoints \) update algorithm given points are added \( vPoints \) vector and a parameter vector of the optical flow \( \text{opt}_\text{flow} \). The algorithm sequentially checks all point vectors \( vPoints \). For each vector \( vPoints[i] \) of the optical compensation is performed using flow \( \text{opt}_\text{flow} \). If the point \( vPoints[i] \) refreshed in a current frame produced update flag reset point and \( \text{CountRefresh} \) counter is incremented by one. Otherwise produced decrement variable amount appearance point \( vPoints[i] \) and in case of achieving zero point is deleted from the vector \( vPoints \). At the final stage of the algorithm checks the total number of updated pixels, in case of exceeding a predetermined threshold occurs \( MAX\_SBOI\_PER \) optical flow fails and is performed to reset all purposes [2][3].

The inputs to the algorithm output is anticipated target vector \( vPoints \). The essence of the algorithm is sequential analysis points \( vPoints[i] \) vector \( vPoints \). For each point, it calculates the distance traveled \( d\_route \), as well as the number of occurrences of the point considered in the frames. If the dot distance exceeding overcomes \( MIN\_ROUTE \) fixed threshold and the number of occurrences in terms \( COUNT\_K\_RED \) frames exceeds a value produced map with target coordinates \( vPoints[i] \).

Acknowledgement

The paper is published within the research, supported by the Grant of the President of Russian Federation for young PhDs, project № MK-5463.2016.9

References

