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ALMATY
UNIVERSITY OF POWER
ENGINEERING
AND
TELECOMMUNICATION

Department of "Computer and
infocommunication security"

PRINCIPLES OF VIDEOIMAGE PROCESSING

The methodical instructions to computational graphic works
for English class students of the speciality
5B071900 – Radio engineering, electronics and telecommunications

Almaty 2016

COMPILERS: Artiukhin V.V., Baigeldinov U.S. The principles of videoimage processing. The methodical instructions to computational graphic works for English class students of the specialit speciality 5B071900 – Radio engineering, electronics and telecommunication. Almaty: AUPET, 2016 - 9p.

The methodical instructions to computational graphic works have been intended for students attending bachelor degree courses having specialized in 5B071900 – "The radio engineering, electronics and telecommunication". These instructions allow to understand the basic theoretical provisions of color TV broadcasting systems, namely: principles of formation of the color image and the basic concepts of colorimetry.

Illustrations - 3, tables - 2, bibliogr. - 3 neim.

Reviewer: candidate of technical Sciences, Professor A. Z. Aytmagambetov

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1 Assignment for computational and graphics work №1

1.1 Calculate the amplitude of the analog luminance and chrominance signals, when transmitting the elements of certain (variants of assignment) chromaticity.

1.2 Transfer the calculated luminance and chrominance signal amplitude into digital form, according to ITU Recommendation 601.

1.3 Construct the graphics of these signals in the time period in the line for the test image "gradation wedge" and mark down the calculated values of the signal amplitudes.

2 Guidelines for the implementation of the computational and graphics works №1

Variant number is selected by the last two digits of the student's record book from table 1.

Table 1 – Job options and input data

Variants				Signals	Colors
01	26	51	76	$E_{R-Y}; E_{B-Y}$	Yellow, Blue
02	27	52	77	$E_Y; E_{R-Y}$	Purple, Yellow
03	28	53	78	$E_{B-Y}; E_Y$	Light Blue, Purple
04	29	54	79	$E_{R-Y}; E_{B-Y}$	Green, Yellow
05	30	55	80	$E_Y; E_{R-Y}$	Red, Light Blue
06	31	56	81	$E_{B-Y}; E_Y$	Yellow, White
07	32	57	82	$E_{R-Y}; E_{B-Y}$	Light Blue, Purple
08	33	58	83	$E_Y; E_{R-Y}$	Purple, Red
09	34	59	84	$E_{B-Y}; E_Y$	Blue, Light Blue
10	35	60	85	$E_{R-Y}; E_{B-Y}$	Yellow, Purple

11	36	61	86	$E_Y; E_{R-Y}$	Light Blue, Green
12	37	62	87	$E_{B-Y}; E_Y$	Purple, Black
13	38	63	88	$E_{R-Y}; E_{B-Y}$	Light Blue, White
14	39	64	89	$E_Y; E_{R-Y}$	Yellow, Light Blue
15	40	65	90	$E_{R-Y}; E_{B-Y}$	Green, Purple
16	41	66	91	$E_Y; E_{R-Y}$	Blue, Purple
17	42	67	92	$E_{B-Y}; E_Y$	Yellow, White
18	43	68	93	$E_{R-Y}; E_{B-Y}$	Purple, Light Blue
19	44	69	94	$E_Y; E_{R-Y}$	Green, Light Blue
20	45	70	95	$E_{B-Y}; E_Y$	White, Yellow
21	46	71	96	$E_{R-Y}; E_{B-Y}$	Light Blue, Red
22	47	72	97	$E_Y; E_{R-Y}$	Black, Purple
23	48	73	98	$E_{B-Y}; E_Y$	Blue, Light Blue
24	49	74	99	$E_{R-Y}; E_{B-Y}$	Yellow, Blue
25	50	75	00	$E_{R-Y}; E_{B-Y}$	Yellow, Light Blue

White signal is defined by the formula:

$$E_y = 0,3E_R + 0,59E_G + 0,11E_B.$$

On the output of color TV camcorder – from the signals E_R , E_G and E_B by using the encoding matrix, generated signals E_Y , E_{R-Y} and E_{B-Y} .

$$E_{R-Y} + E_Y = E_R,$$

$$E_{G-Y} + E_Y = E_G,$$

$$E_{B-Y} + E_Y = E_B.$$

Signal values can be determined from figure 1:

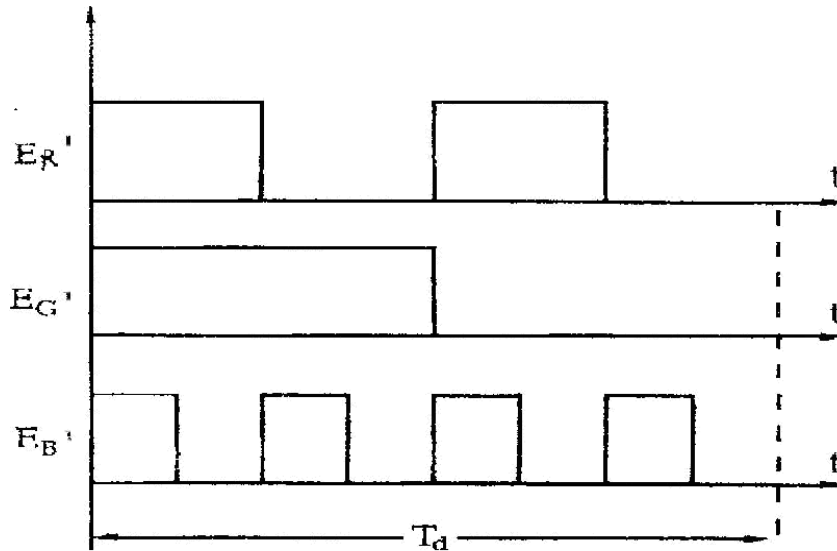


Figure 1 - Waveforms of signals

The formula for converting an amplitude of analog luminance signal in to digital:

$$Y=219E'_y+16,$$

where E'_y - analog luminance signal, changing from 0... 1B;
 Y - digital luminance signal, changing from 16 to 235.

The color-difference signals have reserve areas of 16 quantization levels above and below. Compressed color-difference signals are sent to ADC, generated by:

$$E_R' = 0,713E'_{R-Y}, \quad E_B' = 0,564E'_{B-Y}.$$

E_R' and E_B' vary from -0,5 ... 0,5 B.

Analog to digital conversion of the color-difference signals:

$$C_R = 224E_R' + 128 = 159,712 E'_{R-Y} + 128 = 160 E'_{R-Y} + 128;$$

$$C_B = 224E_B' + 128 = 126,336 E'_{B-Y} + 128 = 126 E'_{B-Y} + 128.$$

The formation of color signals can be determined from figure 2.

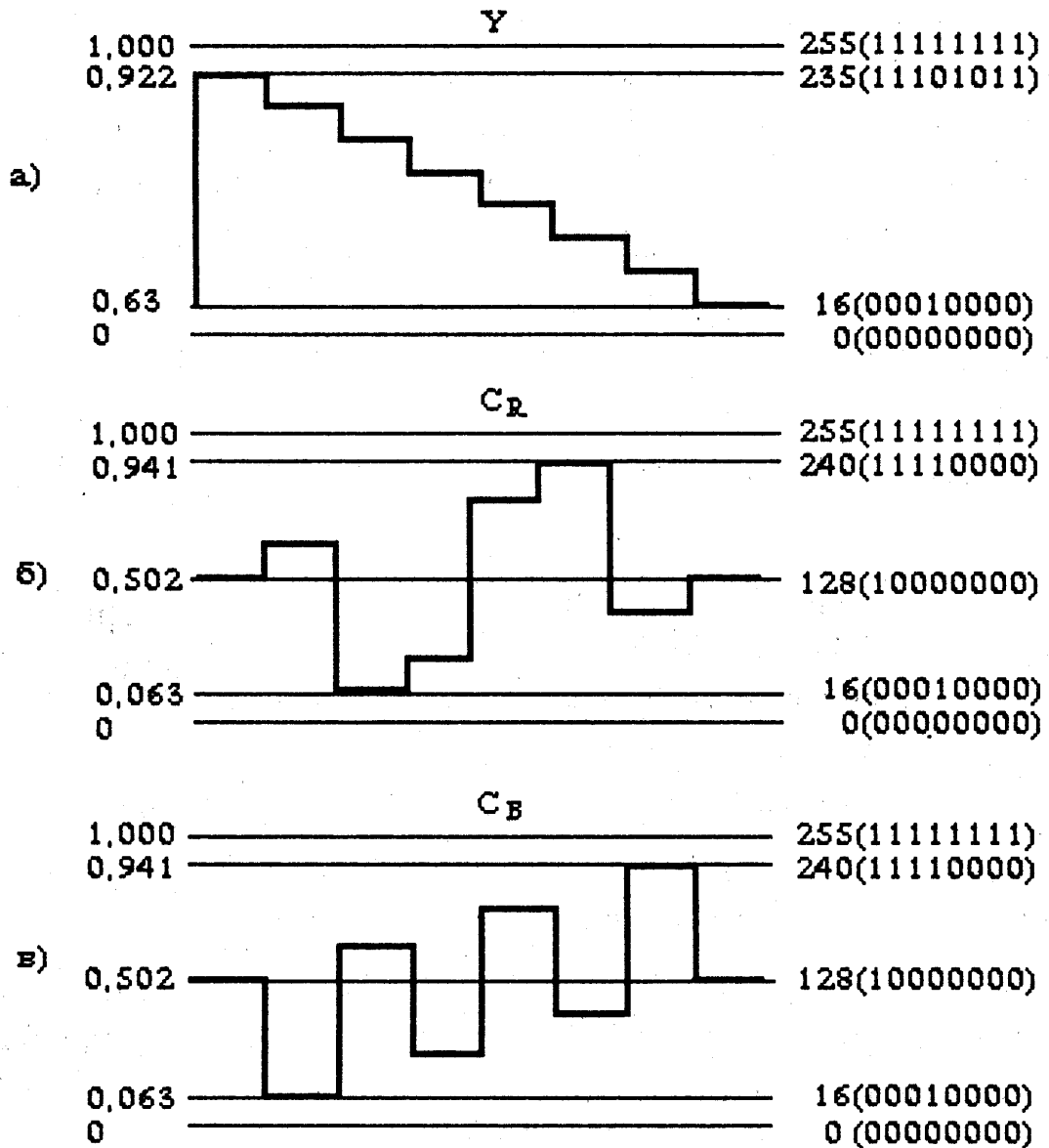


Figure 2 - The formation of color signals

128-the quantization level corresponds to zero value of the color-difference signals.

ITU Recommendation 601:

- n - the number of quantization bits;
- $n = 8$, which gives 256 quantization levels - $N_{kv} = 28$;
- black level $E_y - 16$ - the quantization level;
- level of white $E_y - 235$ -th quantization level;
- quantization levels - 16, 20 from above and below;
- reserve areas in case of an analog output luminance values beyond the nominal range;

- 0 and 255 quantization levels - synchronization signals.

Graphics of changes of luminance and chrominance signals in the line period for the test image gradation wedge are shown in figure 1. It is necessary to bring the graphical construction of these signals, noting the defined color and to make conclusions the report of computational and graphic works №1.

3 Assignment for computational and graphics works №2

3.1 Indicate the resulting values of CGW №1 E_R , E_G and E_B in the color triangle within a locus chart.

3.2 Determine the resulting color shade according to the coordinate point specified in table 2.

3.3 The defined colors must be categorized on the primary colors E_R , E_G and E_B .

Table 2 –Assignment variants

Variant	x	y
0	0,2	0,15
1	0,3	0,4
2	0,3	0,4
3	0,4	0,3
4	0,3	0,3
5	0,5	0,35
6	0,25	0,25
7	0,4	0,3
8	0,35	0,4
9	0,55	0,3

4 Guidelines for the implementation of the computational and graphic works №2

The color triangle within the locus chart is shown in figure 2.

The coordinate points determined by the variant according to the last digit number record-books, according to table 2. The resulting shade of the color points with given coordinates must be broken down into components of the primary colors R, G, B.

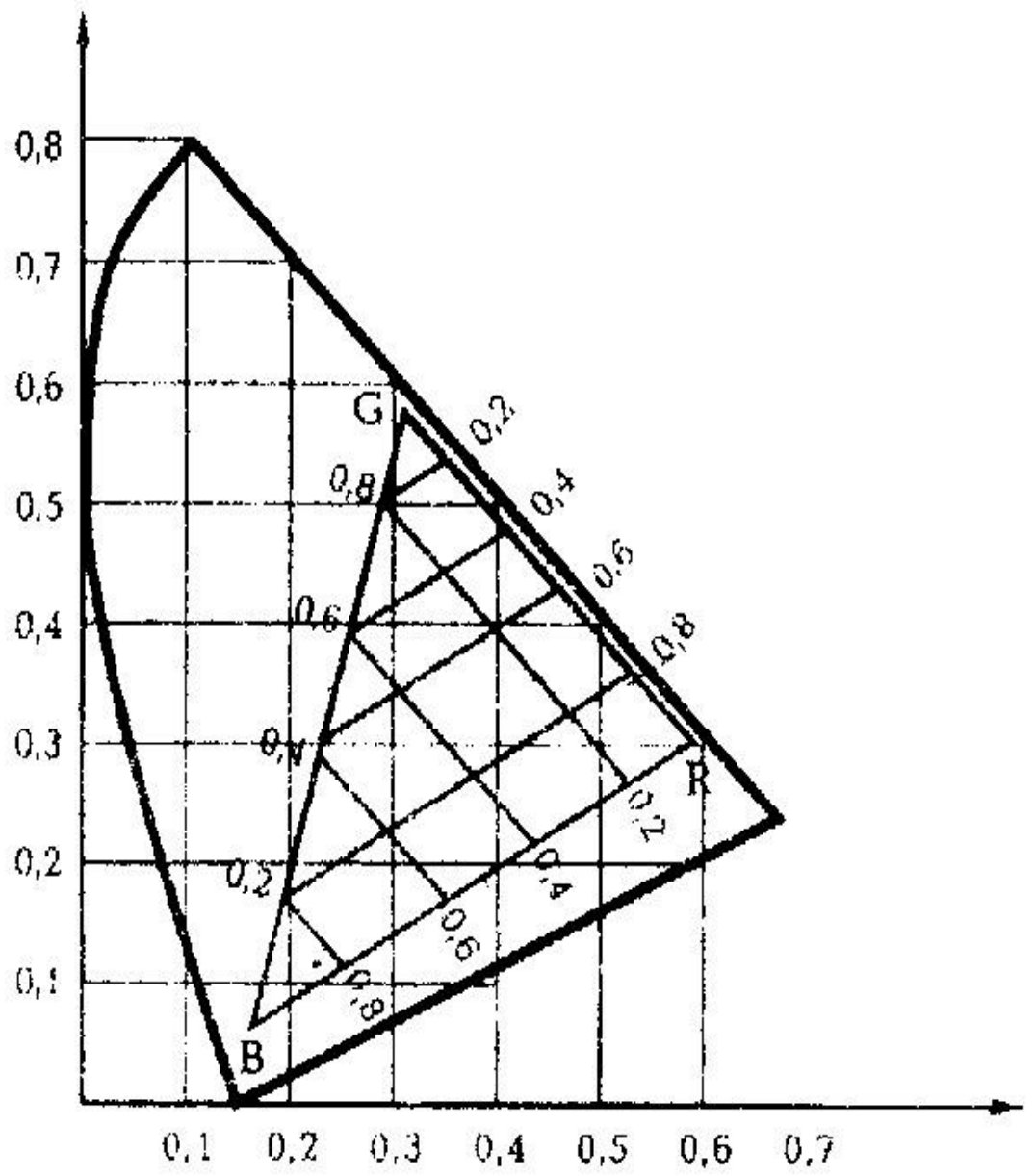


Figure 2 - The color triangle within a locus

Literature review

- 1 Principles of digital television. A.V. Smirnov. – M.: Hot lines – Telecom, 2001.
- 2 Television. Edition. V.Y. Dzhakoni – M.: Radio and communication, 2000.
- 3 Digital television. Edition. Mamayev N.S. - M.: Hot lines – Telecom, 2001.

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Methodological guidelines on the performance of computational and graphics
works for students, studying 5B071900 – Radioengineering,
electronics and telecommunications in English language

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