Use of Digital Modelling of the Print for the Estimation of Quality of a Press

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Abstract

At processing and reproduction of images always it is necessary to be set by questions of quality of received images. Quality of so complex object as the image is very important, but it is simultaneously enough indistinct concepts.

Depending on tasks in view it is estimated by various ways. In the submitted work quality is considered as a measure of a generality of two images, initial (original) and reproduced (the printed image). Such way allows estimating quantitative change of parameters at their transformation, i.e. the process of reproduction.

At a rating of quantitative change of parameters there is a problem to define criteria of quality of the image giving in to measurement which most full meet to system of human vision.

The ideas developed in this work, reflect interrelation between structure of the image, its perception the person, and as its quantitative representation. Proceeding from these preconditions, consideration and the decision of the research problem of parameters of printed process is spent. As against a traditional way of the control over test objects the rating of quality is made on all area of the reproduced image. For definition of parameters of quality the original way of processing of luminosity-chromatic characteristics of the image is used. It enables to establish communication between objective (physical) and subjective (visual) parameters of the image, at its reproduction that facilitates a task of reception of high-quality images.

Introduction

Any graphic object represents the complex phenomenon in information sense. Therefore it is necessary to have physical and mathematical model of this object which would allow spending the settlement description of those transformations which are carried out in system of image processing.

There are two basic approaches to modeling images: determined and statistical. At the determined description of the image mathematical function which describes property of the image in its each point is used. At the statistical description the image is defined by the average characteristics. As model of the image its digital performance acts.

Digital representation of the image.

The compared printed images represent functions of two continuous arguments. For the further processing and the analysis of the given images it is made operations of digitization and quantization. After that images represent matrices of a kind

$$G = Q(g(x, y)) \quad (1)$$

Where G - the digital image;

g (x, y) - the analog image;

Q - the operator expressing operations of digitization and quantization.

The digital array contains the information on brightness and their distribution on spatial coordinates, and a parity of the color component.

In this case chromaticity of the given array is described according to colorimetric system sRGB. In our work it is important to use that color system in which to equal change of coordinates of chromaticity there meets equal change of sensation of color. For this reason translation of the image in color system Lab is made.

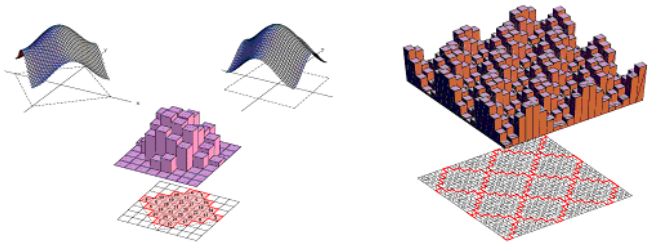
The gradational characteristic of the image is described by the following parameters: factors of reflection both transparency (ρ) and (τ) and optical density (D). In graphic art most widely used the parameter of optical density as the eye linearly reacts not to an increment of brightness, and almost linearly on an increment of optical density which is in logarithmic dependence on brightness.

Creation of the image on a print pursues the purpose to reproduce by means of polygraphy whenever possible an exact copy of the original. Conformity of accuracy of a copy to the original characterizes parameters or criteria of quality of the printed image.

Traditional tool means of quality assurance of prints are densitometers of reflected light. With the purpose of simplification of measurement of optical density on edging fields of prints control labels which periodic measurement during printing enables to watch arising deviations are printed and is duly on them to react. As labels of the control over a print can be up to several hundreds, their measurement on a course of a seal manually becomes very difficult. This circumstance demands system engineering capable quickly enough and precisely to supervise individual parameters of printed process.

The task put with this job, pursues the aim to show an opportunity and development of a technique of the control of individual parameters of printed process with the help of the scanner tool.

The decision of these tasks is based on an opportunity of representation of the bidimentional image in three-dimensional basis. Thus, spatial coordinates of the image are directed on directions *x* and *y,* and coordinates luminance (optical density) in a direction z. The image in such form looks as certain "relief" in which size « peaks and hollows » is set by size luminance (brightness), and character of their formation in space values *x* and *y* (figure 1). Dissecting "relief" in parallel planes *OXY* with any interval ΔL (D) we shall receive a row of sections which will characterize the certain gradation with the certain area (figure 2).



a b

Figure 1 — a) structure of a raster point in space, b) three-dimensional model of the image

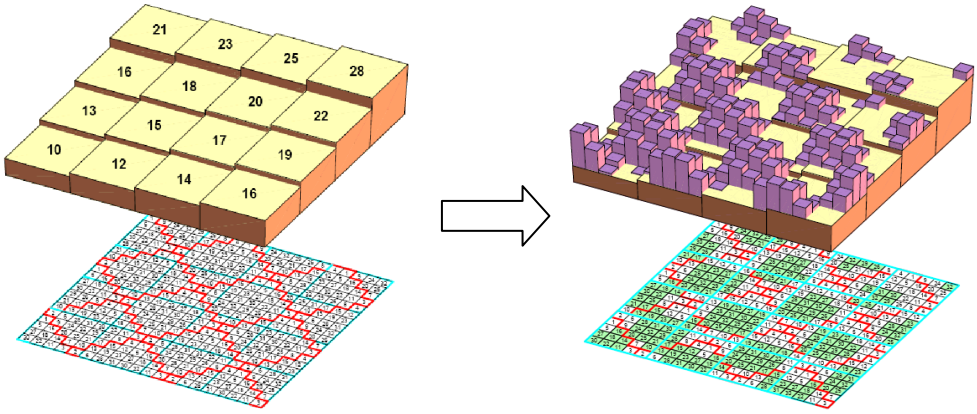
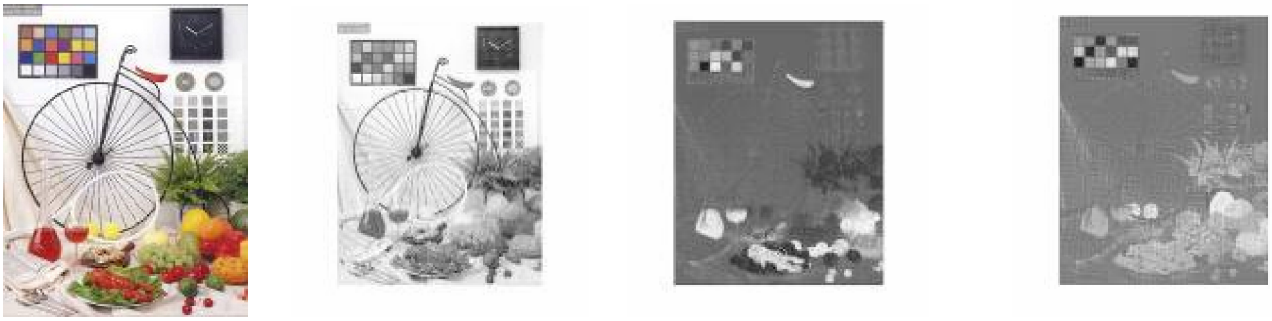


Figure 2. Model of distribution brightness characteristics of the image on its area.



a b c d

Figure 3. a) the image in color space Lab, b) channel — L, c) channel — a, d) channel — b.

For finding-out of an opportunity of realization of the given {task the following comparative experiment was carried out. In this experiment gradational characteristics of reproductive process were measured with the help of a densitometer (optical density) and with the help of the scanner (the areas occupied with identical luminance).

For transformation of the image to the digital form operation of scanning of this image is spent. For the reasons described above the scanned image is translated from color space RGB in Lab (figure 3). After that the image channel-by-channel is processed in system of mathematical modeling.

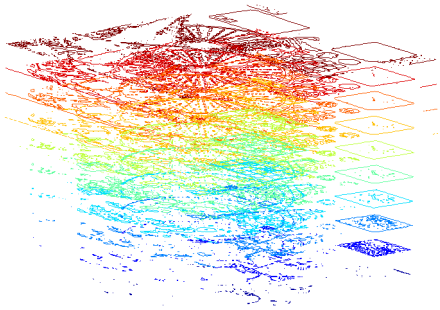
Each selected channel is submitted as a half-tone picture. In each of such images we select the sites having identical brightness. For this purpose a half-tone picture we shall transform in indexed, using cutting off on the certain threshold values. In result the array of the image is broken into layers according to a vector of threshold values. This vector looks like [0 5 10…30 40 50…230 235 255], reduction of a threshold in

светах and shadows is connected by what even little change in these ranges results in essential distortions on the image. In result it is received 32 bidimentional matrixes which describe the area occupied with sites with various luminance thresholds. In figure sites with various levels of brightness are allocated by various colors (figure 4). Further we calculate the areas, using the received matrixes.

We compare the received values with values equivalent to them for the researched image. On the basis of results of comparison we judge conformity of quality of the reproduced image original.

The conclusion

In the resulted dependences we can see concurrence of the data received on the basis of comparison of the given areas, occupied with the identical gradation, determined with the help of the developed way, and a densitometer. Measurements with the help of the scanner appear on much more exact as the sizes of crystals of the CCD on some orders there is less than aperture of a densitometer. On results of work it is established, that the certain parameters specify deviations of qualitative characteristics of the image in the same way, as well as human sight. At carrying out of experiments, it was possible to receive dependences which allow characterizing parameters of transformation of images objectively.



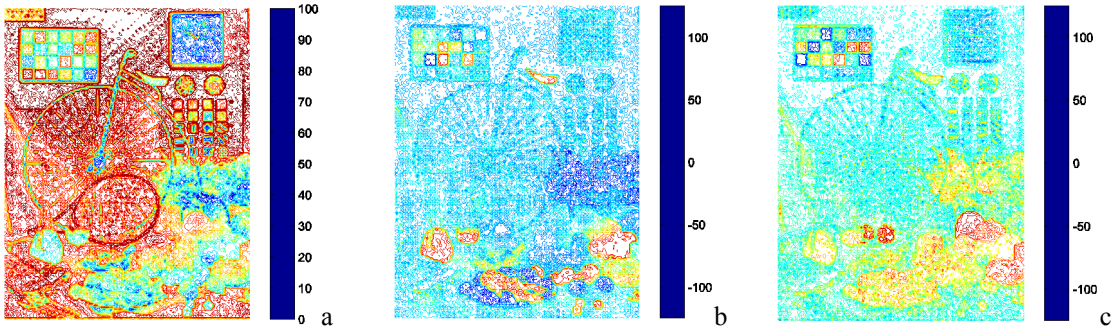


Figure 4. the indexed image of channels of color space Lab, a) channel — L, b) channel — a, c) channel — b.

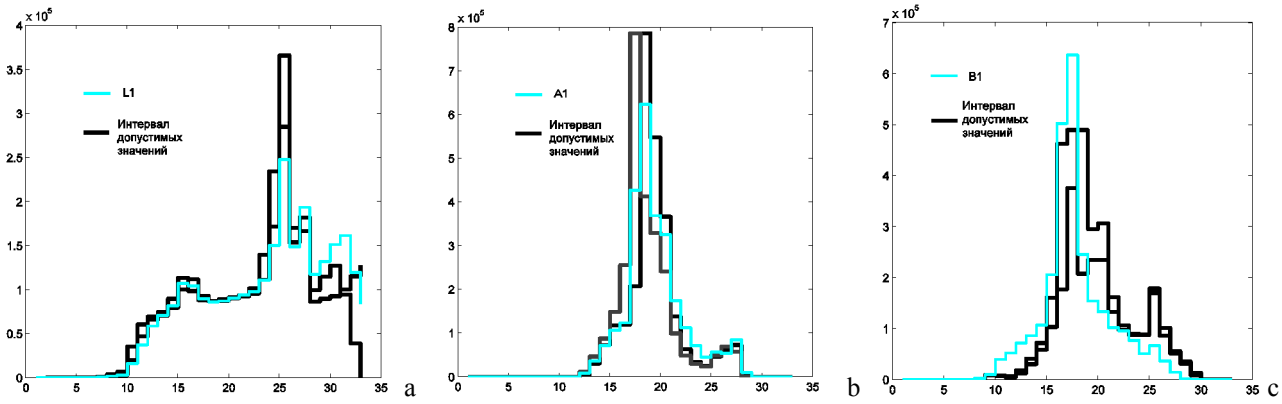


Figure 4. the indexed image of channels of color space Lab, a) channel — L, b) channel — a, c) channel — b.

Concluding remarks

Result of the carried out work is the conclusion that quality assurance of polygraphic production with the help of volumetric modeling a printed print on the basis of scanning systems on all area of the image is possible and can be practically realized.

Result of development of a technique should become creation program and the hardware allowing objectively analyzing a print for the minimal interval of time. In work the sequence of operations which is a basis of algorithm for development of software product is given.

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Dydyshko Sergey. In 2005 I have with distinction completed the Belarus state technological university, faculty of publishing and polygraphy, on a speciality technology of polygraphic manufactures. Has acted in postgraduate study on a speciality, the supervisor of studies professor Sergey A. Gulyaev of the Moscow state university of a press.

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