**SECTION 4. Computer science, computer engineering and automation**

**Semenishchev Evgeny Alexandrovich**
PhD, lector, Don State Technical University

**Semkina Ekaterina Urevna**
master student, Don State Technical University

**Vinogradov Vasily Igorevich**
student, Don State Technical University

# DEVELOPMENT OF AN ALGORITHM FOR DETECTING THE CHARACTERISTICS OF OBJECTS IN VIDEO SEQUENCE

*In this work we get a view of the approach of object characterization in the video sequence. Detecting of low frequency constituents by means of Fourier spectrum analysis. Increasing of selected by user constituents. Examples of change accentuation in video sequence.*

*Keywords: Fourier transformation, video, detecting, searching.*

In modern automatized systems of control and diagnostic the one of important problems is the searching and characteristic analysis of observable object. Using of digital cameras to register changes helps to do remote monitoring. Operator participation in parameter detecting causes additional error, but it increases adaptivity and decreases adjustment time in case of revealed error. Using of computer-managed video-control systems can help operator to notice object that requires special attention. Along with this, there are occasions of slowly varying inter-frame changes to which the operator can not pay attention. Detection of such changes can be used in fields such as: medicine and biology, to contactless control changes of object constituents (heart-rate, breathing, movement); technique, due searching of resonant frequency destruction; Geodesy and Geology, due researching of subsoil deposits and movement of seismic waves; various security systems, that can't identify slow movements, etc.

Mathematically, the sequence of frames can be represented as an expression below (1):

$$Y_k = (V_k + S_k) + \delta_k \quad (1)$$

where: $Y_k$ – frame sequence under review with dimension $n \times m$; $S_k$ – the object of study; $V_k$ – image background, $\delta_k$ – additive noise component of the signal, k – frame number.

Suppression of the noise component in the video is necessary because of the disturbance that affects the quality of the target sequence, and also increases the error of inter-frame change detection. Methods used to reduce effects of noise components should keep the edges of objects. In contribution [2] approach of noise component suppression was presented as multi-criteria method with border crossing retaining.

Figure 1 shows algorithm for searching of inter-frame changes that consists of X steps.

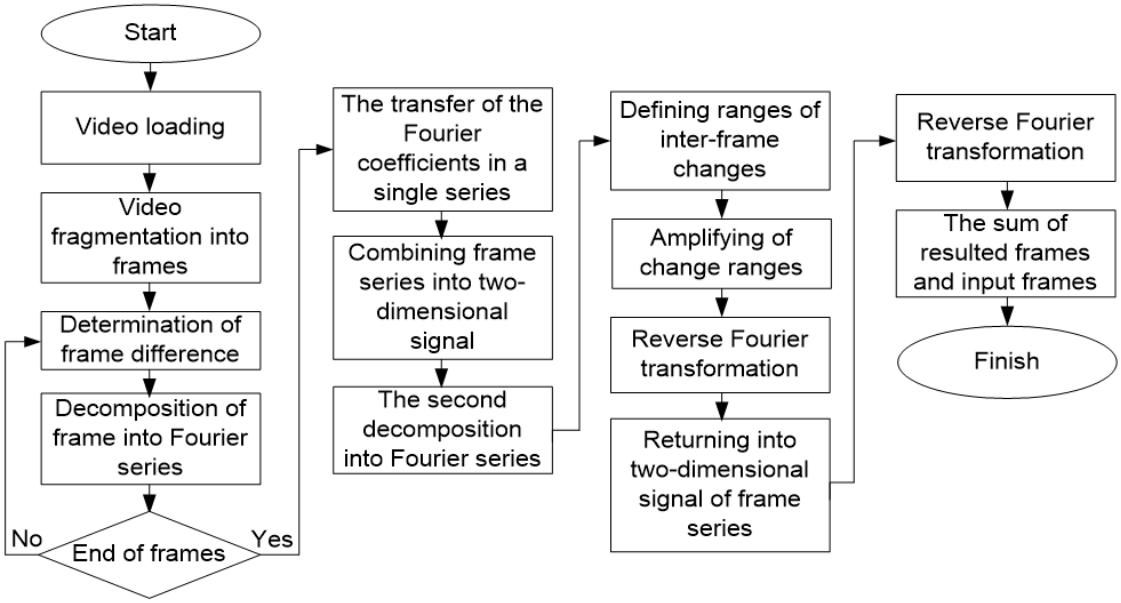


**Figure 1 - Algorithm for searching of inter-frame changes.**

Presented algorithm is implemented by following steps:

First, video frequency analysis is performed: operator selects needed for researching area $S_k$. For computerize searching one of the proposed methods in [3] is put to use, that can find the high-detailed object in the image $S_k$;

Second, frame by frame decomposition of selected area $S_k$ into Fourier series in the whole video sequence is performed.

Third, a transformation of 2D spectrum into 1D array using gradual migration of rows or columns in a single row.

Then formed a single two-dimensional array of sequential association for k obtained from column in the previous step;

In the fifth step the analysis of the received two-dimensional array by its second decomposition into Fourier series and also by its correlation analysis are performed. The example of such union is presented in Figure 3;

Next, algorithm performs identification of repeating changes, theirs selection, amplification by means of multiplying by a specified coefficient $\alpha$;

In the end it restores images by reverse Fourier transformation.

Figure 2 shows an example of inter-frame changes accentuation by proposed algorithm. The research was conducted on a standard video file "boxer", size $160 \times 120$, a frequency change of 24 frames per second. Video represents 20 seconds of sportsman training. He is doing alternate punches. Fixed camera isn't static, received video file executed in eight bit representation grayscale. As an area of interest $S_k$ plays the whole image.

**Figure 2 – The example of inter-frame changes accentuation**

Analysis of the research results shows opportunities of inter-frame changes amplification. The example of accentuation associated with a movement of the hands is in Figure 2.

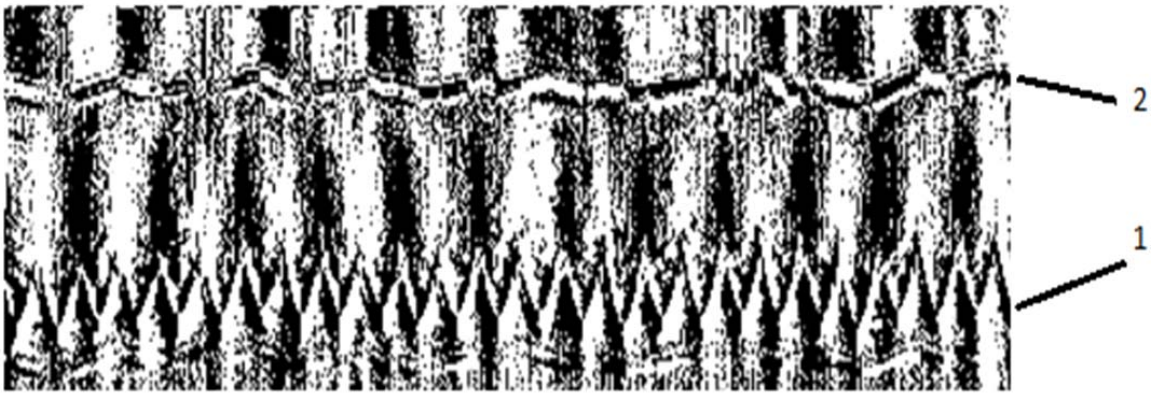


**Figure 3 – The example of decomposition into array**

Looking at Figure 3 it's clearly, that changing domain 1 corresponds with movements of hands and changing domain 2 corresponds with the whole object movements. It is possible to define that the frequency of hand position change makes 0,8 times a second, not static character of the camera of low amplitude with the revealed movements of 6 times in the range of 10 pixels concerning an axis X.

The researches gave the following results:

– developed algorithm for low-frequency and high-frequency motion changes accentuation;

on the basis of field experiments demonstrated the efficacy of the proposed approach, which allowed in test video to amplify the areas in frames where hands move.

**Bibliography:**

1. Rosenfeld A., Kak A.C. Digital Picture Processing. – 2nd ed. – N.Y.: Academic Press,1982. – V. 1. – 435 p.; V. 2. – 349 p.

2. Semenishchev, E.A., The synthesis of two-criterion smoothing method of measurement results / Semenishchev E.A., Marchuk V.I., Shraifel I.S./ Advantages of modern Radio Electronics - M., 2011, №9, P. 21-26.

3. Semenishchev, E.A., Accentuation of local areas of highly detailed objects on the overall scene image / Marcphuk V.I., Toropov I.A., Tolstova I.V./ The non-linear world. №11, vol.10, 2012. p.796-800.