Characterization of Digital Peripheral Devices for the Hybrid Photographic Processes

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Abstract

Last years are characterized by increasing penetration of digital information registration methods in various domains of science and technical knowledge. Digital systems are very attractive because of their universality, flexibility, swift action, and simplicity of technical realization, better stability, accuracy, and reproduction quality in comparison with analog methods. Particularly, digital methods of writing, processing, and reproduction, widely spread in sphere of cinematography, television, and photography.

One of the main problems, which rise on working with digital methods of image processing, is characterization (or calibration) problem of input and output devices.

The sphere of our interest is a hybrid photographic technology,[1] which permits to print digital image, obtained by digital camera or scanner, on the silver halide photographic paper. There are many problems in this sphere; tuning and calibration of digital silver halide printing devices cause the main of them.

The elaboration of methods and calibration profiles for the hybrid photographic process with a stage of digital processing of an image is considered in this paper. Calibration curves were obtained by correlation of optical density behind the red, green, and blue filters (Densitometer Brumicro) and RGB data.

The new hypothesis about possibility to use RGB data instead of relative luminosity values in the referent conception of tone reproduction[2, 3] was proposed during these experiments. It was done by comparison of calibration curves and relative luminosity function in the way of both comparison of linear interpolation correlation coefficients of analyzed data, and calculation of Fisher's criterion statistics by methods of analysis of variance.

The confirmation of the given hypothesis permits to realize a transition from calibration (characterization) to quality indexing of color photographic positives.

Introduction

The problem of evaluating the quality of photographic images from their visual perception has a very long history. The problem is crucial, because in our daily life, at least within the limits of amateur photography, each of us has to evaluate the quality of photographic prints. The reason that this problem is difficult is that visual quality is an unformalized, psychophysical concept, developed by each individual on the basis of a generalization of his previous experience.

In connection it is necessary to note one of the main problem under decision at last years. This problem consists of an estimation criteria development and methods realization for the tone and color reproduction parameters calculation for hybrid silver halide photographic systems with digital image processing.

Experimental

Primary goal of research is to obtain the calibration curves for translation of optical density values in the RGB values of brightness during scanning.

Object of research: photographic systems with digital image processing.

Such systems can be divided into four types, which differ by a principle of the devices choice for image transformation to the digital form conditionally. It can be shooting with the digital camera and the subsequent output of the image to photographic paper, scanning of a photographic negative, slide or a photocopy as seen in Figure 1.

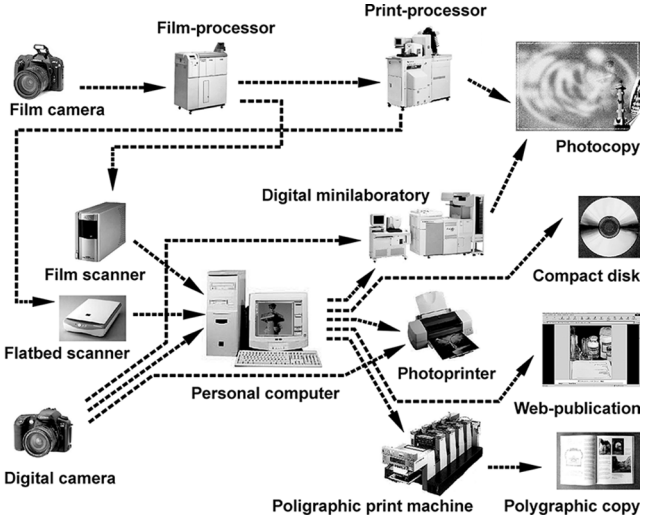


Figure 1. Photographic systems scheme with digital image processing.

For the image quality estimation of such hybrid process at each stage it is necessary to develop uniform criteria of an estimation, which adequately could be applied both for digital, and for a silver halide stage of process.

For this purpose we offer a method of densitometric calibration of scanners. Translation of optical density values (a silver halide stage) in RGB values (electronic stages of process) on calibration curve is stipulated.

Measurement of optical density and the control of tone reproduction were carried out with help of the hardware-software complex "Mirror" developed by authors of the paper.

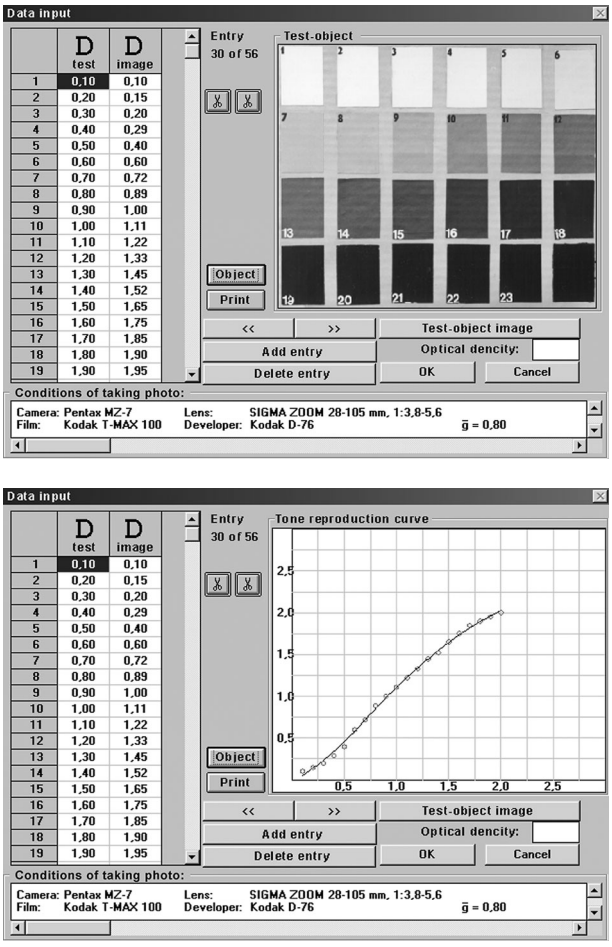
The program "Mirror"[4] includes four basic windows. In the main program window the object of shooting and its image counted on a tone reproduction curve, and also the information on conditions of process realization is deduced.

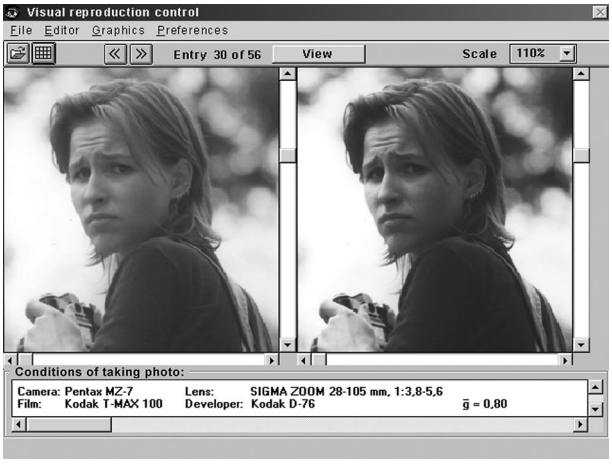
The second window is intended for optical density measurement, data and information on the test – chart recording. Functions of a test – chart choice, a visualization of the tone reproduction curve, and record of the auxiliary information also are stipulated in the given window.

The third window is intended for definition of key parameters of the tone reproduction curve.

The received information acts in a database of tone reproduction parameters, and on its basis construction of calibration curves is made.

Approximation of results was carried out by four functions: logarithmic, exponential, polynomial and a function $y=kx^a$. In each case the factor of correlation was calculated *(Figure 3 – 6)*.





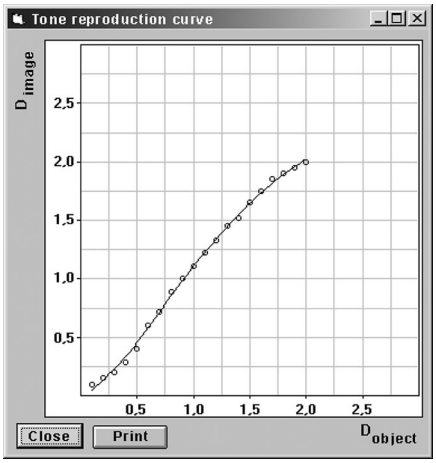


Figure 2. The "Mirror" program windows.

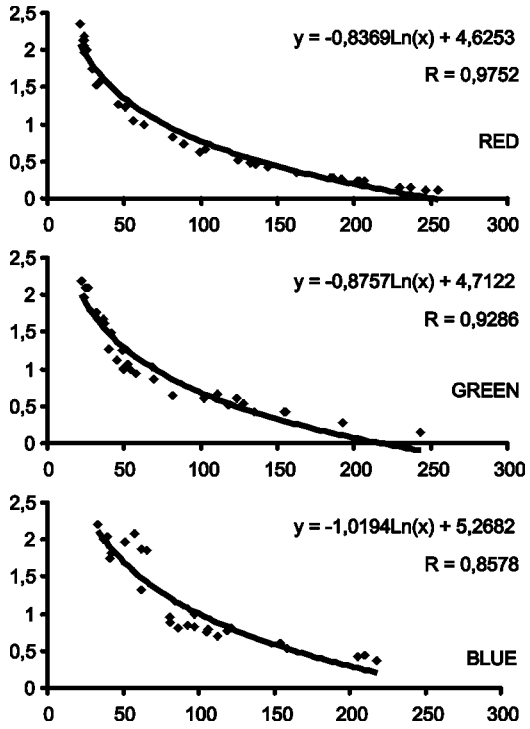


Figure 3. The approximation results by logarithmic function.

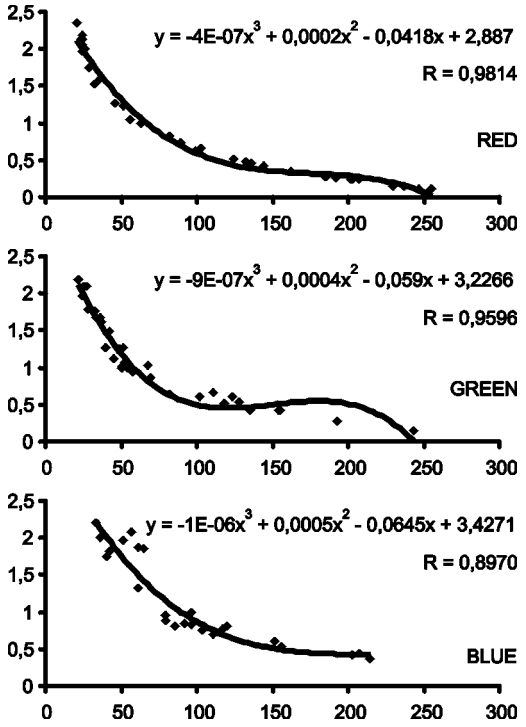


Figure 5. The approximation results by polynomial function.

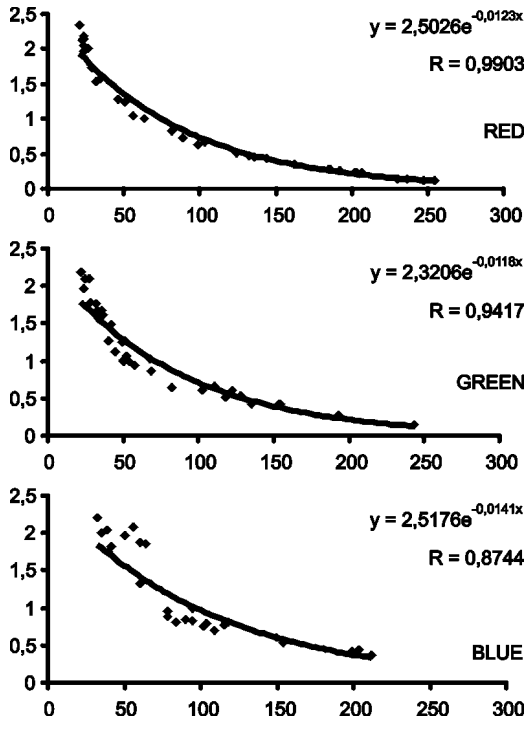


Figure 4. The approximation results by exponential function.

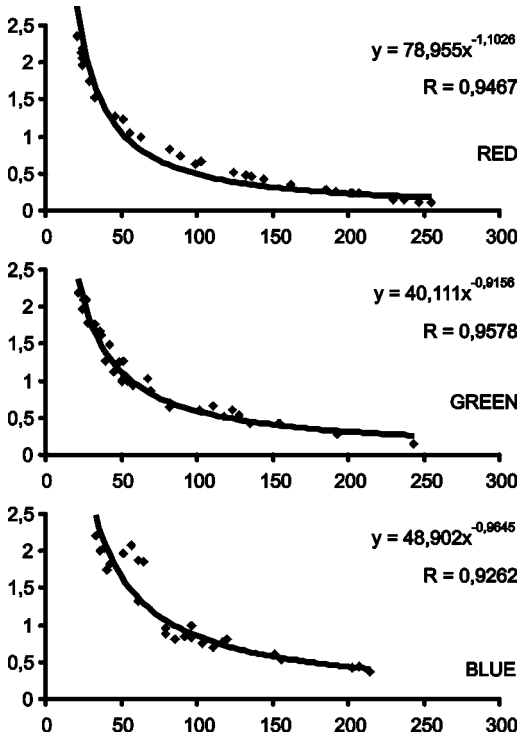


Figure 6. The approximation results by $y=kx^a$ function.

Results have shown, that most adequately calibration curves are described by a polynomial of the third degree.

On the basis of the obtained calibration curves the technique of the through photographic control procedure of the processes including stages of digital image processing is realized. It will allow to unify image quality estimation criteria in a digital and silver halide photo.

References

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Biography

Helena Konstantinova received her B.C. degree in chemical sciences from the Institute of Cinema engineers at Leningrad in 1985 and a Ph.D. in technical sciences from the St.-Petersburg's state university of moving picture and television.

Since 1985 she has worked at cathedra of photography of St.-Petersburg's state university of moving picture and television as a lecturer.

Her work has primarily focused on the problems of tone and color reproduction in silver halide photography and digital photographic systems. She is a member of the IS&T.

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