The Method Of Video Streams Processing For Information Technologies Of Aero Monitoring

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***Abstract*—In article the questions related with video streams processing which are formed in the conditions of aero monitoring by UAC are considered. It is shown that the video stream is presented in the form of images frames sequence which segments are characterized by the different semantic saturation. Various approaches of the video frames processing which allow to select significant information in the image, namely planimetric and textural are considered. Contradictions between increase in amount of the temporary redundancy caused by existence of interpersonnel structural regularities and requirements which are imposed to process on a video stream processing are stated. Need of orthogonal transformations application for textural areas of the image processing is proved. The method of two-hierarchical aerial photograph blocks coding taking into account the image blocks semantic saturation is developed. Graphs of information intensity reduction coefficient dependences on the blocks semantic saturation level of various images classes are presented in article.**

Keywords— video streams; blocks; aerial photograph; coding; vector; sequence.

I. INTRODUCTION

Nowadays it is a keen interest in means of information collection in the system of aero monitoring, namely in use of unmaned arial complexes (UAC) [1-3]. As the obtained information, as a result of aero monitoring of UAC, digital aerial photographs are considered.

The received aerial photographs differ in high degree of a saturation in small details, having significant amounts of information reaching about 100 Mbit. The UAC onboard equipment performs function of information transfer on communication channels on a land complex. At the same time the onboard complex is characterized by a number of restrictions: dimensions, power of the onboard generator, rather low capacity of radio channels of data transmission [6-10]. The equipment of data transmission doesn't allow to use the powerful radio equipment. The problems connected with the organization of data transmission are a consequence of such shortcomings. Data transmission channels between the UAC and a land complex don't provide timely delivery of information. Not timely delivery of information in the course of air monitoring leads to her obsolescence and wrong drawing up the report to the relevant department. It affects on reliability of the obtained information, and also efficiency of performance of tasks in system of air monitoring [13-15].

One of effective solutions in information delivery efficiency increasing is reduction of the processed and transmitted data volumes in telecommunication networks. It is for this purpose offered to carry out previously onboard the UAC processing of digital aerial photographs. It will allow to reduce information intensity taking into account saving information, semantic significant for decryption. However in this case a part of useful information can be distorted or lost. Therefore process of decryption can be carried out with mistakes. And it in turn leads to decrease in its efficiency.

Therefore for an exit from this situation it is offered to allocate the objects bearing the main key information in processing. Efficiency of decryption depends on saving key information on an object. Information on objects is offered to be transferred with preservation of the greatest informational content in order that at the following stage quickly to transfer information with the smallest distortion. Such approach will allow to keep informational content of an aerial photograph, taking into account the low capacity of communication channels.

The existing technologies and methods of information processing have a number of shortcomings [4]. These methods are characterized by both high computing complexity, and loss of information in aerial photograph blocks. It leads to complexity of implementation of requirements for preservation of resolution of an aerial photograph, and also to increase in time of delivery of a video information from an UAC board. It is necessary to use such methods of images processing which will be directed to decrease in their

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information intensity, considering the semantic saturation of the received aerial photographs with saving of key signs information.

The formulated problem is offered to be solved with use of technology of information intensity reduction. Here the most widespread and popular methods of images processing are methods on the basis of the JPEG platform. One of transformations that is used in such methods, in process to processing of textural areas in images, is the discrete cosine transformation (DCT) [5, 12]. Use of the DCT mechanism is result of a transformant with coefficients. The received transformants frequency coefficients will allow to select significant information in aerial photograph blocks, to classify aerial photograph blocks by degree of semantic saturation. Application of digital aerial photographs processing methods will allow not only to allocate the most informative blocks and to save information on key signs, such as contour and border of objects.

Thus, the purpose of article is development method of video streams processing for information technologies of aero monitoring. It will allow to allocate aerial photograph blocks which bear the main semantic saturation, saving at the same time information on key signs that will lead to information intensity reduction of the processed and transferred pictures on communication channels.

II. The Classification of an Aerial Photograph Blocks Semantic Saturation for Determination of Their Informational Content Level

High-contrast areas of an image, differences of brightness, the linear sizes of objects make the most informative part of an aerial photograph. Therefore when processing it is necessary to consider a set of details: picture scale, resolution, quantity of objects, etc. However special attention needs to be paid to the choice of a semantic saturation in the considered aerial photographs.

Semantic saturation of an aerial photograph we understand as the most significant information - the contours and borders of objects of the area.

One of problems of processing of images is their classification. Among different types of classifications by importance degree, the problem of a semantic saturation which allows to obtain substantial information on the importance of the blocks of an aerial photograph is allocated

For creation of technologies of data processing onboard it is required to consider how features of functioning of an onboard complex, and the fact that the main class of the data formed onboard means of aero monitoring are aerial photographs of a different saturation. It is offered to consider blocks aerial photographs on degree of a semantic saturation [11]:

a) "Low saturated"; b) "middle saturated"; c) "high saturated"

We offer, to classify these blocks of an aerial photograph on two general groups [4]:

I group - the blocks which are high-coherent and with rather uniform content of structure.

- II group - the blocks with non-uniform structure which are low-coherent.

- We will carry out classification of groups of blocks of the image on classes. On the basis of classification we will receive:

- I.1. Uniform blocks, which image elements close or identical on color.

- I.2. Blocks with smooth transition of flowers in which there is a gradual change of one color of an element of the image to another.

- II.1. Planimetric blocks which can be divided into two areas with sharp difference of color between image elements.

- II.2. Textural blocks at which there are sharp differences of colours of an element of the image at some local area).

The following step we will apply dct-transformation to processing of blocks of an aerial photograph of these classes. In the beginning will be executed segmentation of an aerial photograph on blocks of the sizes 8×8 of pixels which are exposed further to two-dimensional discrete cosine transformation. As a result of performance of dct-transformation matrixes (transformant) of frequency coefficients, the size 8×8 of elements turn out.

There are most significant coefficients, correspond to the lowest frequency (are grouped in low-frequency area). All other components are high-frequency components. They contain insignificant information on the image. Thus, DCT creates conditions for assessment of a structural saturation of blocks of an aerial photograph.

As a result of redistribution of energy between components transformant we will carry out distribution of its frequency coefficients on groups [16]:

I - all frequency coefficients; II - low-frequency coefficients; III - high-frequency coefficients; IV - zero coefficients.

On the basis of the distributed frequency coefficients in a transformant of dct-transformation on groups, we will define structural characteristics of the classified aerial photograph blocks. For the analysis of the distributed frequency coefficients transformant we will calculate parameter P_{dct} for each group.

For analysis of the distributed frequency coefficients of the studied blocks of an aerial photograph calculates parameter P_{dct} for each group of frequency coefficients on.

The value of parameter P_{dct} is analyzed for zones of coefficients on a formula:

$$P_{DCT} = [\log_2(\prod_{\gamma=1}^{D_d}\prod_{\xi=1}^{N_y}(y_{\gamma,\xi}))], \quad (1)$$

where: $y_{\gamma,\xi}$ - component of transformant C on position with coordinates (γ, ξ), to diagonal D; D_d - quantity of diagonals in indicative group of a component; N_γ - quantity a component which correspond to diagonals in indicative group.

The carried-out calculations allow to draw a conclusion that there is a dependence between frequency coefficients in the block and parameter in each group.

Further the technology of classification of blocks of an aerial photograph for degree of a semantic saturation is carried out that is presented by the following steps:

1) Choice of indicative characteristics of blocks: saturation index $p^{(1)}_{k,\ell}$ and structural index $p^{(2)}_{k,\ell}$.

2) Assessment of the indicational characteristics of the block on the basis of which degree of accessory of blocks each other in uniform indicational space is defined.

3) Clustering of blocks of an aerial photograph which results in the distributed blocks $m_{i,j}$ by clusters M_j, on a basis indicational characteristics, what in turn leads to formation of three classes of a saturation of blocks (high-, middle- and low saturated) [5]. It will allow to make a choice concerning a class of a saturation of the studied blocks, taking into account the choice of j-th type of block $m_{i,j}$. At the same time the parameter g of quality of the saved information on key signs of decryption will be chosen according to a class of a semantic saturation.

In this case, dependence of parameter g of quality of transfer of key signs on degree of a saturation is presented by expression:

$$g = f(m_{i,j}, j), \qquad (2)$$

where: $m_{i,j}$ - i-th block that belong to j-th cluster according to a class of a semantic saturation.

Thus, on the basis of the received blocks classification by semantic saturation degree - the informational content level of an aerial photograph is defined.

III. The Information Technology of Video Streams Processing Taking Into Account Allocation of Semantic Saturation Degree

The first step is the elaboration of strategy of quantization a component transformant. Each component $y_{\gamma,\xi}$ of the transformant C is exposed to correction, according to quantization coefficients. Here the balance is provided, on the one hand, between increase of the length of the zero chains q_χ of the component transformant and growth of extent of reduction of volume of transmitted data, on the other hand – increase in efficiency of decryption of aerial photographs due to preservation of key and significant signs of decryption (a contour, texture and uniformity of landscape areas). Thanks to it there is an increase in efficiency of delivery of information at the set quality of decryption [11, 13].

The final result of the first step is receiving of quantized component of transformant C', according to a saturation of key signs.

The first level of two-hierarchical coding consists in receiving of the structured representation of the transformant with further allocation of the sequence $\hat{R}_{v_{vkt}}$ of two-element vectors.

At first it is carried out structurization of the transformant, by formation of a one-dimensional vector, i.e. it is carried out an allocation of lengths q_χ of chains, consisting from a component transformant, having zero values after quantization. Further it is carried out a formation of the vector consisting of two components: q_χ - length of a chain zero components; b_χ - value components different from zero value. Thus, we receive a two-element vector $\{q_\chi; b_\chi\}$ of structural characteristics of transformant. The following step carries out creation of vectors $\{q_\chi; b_\chi\}$ in the sequence $\hat{R}_{v_{vkt}}$ of two-element vectors that is presented by expression:

$$\hat{R}_{v\,vkt-2} = \{(q_2; b_2), ..., (q_\chi; b_\chi), ..., (q_{v_{vkt}-1}; b_{v_{vkt}-1})\}.$$

Where: v_{vkt} - length of the sequence $\hat{R}_{v_{vkt}}$ of two-element vectors.

At the second level of two-hierarchical coding occurs formation of code representation for separate two-element vectors $\Xi^{(2)}_\chi$. And for each vector, as two-element number $\Xi^{(2)}_\chi$ of the first level, code value $Z(\Xi^{(2)}_\chi)$ is formed.

On the following step it is carried out a formation of a chain S, maked of values of codes $Z(\Xi^{(2)}_\chi)$, which is the generalized number in a base of structural constraints of a transformant that is provided by expression:

$$S = \{Z(\Xi^{(2)}_2); ...; Z(\Xi^{(2)}_\chi); ...; Z(\Xi^{(2)}_{v_{vkt}-1})\}. \qquad (3)$$

Proceeding from it, there is a formation of the general code conception $Z(S)$ taking into account the received code values $Z(\Xi^{(2)}_\chi)$ at the first level that is represented by expression:

$$Z(S) = \sum_{\chi=2}^{v_{vkt}-1} Z(\Xi^{(2)}_\chi)\, N(S^{(\chi)}). \qquad (4)$$

Value $N(S^{(\chi)})$ acts as weight coefficient χ-th element of the generalized position number in basis of structural restrictions of transformant.

Thus, received generalized code representations $Z(S)$ to allow to receive a codegram Ω for the generalized number, that necessary for data presentation in a binary form.

The efficiency assessment of the developed method is carried out taking into account creation of intensity reduction index dependences. (K_{cmpr} -compression ratio) on aerial photograph saturation degree with blocks of three classes of semantic saturation that is presented in Fig. 1.

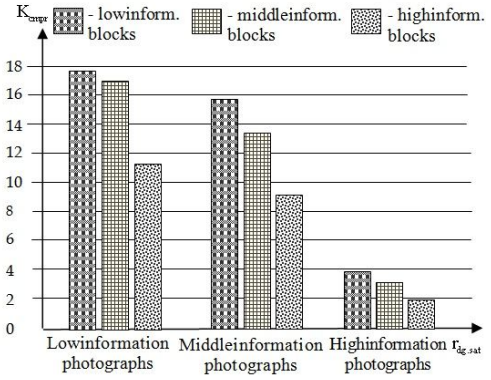

Fig. 1. Indicator of intensity dependence on degree of informational content of an aerial photograph in blocks of three classes.

The assessment of dependence degree intensity reduction on an aerial photograph quality index h_{add} (PSNR – peak signal-to-noise ratio) for blocks of three classes, it is shown in Fig. 2.

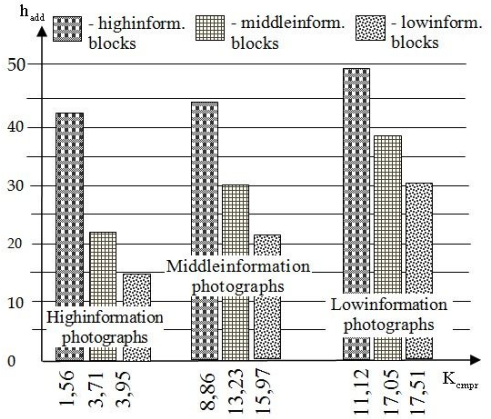

Fig. 2. Indicator of an aerial photograph quality for three classes of blocks.

IV. CONCLUSION

The classification of aerial photographs blocks by semantic saturation degree is received.

Interpretation of the sequence of significant two-element vectors as the generalized number of uncertain length is stated. At the same time elements of the generalized number are the codes of two-element numbers of the first level formed for separate two-element vectors.

The information technology of video streams processing taking into account allocation of semantic saturation degree is developed. It is based on formation of the sequence of significant two-element vectors for the structurized transformants.

Information technology of video streams coding based on the clusterized blocks structural processing is for the first time created.

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