SIMULATING OPTICAL PATTERN RECOGNITION ALGORITHMS FOR OBJECT TRACKING BASED ON NONLINEAR MODELS AND SUBTRACTION OF FRAMES

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Abstract. We have proposed and discussed optical pattern recognition algorithms for object tracking based on nonlinear equivalence models and subtraction of frames. Experimental results of suggested algorithms in Mathcad and LabVIEW are shown. Application of equivalent functions and difference of frames gives good results for recognition and tracking moving objects.

Keywords: optical pattern recognition algorithm, object tracking, nonlinear equivalence model, subtraction of frames, space-invariant recognition, Mathcad, Labview.

Introduction. For many applications applied in the creation of biometric systems, identification systems, extreme-correlation guidance neural cyber machine vision systems and other necessary solve the problem of object recognition in images and scenes support problem-identifying moving objects. There are many known methods and means [1, 2] to address these problems. The basis of most known methods and algorithms is to compare two different images of the same object, or its fragment, or two images, one of which is a benchmark or its transformed image and the second image is a set of images that belong to different classes and only some of them belong to the class that represented the standard. Discriminated measure of the mutual alignment reference fragment with the current image, the coordinate offset is often a mutual two-dimensional correlation function. In paper[3] it was shown that to improve accuracy and probability indicators with strong correlation obstacle-damaged image, it is desirable to use methods of combining images based on mutual equivalently two-dimensional spatial functions, nonlinear transformations of adaptive-correlation weighting. At the same time, an acute problem of recognition is not only static, but also moving objects, their maintenance, i.e. tracking. In addition, in real systems is the need to recognize in such adverse situations where a moving object obstructing the obstacles which reduces the share of standard, on which the recognition is performed. The purpose of this section is a series of model experiments in model environment Mathcad verification methods for detection of moving objects with sufficient probability and accuracy.

Model experiments in Mathcad. To test the accuracy of coordinate reference standard in recognizing moving objects by simulation we used the previous video file splitting into individual frames and mutual combination of two methods for the selection frame to current staff. One group of methods included processing the current frame of image and the support position of these fragments. The second group included the formation of difference frames and further processing and combining the current frame difference with the selection of these shots difference. In addition, for both the first method consisted in finding equivalent functions between the selected fragment to study with the object of attention and the current image by processing halftone images. The second method is different from the first that the resulting equivalent function is calculated by weighing all eight successive discharges functions from bit-maps of images which were processed in each frame. In both cases additionally used equivalently adaptive non-linear weighting strengthened discriminates used measure, and allow better highlight extremes (peaks) two-dimensional spatial functions. The experiments showed that the best of these options is available by combining equivalent difference comparing the current frame with selected position from these difference-fragments, representing objects of attention. Figure 1 shows the simulation results. For both groups, the second method of processing successive-slice combination gives the best results and for moving objects, that disappear when their movement by barriers second group recognition on the basis of the formation of the current frame images of inter-frame difference images (sees Fig. 1, second right images in the top row).

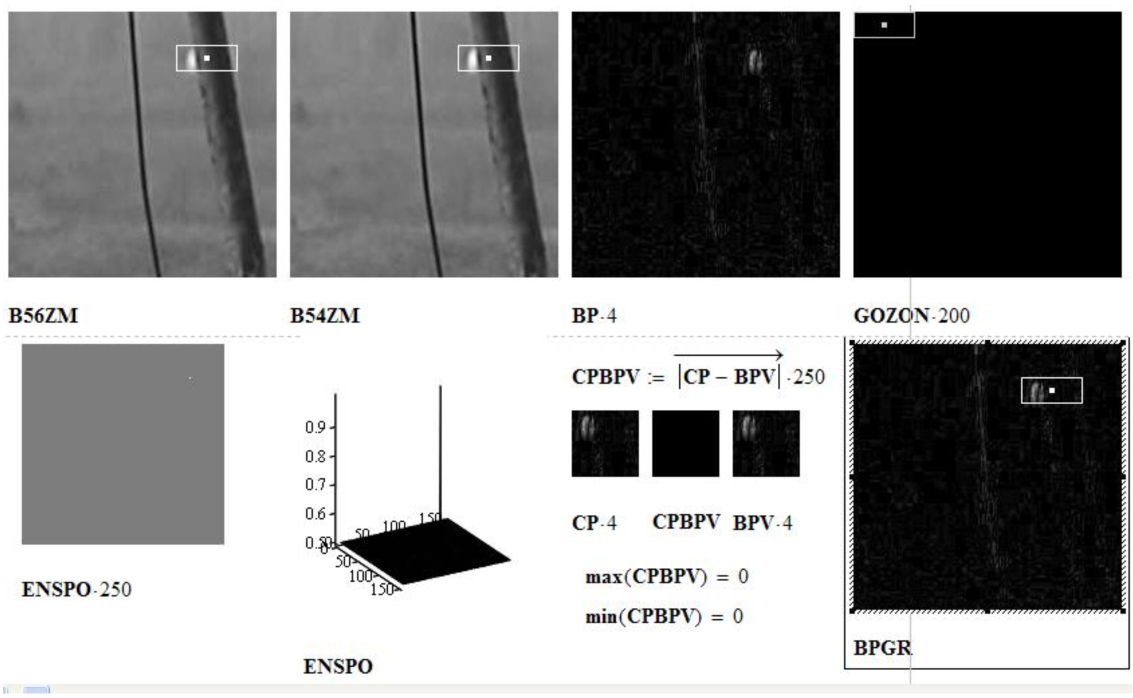

Figure 1. Model experiments in Mathcad

Experimental research of tracking algorithm of moving objects. Especially the process of verification and investigation of algorithms for allocation and tracking of moving objects, which are recorded by cameras, there is a need of fixing, recording, playback and processing of a large number of frames (images). In addition, the dimension of the processed images have a significant and processing inline frames forming descriptors, compares them with the help of criteria functions, a decision of a moving object of interest or part thereof, with the subsequent issuance of markers and designators, must be made continuously and in real time . Therefore, the choice of tools for research, we settled on Labview, as the most powerful integrated with the hardware platform and development environment created in the graphical programming language «G» company National Instruments (USA). Harnessing the power of Labview and its basic applications and modules makes it relatively quickly design the required system of recognition and support, to quickly change the behavior, structure and model of the system or process, write, read and analyze video file (AVI) frames, which significantly simplifies the process of verification of developed systems -specific features and statistics. At the same time for in-depth mathematical formalism and describe some of the important stage process, for example, such as the construction of two-dimensional functions of criteria we use Mathcad, which as the results of our previous studies, there is a powerful tool. We have developed a number of possible projects detection and tracking of moving objects (DTMO). Subject to the restrictions consider DTMO one embodiment shown in Figure 2 shows a block diagram of a project, and fragments 1b shows the basic design. The system introduced by the node read AVI-files to generate both the original video stream and video stream of difference frames with the possibility of setting a different delay time (in frames) between the deductible frames. Knot formation pattern from the selected frame and the node template comparison with selected fragments of the current frame chosen standard, but, as will be shown below, also require improvement. Results of the first experiment in support of a moving car for scenes with overlapping objects obstacles is shown in Figure 3a shows one of the frames from which was isolated and formed pattern, see Figure 3b. Some frames with dedicated red markers (frame) and the designator shown in Figure 3c. This test uses frames of the original file without pre-processing, the size of RGB-image frames - 281 × 126 resolution 8bit pattern 44 × 24, and for comparison with the current template frame mode is used «Grayscale», so use a special type of converters, and image formats. To determine the quality of support was estimated number of frames with markers in a video, which was recorded as the video output of the project and who was using the application Vision

Acquisition transformed into a set of 256 frames. Number of frames, in which a moving object (MO), was placed fully, equal to 135. Therefore, the proportion of frames in which the object is not specified, was (135-88) / 135, which corresponds to approximately 35%. And this in the case, where large relative to MO barrier to not.

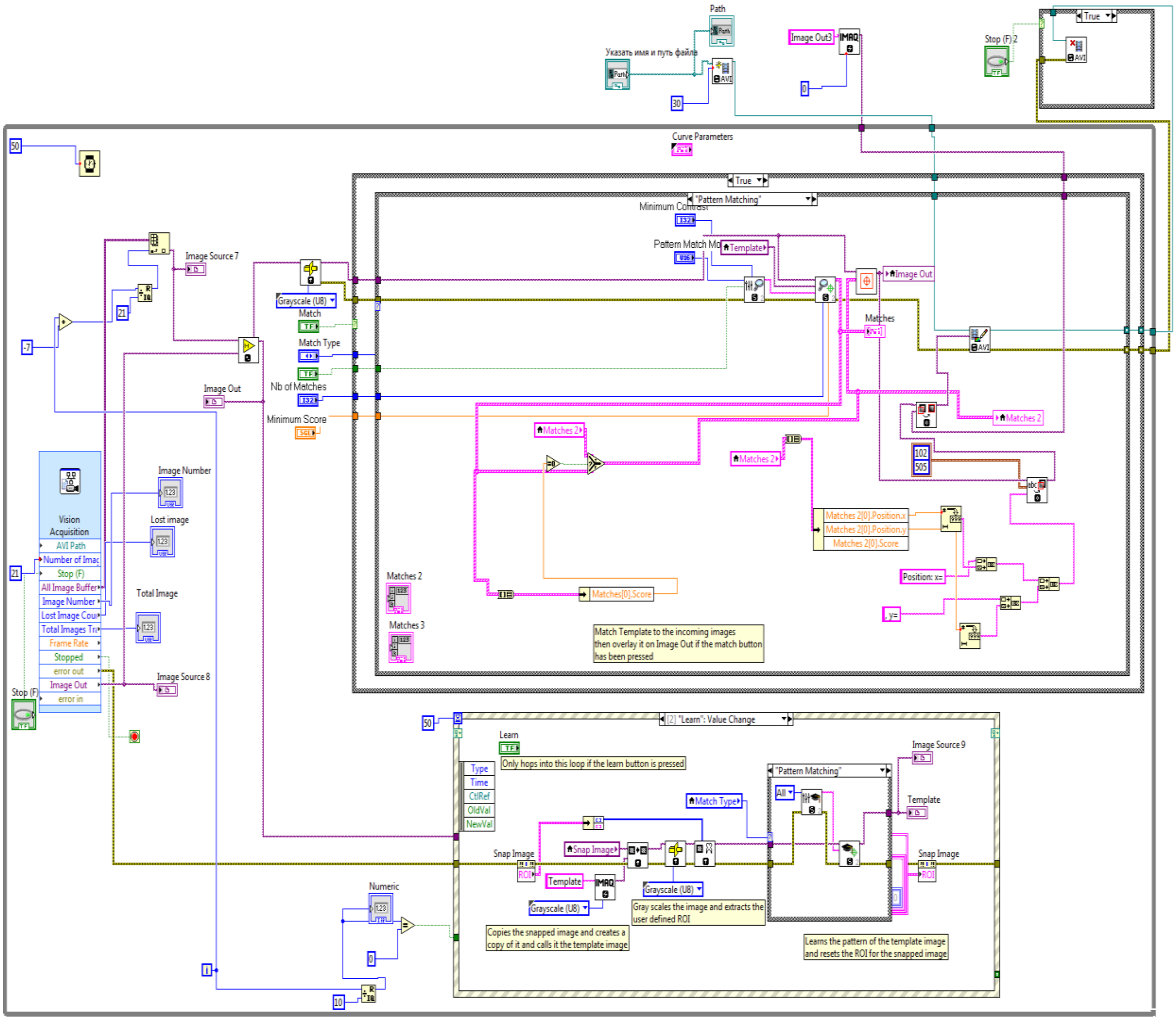

Figure2. Block diagram of the project

In this regard, we conducted a second experiment in which watched from the source to the video has been formed from the difference inter-frame video images. Number of frames for which delayed video stream varied between 3 to 7 and more. Figure 4 shows the results of simulation where the difference frames formed by delaying them in frame 7 as an absolute difference of pixel intensities. The experiment showed that the percentage of frames without reference to the MO, i.e. with the loss of support, depends on the delay time for the inter-frame subtraction, the size of the object, since the difference pattern increases with the delay, the speed of movement relative to the frame rate and shooting conditions, and also on the specific nature scenes. For example, the camera shake when shooting hand-forms on the difference frames the contours of objects (trees, poles, etc.). In addition, the quality of the support and influence the choice of the template when a template can be selected only some (front, rear) part of the total difference pattern 4b. This experiment showed that for the most optimal video there is a delay of 7 shots, but winning over the first experiment, as there is practically no maintenance. Therefore, an additional check, we tried to work with a video file of larger dimensions (416 × 125 8bit image) and other shooting conditions. The results for this case are shown in Figure 5. The experiment with the file showed that the quality of support has improved and the proportion of lost bindings decreased to 15% (268 frames in all, 228 with the correct reference, 40 frames in the search mode or a loss of MO to). Thus this and similar experiments, we show that the use of inter-frame subtraction positively affect the quality and support to at least two or three times, but for special occasions, reduces the proportion of errors.

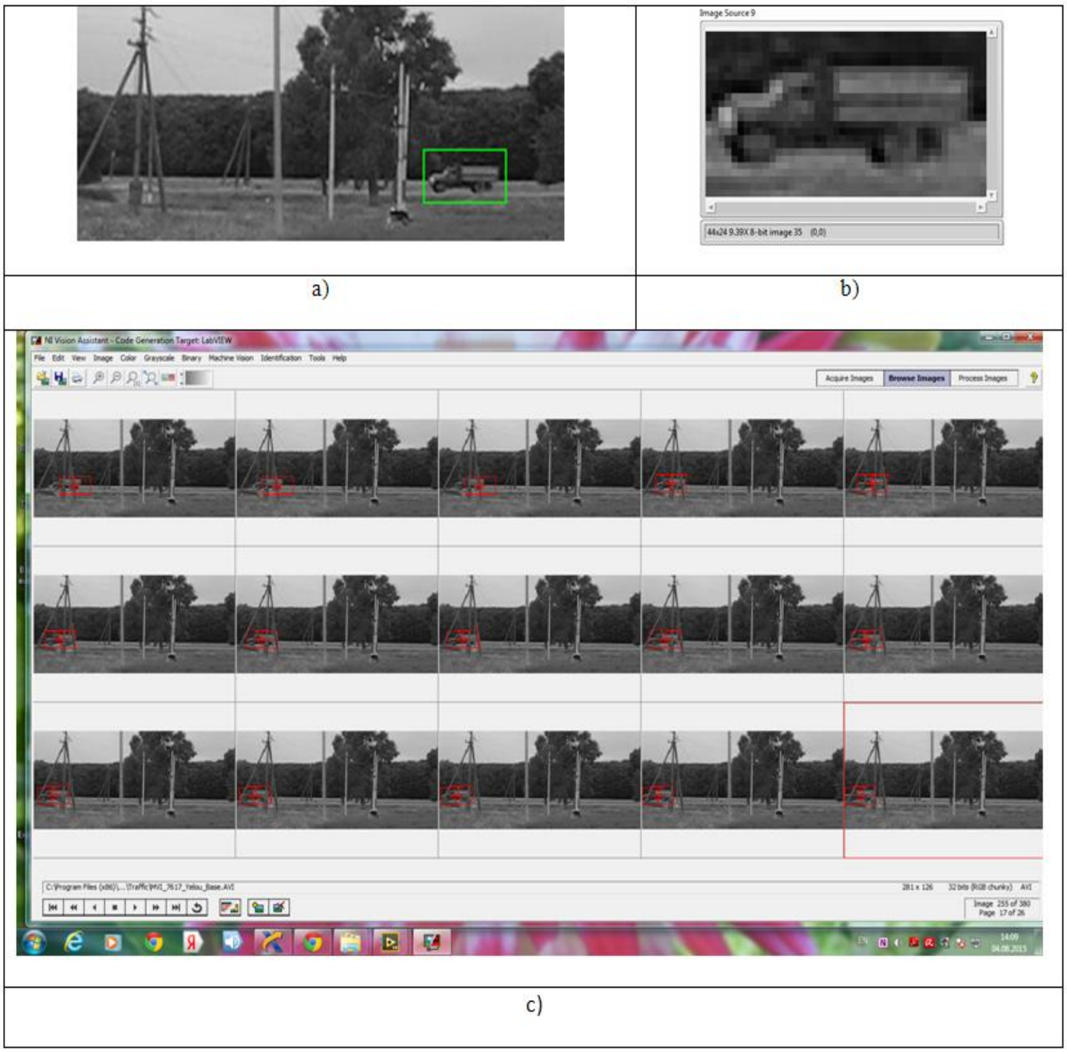

Figure 3. Modeling results: a) -- One of the original frames; b) - Template; c) - Set of frames with markers and pointers of a moving object

Fourth, our experiment was to check the quality of the project in which we used a dynamic template and the results of which are shown. This experiment showed that such an approach has its advantages and disadvantages, but significant gain compared with the previous experiment does not (error rate was 15%). Further studies are needed.

Conclusions. Experiments in Mathcad have shown that the best option is the use of bit-map image processing and non-linear equivalence functions to align positioned comparing fragments of the difference current frame with the reference difference fragment representing the object of attention. The proposed tracking method implemented in the Labview- project, which allowed them to effectively carry out the simulation. Five different experiments with video-file showed, that application of equivalently image functions and difference frames gives good results combining recognition and consideration of moving objects in video and allows using image momentum features, set point and target designation follow this object.

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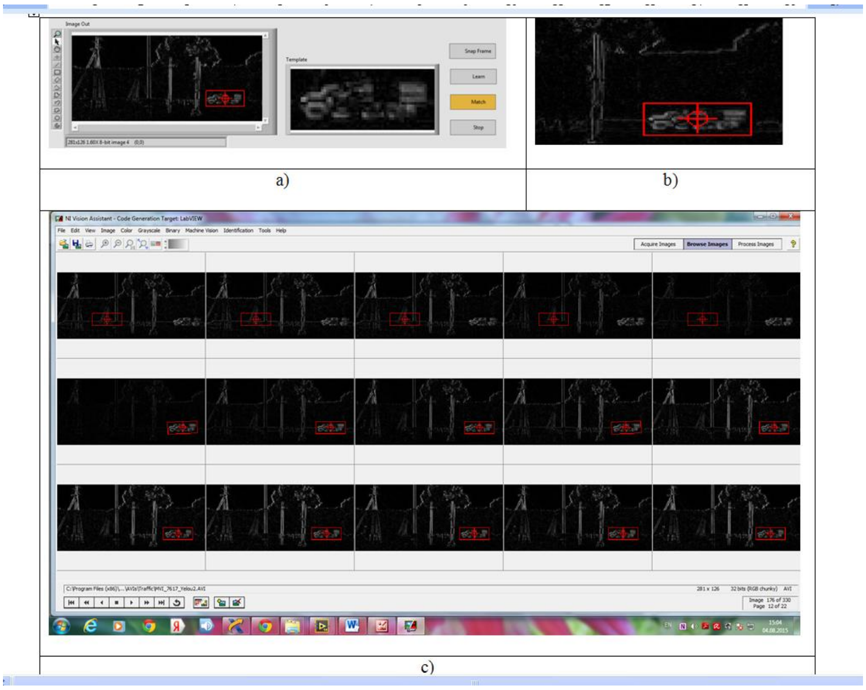

Figure 4. a) - Difference frame with selected object (left) and a pattern (right); b) - The enlarged area of selected object (difference); c) - Frames with selected object and with loss of the object.

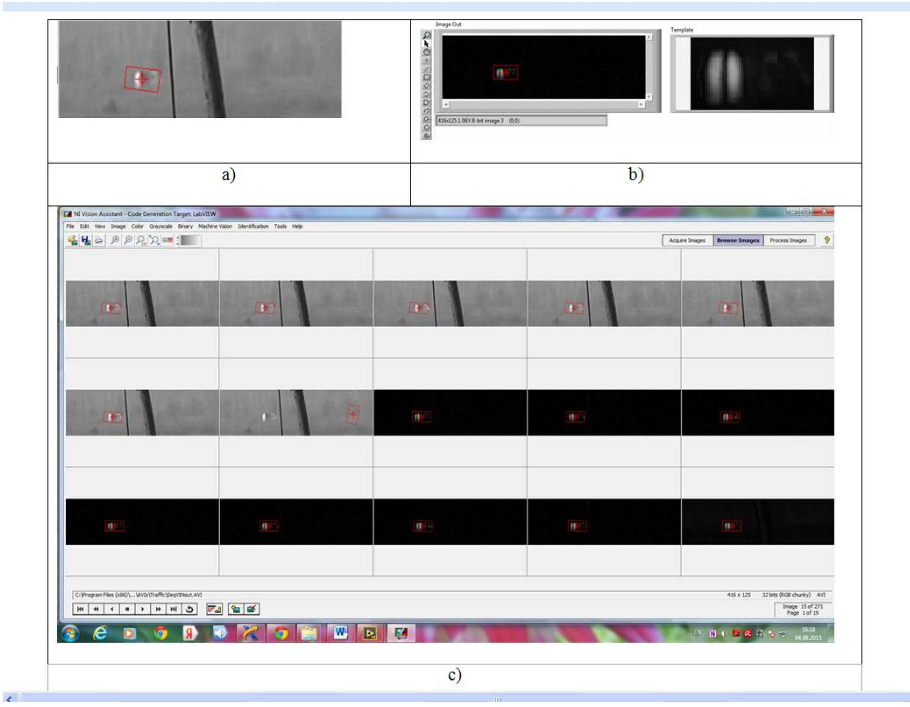

Figure 5. Modeling results: a) -- One of the original frames; b) - One difference from the frame array; c – A set of frames (the original seven and the remaining difference)

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