PECULIARITIES OF THE REPRODUCTION OF STEREOSCOPICAL IMAGES BY USING RASTER METOD OF STEREO MATE DIVISION

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Abstract: **The article deals with the analysis of the optical raster for the reproduction of stereoscopical images on matrix displays, analizes the peculiarities of coupling the raster and the matrix display and the influence of raster parameters on the stereoscopical image quality. In Delphi-system there was created a program for calculating the dependence of the square and the position of areas with a good quality of the image from the display parameters. The results allow to make necessary calculations for creating an optical raster.**

Index Terms: **stereoscopy, stereo mate, lenticular raster, matrix display, vision zone**

I. INTRODUCTION

One of the ways to improve the quality of TV images is creating stereoscopical images. To view such images separate reproduction of the stereo mate frames is required. There are several methods of separating images: anaglyphic, polarization metod, light-valve and beam-scanning method (raster). The main disadvantage of the first three methods is using glasses. The raster method allows to receive a stereoscopical image without additonal devices (autostereoscopical method). It has been known for a long time, but recently we have got a chance to develop it using a new technological base because of new matrix devices .

Getting a coded image

For getting a coded stereo image shots from two positions are made – for the right and the left eye. Then the coded image is created on the matrix display screen (PDP, LCD or OLED). It consists of intermittent columns of the left and the right frames of the stereo mate. The matrix display is covered with an optical raster that consists of vertical cylindrical lenses. Each of them covers two columns of the matrix display. The main purpose of the lenses is separating the image for the left and the right eye. The parameters of the optical raster are chosen so that the right eye of the observer situated in the certain zone sees only odd columns, the left eye – only even. (Fig.1). Raster parameters are connected with variable and given parameters of the stereoreproducing system (autostereoscopical display). That is why at first we need to define which parameters cannot be changed, and which ones can vary. The parameters that are given are: Ps – the spacing of the column couples of the matrix display (the average value - Ps = 0.27*2 мм), L – the distance from the stereoreproducing system to the observation plane (L = 300…600 mm), b0 – eye basis (average value - b0=65 mm). Variable parameters are: d1 – thickness of the raster, d2 – distance between the raster and the matrix display, Pl – spacing of raster lenses, R – the radius of the curvature of the raster, n_l – refraction index of the raster material.

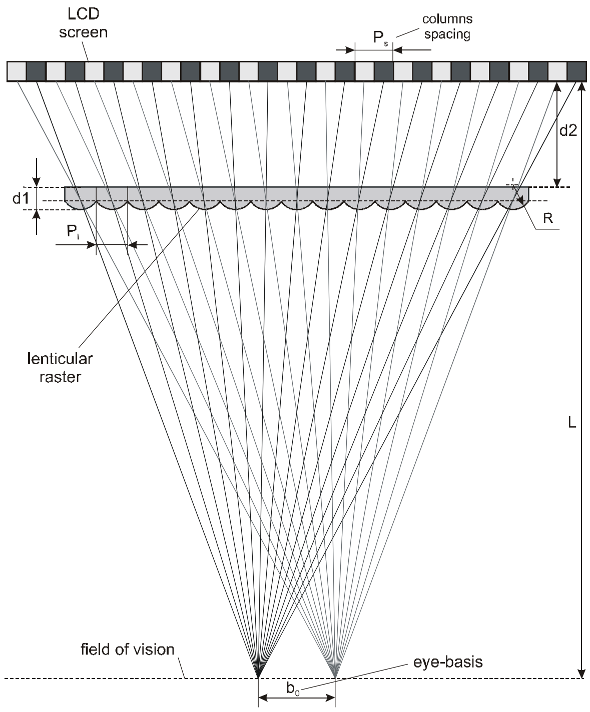

Fig. 1 Raster parameters

Calculation of raster parameters

Simple geometrical constructions allow to receive main raster parameters. For example, the distance d1 can be calculated by formula (1):

$$d_2 = \frac{L \cdot P_S}{b_0} \qquad (1)$$

Lenses focal length (2):

$$f = \frac{P_S \cdot L}{P_S + b_0} \qquad (2)$$

Raster lenses spacing (3):

$$P_l = 2 \cdot P_S \cdot \frac{L - f}{L} \qquad (3)$$

Radius of lenses curvature (4):

$$R = f \cdot \left(n_l - 1\right) \qquad (4)$$

In the Fig. 3 light rays are showed coming only from the centers of the matrix displays columns (for simplification). That is why vision zones of the stereo mate turn into points. If we consider rays from the whole surface of the column the vision zone becomes

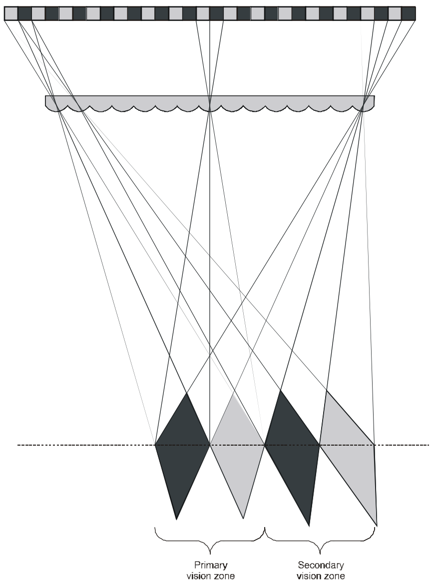

Fig. 2 Vision zone

a three-dimensional rhomb (Fig. 2). The picture shows the multiplying property of the raster. Thanks to the fact that the light from the column of the matrix display can go through several optical raster lenses several vision zones appear in the vision plane - one main and several secondary zones. Multiplying raster property allows several people to view the stereoscopical image at the same time.

II

Calctulation peculiarities

But Fig. 2 doesn`t take distortion made by the optical raster into consideration. This distortion is caused by two reasons – lenses spherical aberration and miscalculations during raster production. For the estimation of the image quality we need to consider some factors. First of all, because of the lenses aberration vision zones are extending and image separation at the interfaces between lenses becomes worse. Secondly, with the vision angle different from the right angle the lenses curvature and the ray length in the raster change. Thirdly, the interface between lenses cannot be made with geometrical precision. In any case it will have a rounded radius different from zero. That is why the ray that gets to the interface between lenses will give a flare light in the “foreign” vision zone.

Method description

For calculating ray path and estimating the autostereoscopical display quality we offer a model shown on the Fig. 3. Main peculiarities of this approach are calculation of the rays in the reverse path (from the eye to the screen), the use of Feder`s co-ordinates and computer calculations. The idea is the following. In the outer loop we assign the eye position. Qualitative indexes for stereo image are calculated in the inner loop for every raster point (with a certain spacing). Then the eye position is changed in the outer loop, and the inner loop repeats. The main qualitative index

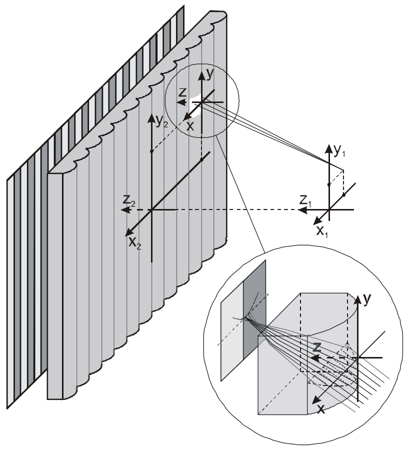

Fig. 3 Mail model

of the stereo image is in this case the separation factor for the left and the right eye images:

$$K_l = \frac{L_l}{L_r},$$

where L_l is the luminosity produced by the column of the left eye image, and Lr - is the luminosity produced by the column for the right eye. Coordinates $x_1y_1z_1$ and $x_2y_2z_2$ are auxiliary. They are needed for calculating angular data - direction cosines of the rays. Linear coordinates are calculated in the xyz-system. In the same co-ordinates the impact point of the cylindrical surface and the ray refraction, move and one more refraction are calculated. For calculating the separation factor a ray bundle is allowed through every lens. Then the ratio of the ray in the “own” and “foreign” zones of the matrix display is calculated. This is the separation factor.

III.CONCLUSION

The given method considers lenses aberrations, laws of the optics and the photometry. It also allows to analize the quality of the stereo image according to the raster parameters, the matrix display, the observers position, the turn of the ovservers head, raster turns in the space and a number of other parameters. Acknowledgments to those who contributed to this paper: Ukrainski O.V., Ernest Tchikolian, Evgenia Shukalova.

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