Effectiveness of Statistical Methods for Encoding Images

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Abstract- **The paper presents effectiveness of statistical methods for encoding images based on four coding methods: block method, coding set length with cipher, one dimensional coding method with modified Huffman cod (MH) and with READ code.Coding of static images could be optimized with scanning the filmed object and determine if this is a text, picture or both types. Each coding method has a need from processor power for satisfaction the speed needs, on the other hand the size of the coded chunk should be mentioned, however.**

Keywords **– effectiveness, coding, methods, images**

I. Introduction

Noise protection analysis is based on four coding methods:

1.Block method;

2.Coding set length with cipher;

3.One dimensional coding method with modified Huffman code (MH);

4.Method with READcode.

All considered methods accomplish lossless coding,if these isn't any noise in connection channel.[1]

The analyze results from comparison include presumptionthat mistakes in binary digit appear independently of each other. We use the following quantitative parameters for comparison, determining distinctions between original and reproduced figure:[2]

1.Coding data bits - the number of coding bits after compression;

2.Coding bits - the number of coding bits after compression, including all subsidiary bits;

3.Compression coefficient **(CC_1)**–ratio between coding data bits to the number of figure elements;

4.Compression coefficient (**CC_2**) - all coding to the number of figure elements ratio;

5.Bit-error probability (**BEP**)-ratio between errors in accepted figure and quantity of transmitted elements ;

6.Transition probability from white to black element (**TPB**)- ratio between quantity of elements, transformed from white to black, to all white elements;

7.Transition probability from black to white element(**TPW**) - ratio between quantity of elements, transformed from black to white, to all blackelements;

8.Symbol-error probability (**SEP**)– ratio between the amount of transitions from white to black and black to white, and quantity of elements in the figure.[3]

All coding methods have different noise protection and influence of channel noises is different for each method.

II. Analytical Results

The comparison analyze is with the defined parameters:

-the figure/image has 1024 * 256 elements.

-the figure/image format is 100*50 mm.

-the size of raster surface is 100 * 100 μm.

-probability of bit-error in the communication channel is in the rate 4.10^{-6} - 10^{-4}.

-number of sections causing errors in the channel (**NES)**

-number errors in image restoration (**NEI**)

The results are presented as follows:[4]

TABLE I
BLOCK METHOD

NES	NEI	BEC	SEP	TPW	TPB	BEP
1	167	0,4	1,924	1,801	9,93	1,67
3	169	1,2	1,928	1,82	9,94	0,563
5	173	2	1,94	1,89	9,97	0,346
7	183	2,7	1,98	2,11	10,1	0,261
9	9161	3,5	17,8	98,6	54,37	10,179
11	9163	4,3	17,82	98,6	54,42	8,33
13	83687	5	163	981	459,5	64,375
15	92568	6	180	1090	507	61,712

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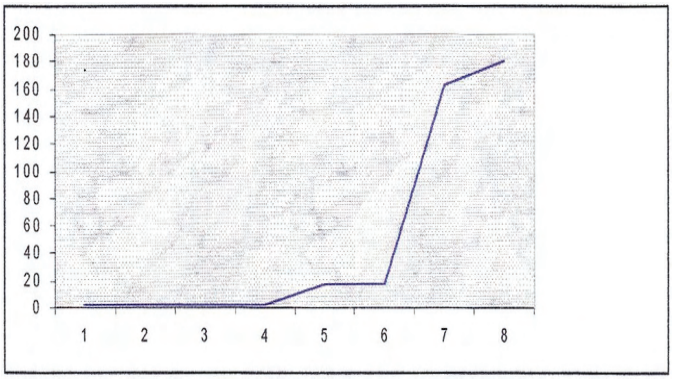

Fig. 1.Probability of error SEP depending on the increase of ***NES***. Block method

TABLE II
METHOD, CODING SET LENGTH WITH CIPHER

NES	NEI	BEC	SEP	TPW	TPB	BEP
1	764	0,6	1,56	1,29	2,25	7,64
3	1232	1,2	2,35	1,67	5,54	4,107
5	1656	3,1	3,16	2,4	6,74	3,312
7	2237	4,3	4,27		9,74	3,196
9	2624	5,5	5,02	3,55	11,88	2,916
11	2930	6,8	5,59	4,32	11,58	2,664
13	3070	8	5,87	4,79	10,9	2,362
15	3352	9,2	6,41	4,84	13,7	2,235
17	3473	10	6,64	4,98	14,38	2,043

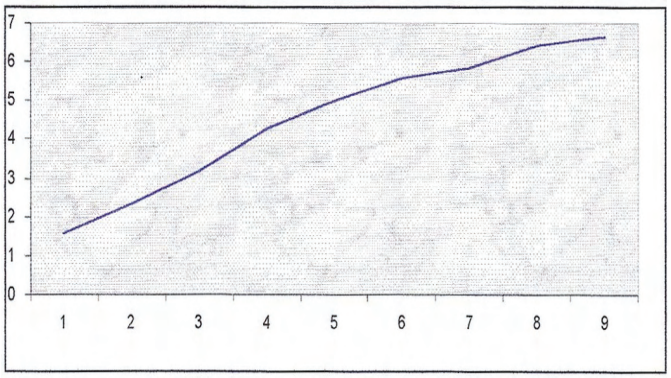

Fig. 2. Probability of error SEP depending on the increase of ***NES***. Method, coding set length with cipher

TABLE III
ONE DIMENSIONAL CODING METHOD OF SET LENGTH WITH MODIFIED HUFFMAN CODE (MH)

NES	NEI	BEC	SEP	TPW	TPB	BEP
1	89	0,7	0,17	1,02	4,89	0,89
3	402	2,1	0,768	4,5	22,6	1,34
5	571	3,5	1,09	6,42	31,9	1,142
7	668	4,9	1,27	7,6	36,9	0,954
9	1003	6,2	1,92	11,5	55,1	1,114
11	1772	7,6	3,39	18,5	106	1,611
13	2174	9	4,15	23,2	126	1,672
15	2415	10	4,62	24,4	148	1,61
17	3263	12	6,23	34,2	194	1,919

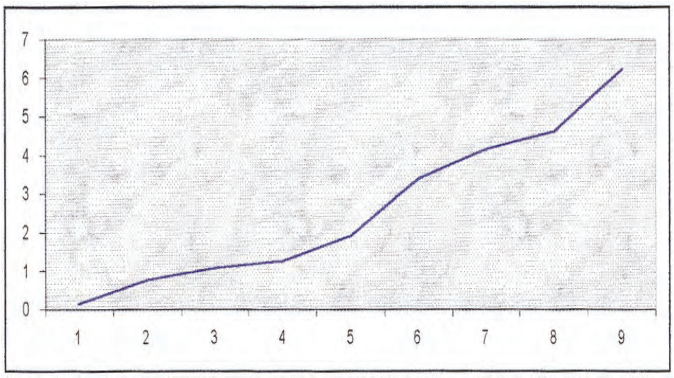

Fig. 3. Probability of error SEP depending on the increase of ***NES***.Huffman code (MH)

TABLE IV
CODING METHOD WITH READ CODE (κ = 2)

NES	NEI	BEC	SEP	TPW	TPB	BEP
1	668	0,86	1,315	7,652	3,89	6,88
3	900	2,6	1,72	10,157	5,02	3
5	1212	4,3	2,316	10,78	8,12	2,242
7	23805	6	45,49	272,38	131,04	34,007
9	24107	7,7	46,07	275,9	132,6	26,786
11	25133	9,5	48,031	287,66	138,31	22,848
13	25280	11,2	48,312	287,45	140	19,446
15	25586	13,1	48,897	290,83	141,7	17,057
17	26447	15	50,54	299,2	147,19	15,557

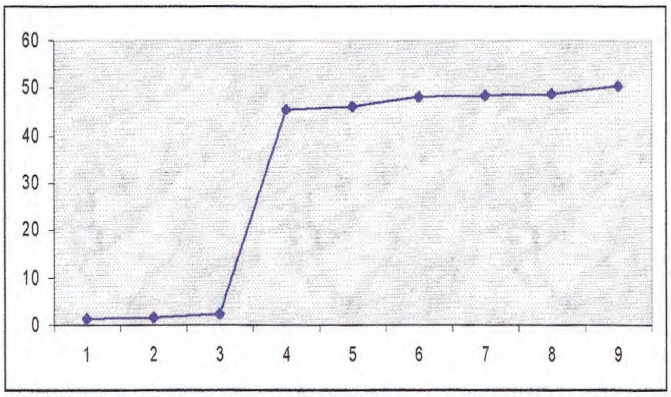

Fig. 4. Probability of error SEP depending on the increase of ***NES***. Coding method with READ code (κ = 2)

TABLE V
CODING METHOD WITH READ CODE (K = 4)

NES	NEI	BEC	SEP	TPW	TPB	BEP
1	2	0,997	0,0038		0,02	0,02
3	490	0,936	0,936	6,331	2,358	1,633
5	13917	26,59	26,59	156,8	77,75	27,834
7	14624	27,59	27,95	164,7	81,74	20,891
9	14948	28,57	28,57	169,5	83,02	16,609
11	9605	18,38	18,35	100,6	57,23	8,732
13	9617	18,39	18,38	100,87	57,23	7,398
15	11105	21,22	21,22	107,8	70,155	7,403
17	12429	23,75	23,75	124,4	76,75	7,311

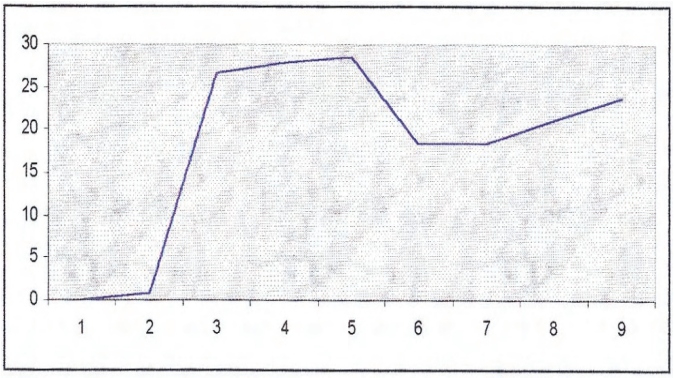

Fig. 5. Probability of error SEP depending on the increase of ***NES***. Coding method with READ code (κ =4)

We analyze results from comparison of the five coding methods with program modeling and parameters of transmitted message.
The results are present in Table VI.

TABLE VI
CODING METHOD. ANALYZE RESULTS.[6]

Coding method	Code sequence	Full Code sequence	CC_1	CC_2
Block method	253 824	253 824	0,484	0,484
With cipher	76 648	162 016	0,146	0,309
Modified Huffman code (MH)	137 776	143 920	0,263	0,274
READ code k = 2	109 744	115 888	0,209	0,210
READ code k = 4	36 176	102 320	0,183	0,195

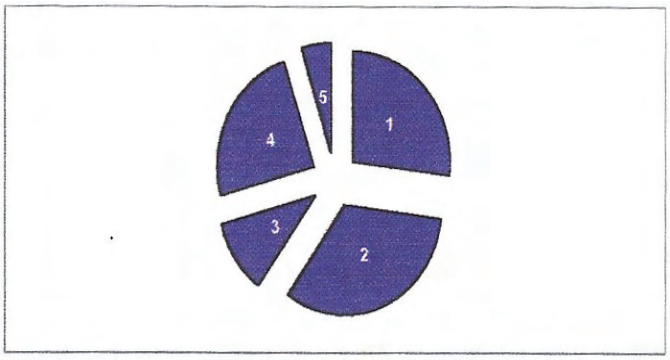

Fig.6 . Ratio between the studied methods of **SEP** in 3 sections, causing an error.

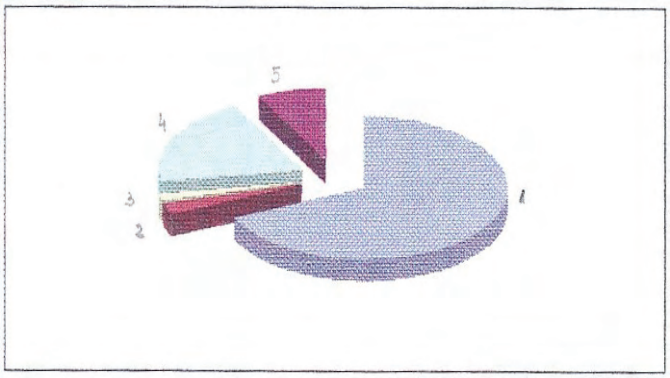

Fig.7. Ratio between the studied methods of **SEP** in 13 sections, causing an error.[5]

Bi-dimensional methods as block method lead to errors in some letters or words anywhere in the text, but one-dimensional have determinate effect in continuation of one working line.

Increasing of error probability increase general number errors in figure restoration and increase number of transformations from black to white element.

III. CONCLUSION

In block method errors in code sequence may balance each other in reproduction of transmitted message.

READ-code is better in noise protection than block method and reduce digital flow five times (when k=4, CC2 = 0.195 bit). For standard resolution parameter k=2, and for higher resolution k=4.

Coding set length with cipher is suited for increasing noise protection fore given period of time, but he has big excess.

Modified Huffman code (MH), used for fax machines group 3 has high stability, high compression levels, but in comparison with READ-code has more transformations white-black and black-white, that decreases it noise protection.

Probability of bit-error in the communication channel (**BEC**) *(10^{-5});

Obviously, all coding methods have different noise protection.

Increasing of error probability increase general number errors in figure restoration.

That also increase number of transformations from black to white element.

The effectiveness of coding methods is judged by probability of errors as a function of factors "worsening" the transfer of code sequences in communication channels.

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