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THE METHOD OF TIME SPENT ESTIMATING ON PROCESSING AND TRANSMISSION OF COMPRESSED VIDEO STREAM

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The paper analyzes the main characteristics of the efficiency of methods for processing video, which influence the evaluation time costs in the processing and transmission of the video stream. An evaluation of the effectiveness of time spent in the processing and transmission of the video stream based on the experimental hardware and software implementations for the stationary background of dynamic images from different values of the threshold filtering. Built method for estimating the time spent on processing and transmission of the video stream. The conditions under which the time required for the processing and transmission of the video stream to the developed technology reduces the relative time costs for the technology MPEG.

Keywords: time coding, decoding time, the transfer time, the speed of data transmission, the video stream.

У статті проаналізовано основні характеристики ефективності методів обробки відеопотоку, які впливають на оцінку часових витрат під час обробки і передачі відеопотоку. Проводиться оцінка ефективності часових витрат при обробці і передачі відеопотоку на основі експериментальної програмно-апаратної реалізації для динамічних зображень стаціонарного фону від різних значень порогу фільтрації. Побудовано метод оцінки часових витрат на обробку і передачу відеопотоку. Визначені умови, при яких часові витрати на доставку відеопотоку для розробленої технології зменшуються щодо часових витрат для технології MPEG.

Ключові слова: тимчасове кодування, час декодування, час передачі, швидкість передачі даних, відеопотік.

Introduction

Providing videoinformation services in automated video surveillance systems in rail transport with the use of wireless communication technologies is the current issues of scientific and applied research. This is on one hand limited by the characteristics of wireless technology for time-consuming processing and transmitting video and the other sharp increase image quality. To overcome this imbalance developed video compression systems [1–3]. One of the most efficient video compression technologies are considered in [4; 5] that reduce the volume of video streams in terms of the technical implementation of the permissible treatment processes. Such systems are described in [4; 5]. To evaluate the effectiveness of the developed methods regarding the processing of videodata necessary to estimate the time required for the processing and transmission of the video stream in telecommunication systems. Hence, the goal of research is to construct a method for estimating the time spent on processing and transmission of compressed video in telecommunication systems based on the technology of dynamic images compact representation of stationary background with the formation of differentially represented by the frame-based processing of dynamic content, binary mask stationary background and matrix signs.

Estimate the time spent on processing and transmitting compressed video

Estimate the time spent on processing and transmission of compressed video is performed to compression technology developed by dynamic images stationary background with the formation of differentially represented by the frame. This technology is based on the processing of the dynamic component due to a one-dimensional position-encoding with adaptive selection of the base, on the processing of binary mask stationary background at the expense of the two lengths coding capacity of the binary alphabet series and on the treatment of the matrix of characters due to encoding the alphabet in power, taking into account the structural similarity with the matrix binary mask.

The values T_{var} of the total processing time and the frame is calculated by the formula:

$$T_{\text{var}} = T_k + T_d + T_t ,$$

where T_k , T_d — the time required respectively for coding and decoding videodata; T_t — estimate of the data transmission in the telecommu-nications network.

Time spent on coding and decoding of the first frame, respectively, are determined from the expressions:

$$T_k = \nu_k / U_{MP}; \qquad T_d = \nu_d / U_{MP},$$

where ν_k, ν_d — the average number of machine operations, respectively spent on coding and decoding; U_{MP} — speed of the microprocessor.

Average compressed frame transmission time calculated by the formula

$$\bar{T}_t = \bar{V}_k / U_t, \qquad (1)$$

where U_t — the transmission speed of the communication channel (expressed as the number of bits per second); $\bar{V}_k$ — the average number of bits spent for one frame compressed representation.

The average volume $\bar{V}_k$ for a single frame in the compressed representation of the flow is given by

$$\bar{V}_k = \frac{\sum_{i=1}^{f_k} V_{k,i}}{f_k}, \qquad (2)$$

where $V_{k,i}$ — the number of bits it takes one frame compressed representation; f_k — frames per second; $\sum_{i=1}^{f_k} V_{k,i}$ — a concise representation of the flow rate f_k.

Volume compressed frame is calculated by the formula

$$V_k = \nu(l_a + l_i),$$

where ν — the number of codewords in the compressed image; l_a, l_i — the length of the address and data parts of the codeword.

Substituting into (1) the expression (2) for the value $\bar{V}_k$ of an expression for the estimate of the average transmission time of one frame

$$\bar{T}_t = \frac{\sum_{i=1}^{f_k} V_{k,i}}{f_k U_t}.$$

Knowing the time of coding T_k and decoding T_d the current frame and the average time for data transmission $\bar{T}_t$ in a telecommunications network, we can calculate the total time T_{var} of processing and transmitting video data. For the time T_d dependence of the developed method of decoding frames on the values ΔP of percolation threshold will be symmetrical encoding time T_k frame of the thresholds. Diagram of the dependence of the encoding T_k different threshold values ΔP shown in fig. 1.

From the analysis of the chart in fig. 1 can draw the following conclusions:

1. Encoding time frame when choosing a threshold with a good-quality mode (number 2) was 10.2 ms, which is 48% less than the encoding time frame when choosing a threshold without loss of information (mode number 1).

2. Depending on the percolation threshold ΔP time code T_k frames varies from 16.4 ms to 6.1 ms. The time code T_k frames decreases with increasing values ΔP of the percolation threshold on the average 28 %.

Graph comparing the encoding time T_k frame of different threshold values ΔP based on the technology developed and based on the MPEG technology is shown in fig. 2. From the analysis of the chart in fig. 2 we can make the following conclusions:

1. Depending on the threshold values ΔP for the encoding T_k frame of the technology is reduced on average by 21%, and for MPEG technology reduced on average by 56%.

2. The time T_k frame for the coding of the technology according to the percolation threshold ΔP will be less than 100 to 10 times than the time block coding T_k technology for MPEG. Figure transmission time T_t frames according to the method developed by a peak signal/noise ratio at a data rate of the communication channel $U_t = 126$ kbps is shown in fig. 3.

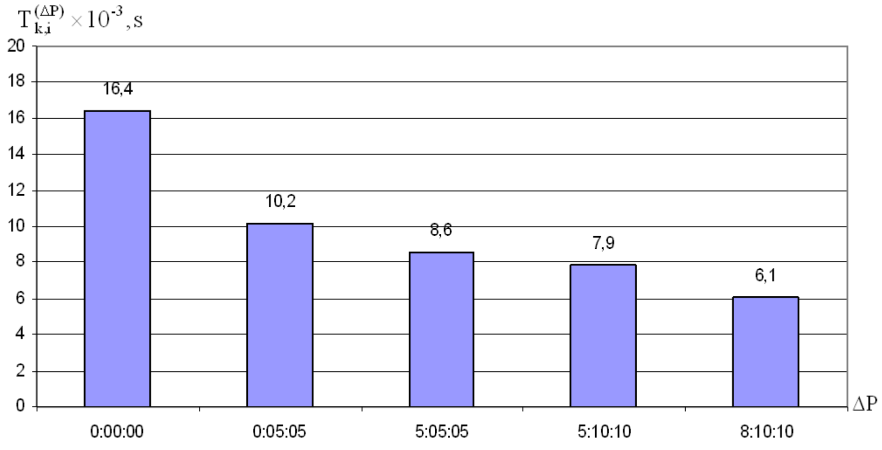

Fig. 1. A plot of the encoding time T_k for different thresholds ΔP

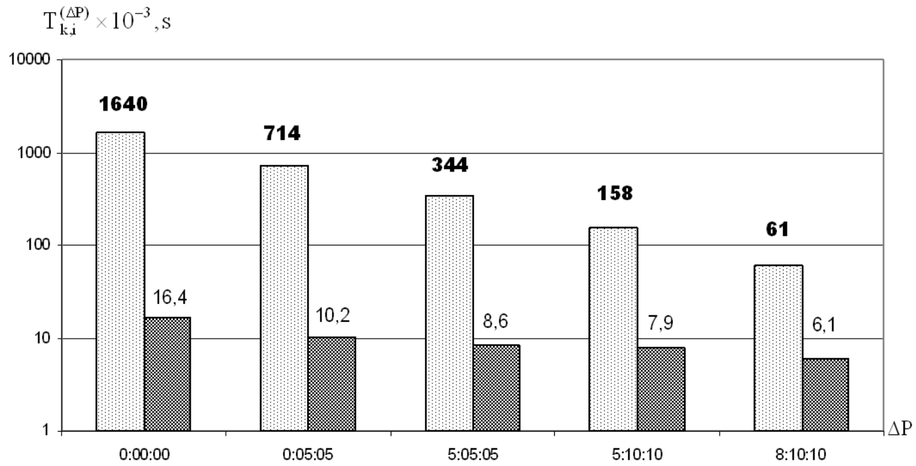

Fig. 2. Graph comparing encoding time T_k frame of the threshold values ΔP for the developed technology and MPEG

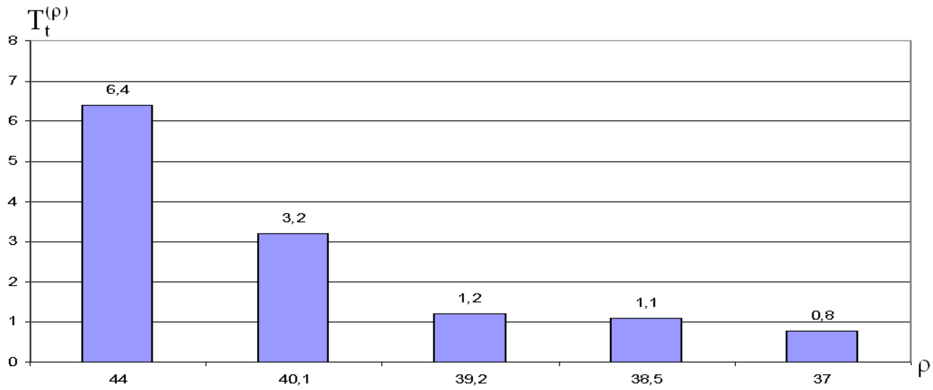

Fig. 3. A graph of the transmission time T_t of the peak signal/noise ratio ρ at U_t = 126 kbps

From the analysis of the chart in fig. 3, the following conclusions:

1. Time T_t frames for the transmission of this method at a data rate of the communication channel $U_t = 126$ kbps is changed from 6.4 s to 0.8 s, depending on the peak signal/noise ratio.

2. With the change of the peak values of the signal/noise ratio from 44 to 37 db at a data rate of the communication channel $U_t = 126$ kbps transmission time T_t frame is reduced by an average of 45 %.

Figure transmission time T_t frames according to the method developed by a peak signal/noise ratio ρ at a data rate of the communication channel $U_t = 512$ kbps is shown in fig. 4. From the analysis of the chart in fig. 4 it can be concluded that the time T_n frame for the transmission of this method at a data rate of the communication channel $U_t = 512$ kbps is changed from 1.6 s to 0.2 s, depending on the peak signal/noise ratio ρ.

Figure transmission time T_t frames according to the method developed by a peak signal/noise ratio ρ at a data rate of the communication channel $U_t = 2.048$ mbps is shown in fig. 5.

From the analysis of the chart in fig. 5 it can be concluded that the time T_t frame for the transmission of this method at a data rate of the communication channel $U_t = 2.048$ mbps ranges from 0.39 s to 0.05 s depending on the peak signal/noise ratio ρ.

Graph comparing the transmission time T_t frames according to the peak signal/noise ratio ρ at a data rate of the communication channel $U_t = 2.048$ mbps and the developed technology based on MPEG technology is shown in fig. 6.

From the analysis of the chart in fig. 6, the following conclusions:

1. At the peak signal/noise ratio ρ of 44db up to 38.5 db at a data rate of the communication channel $U_t = 2.048$ mbps transmission time T_n frame for technology developed by an average of 39% less than the time frame for the transfer of technology MPEG.

2. At the peak signal/noise ratio ρ 37db at a data rate of the communication channel $U_t = 2.048$ mbps transmission time T_n frame for the developed technology and technology for MPEG approximately the same.

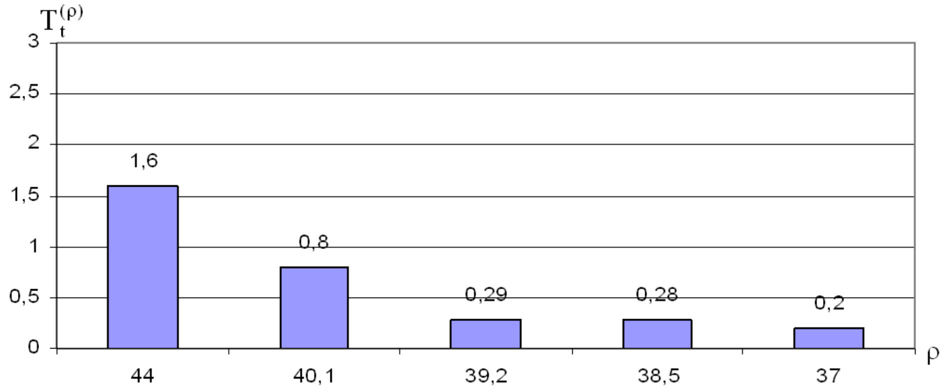

Fig. 4. A graph of the transmission time T_t of the peak signal/noise ratio ρ at $U_t = 512$ kbps

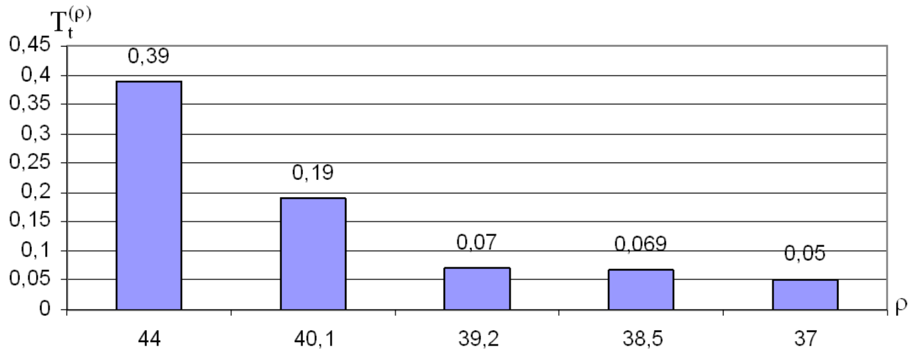

Fig. 5. A graph of the transmission time T_t of the peak signal/noise ratio ρ at $U_t = 2.048$ mbps

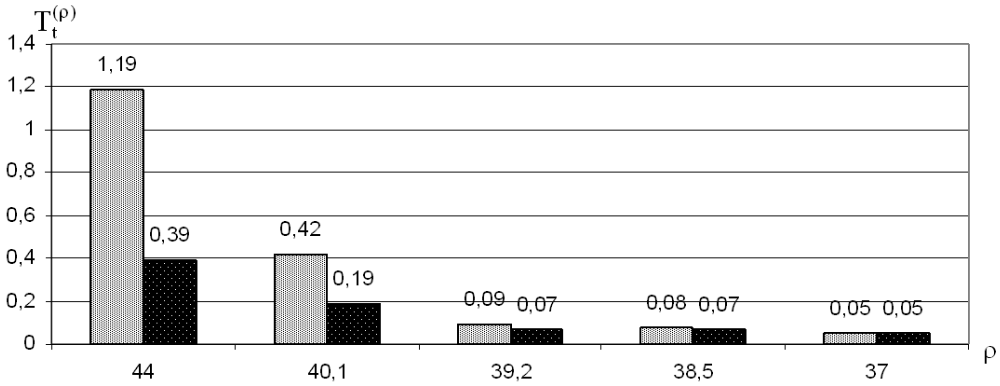

Fig. 6. Chart comparing the time T_t to transmit a frame at a speed image transmission $U_t = 2.048$ mbps on the basis of the technology and technology-based MPEG

3. Time frame transmission T_t with a data rate of the communication channel $U_t = 2.048$ mbps at the peak signal/noise ratio ρ 44 db for the developed technology for MPEG technology will be the greatest.

4. Time frame transmission T_t with a data rate of the communication channel $U_t = 2.048$ mbps at the peak signal/noise ratio ρ of 37 db and developed technology for MPEG technology will be the smallest.

Conclusions

Developed a method for evaluation of the time spent on processing and transmission of compressed video, which provided the following estimates:

1) depending on the threshold ΔP filtering the encoding T_k frame varies from 16.4 ms to 6.1 ms. With increasing threshold values T_k at the time of encoding is reduced by an average 28%.

2) The time frame for the coding of the technology according to the percolation threshold is less than an average of 48 times than the time block coding technology for MPEG.

3) when the peak signal/noise ratio ρ of 44 to 37 db and increasing the data rate of the communication channel during transmission of the frame is changed from 6.4 s to 0.05 s. Depending on the peak signal/noise ratio ρ and data rate of the communication channel du-ring transmission U_t frame is reduced by an average 45%.

4) developed technology provides real-time, depending on the percolation threshold which determines the quality of the reconstructed image, with a data rate of the communication channel 2.048 mbps: the frame rate of 800.4 kb and transfer time from 0.39 c – 2-3 frames per second at a frame rate of 397 kb and transfer time from 0.19 s – 5 frames per second at a frame rate of 147.4 kb, 141.7 kb, respectively, and the transfer time to 0.07 s, 0.069 s to – 14 frames per second at a frame rate of 103.3 kb and the transmission time of 0.05 s – 20 frames per second.

5) the time T_t frame transmission, depending on the values of the peak signal/noise ratio ρ at a speed image transmission $U_t = 2.048$ mbps for technology developed by an average of 39% less than the time frame for the transfer of technology MPEG.

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