The Calibration Method Research for Biology Image

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Abstract—Biology image is a main approach of biology research, So the measurement **and recognition accurately of biology image, especially the monometer image like cell image, is very important and critical. All these depend on the accurate display of biology image. A key model of standard display function(SDF) for biology image is established at cell level, and measurement images are calibrated by the metrology standard of image using this model. The biology image can be appeared more "true" through this calibration. The SDF of several serial image data at key wavelengths are calibrated using the model, and then these serial data are combined in one image, thus the calibration is achieved. A kind of human erythrocyte image is measured and calibrated correspondly. After calibrated, the chromatism of this image is improved by 3 and the luminance contrast of that is improved by 2.**

.Keywords—biology image calibration standard display function(SDF) chromatism

Ⅰ INTRODUCION

Recently, biology image as a main approach of biology research become more and more important. So the measurement and recognition accurately of biology image, especially the monometer image like cell image, is very important and critical. All these depend on the accurate display of biology image. The international medical image standard-Digital Imaging and Communication of Medicine (DICOM)-Part14 defines Grayscale Standard Display Function (GSDF).[1] The purpose of this standard is the standardization of the display of medical image, furthermore, improving the veracity of these images which can be judged more easily [2]. Thus the same method as this standard for biology image, especially the monometer image like cell image, can be established with some modification [3,4]. If the chromatism and the luminance contrast of biology image are improved through this method, the biology image also can be identified more easily. Furthermore, these biology images also can be display in standard scale. This method is also a basement of biology image co-recognition and remote research.

Ⅱ The BIOLOGY IMAGE DISPLAY MODEL

A biology image is represented with bitmap format generally. So every pixel in the image has a luminance value in certain wavelength. A biology image can be represented as equ1(x, y denote the coordinate of the image and λ denote wavelength).

$$l = f(x, y, \lambda) \tag{1}$$

The luminance value at every pixel which denoted as l should be realized accurately. This is the basement of the identification of biology image. Thus an accurate measurement of biology target can be achieved finally. The key steps of this realization are the distinguish ability of l as the luminance contrast of the image and the influence of the wavelength as the chromatism of the image.

The luminance contrast of the image can be realized using classification method[5]. A luminance unit which denoted as l_{base} is defined to represent the minimum luminance which can be distinguished. Every pixel value l of an image can be separated with the unit l_{base} as shown in Equ2 .

$$j(l) = l / l_{base} \tag{2}$$

The purpose if this transfer is establishing a relationship between the biology image and the metrology standard of image(MSI). MSI is the standard of image in National institute of metrology(NIM) of China. MSI can provide a serial of standard image whith two dimension of geometry and one dimension of wavelength. In this standard equipment, a standard light source which is calibrated with luminance is translated to different grayscales which projected as standard image using digital light process(DLP) technology. Thus digital images can be compared with these standard grayscale images. The wavelength characteristic curve of the standard image projected from MSI is shown in Fig1.(Three representative wavelength are selected as shown with red, green blue color)

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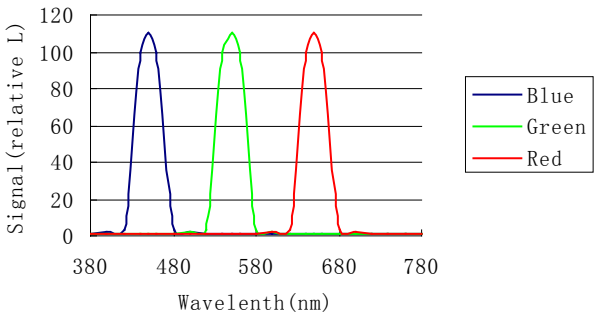


Figure 1 The wavelength characteristic curve of the standard image projected from MSI

Applying this standard equipment, the calibration model of biology image is defined by a mathematical interpolation derived from Barten's model. Thus the pixel value （luminance L, in candelas per square meter） of the calibrated image can be calculated by the model as shown in Equ.3.

$$L = k(\lambda_i)\frac{a + cj(l) + ej^2(l) + gj^3(l) + ij^4(l)}{1 + bj(l) + dj^2(l) + kj^3(l) + hj^4(l)} \qquad (3)$$

In Equ3, $k(\lambda_i)$ denote wavelength factor which defined as Equ4.

$$k(\lambda_i) = \frac{f(\lambda_i)}{\sum_{i=1}^{n} f(\lambda_i)} \qquad (4)$$

$f(\lambda)$ is the wavelength characteristic curve of the display system which will be used to display the biology image. And $f(\lambda_i)$ is the corresponding value of $f(\lambda)$ when $\lambda = \lambda_i$. Every coefficient value of the model as shown in Equ.1 is list in table 1.

TABLE1 COEFFICIENT VALUE OF THE MODEL

symbol	value	symbol	value
a	5.2623E-02	b	-2.4650E-03
c	3.6245E-03	d	2.4288E-06
e	1.0254E-04	g	-6.7497E-09
h	2.1040E-13	i	4.2880E-11
k	-1.1328E-09		

The origin measurement data l has been transferred to the calibrated data L through the procedure as described above. Thus the biology image is calibrated.

III THE CALIBRATION PROCEDURE AND A EXAMPLE OF HUMAN ERYTHROCYTE IMAGE

The calibration schematic of biology image is shown in Fig2. The calibration procedure using the calibration model and MSI. The input conditions of this calibration procedure include the origin measurement data , the characteristic curve of the display equipment which will be used, and the minimum luminance l_{base} which can be distinguished and matched to MSI. According these conditions, MSI output the suited standard image and the corresponding calibration coefficients are achieved by comparison. Then the calibration data are achieved and procedure which is shown in Fig 2 is accomplished.

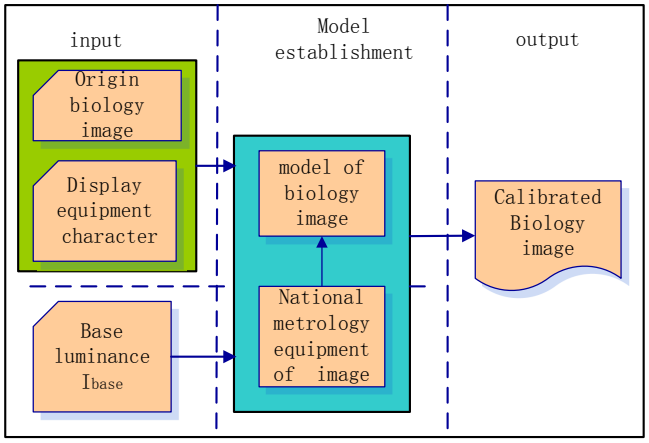


Figure 2 the calibration schematic of biology image

An example of human erythrocyte image is calibrated. The origin measurement image of human erythrocyte is shown in Fig 3. This image is calibrated in order to display on an equipment which's characteristic curve is shown in Fig4.[6]

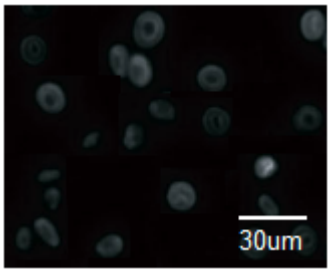


Figure 3 The origin measurement image of human erythrocyte

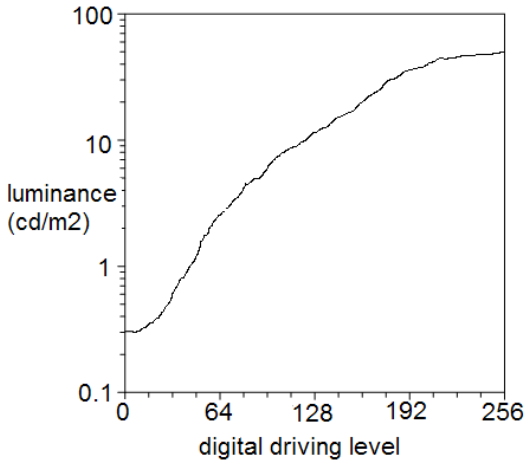
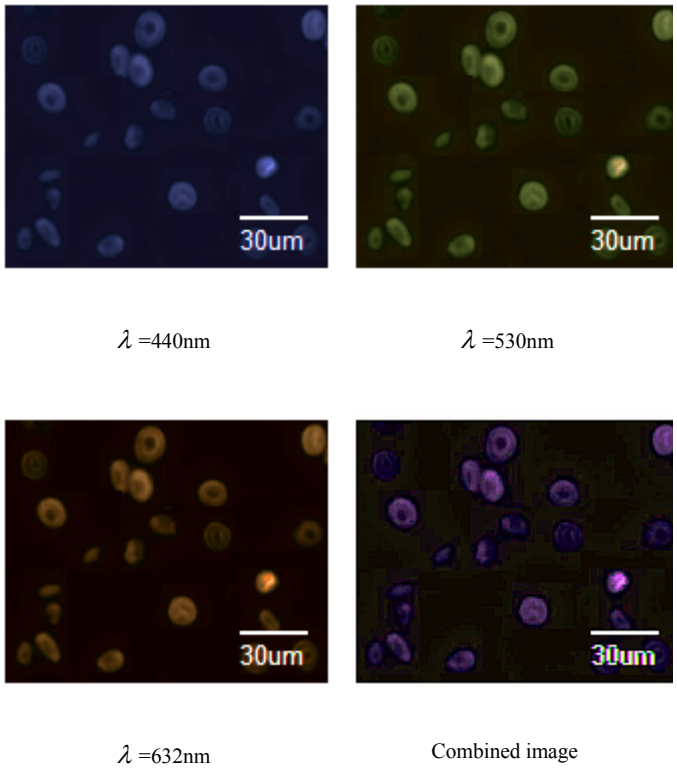


Figure 4 the characteristic curve of the display equipment

Three calibration images with representative wavelengths which are 440nm, 530nm and 632nm are shown in Fig 5. Then the combined image with different wavelength achieved. After calibration, the chromatism of this image is improved by 3 and the luminance contrast of that is improved by 2. The contrast data between these two images are list in table 2.



λ =440nm λ =530nm

λ =632nm Combined image

Fig ure 5 Three calibration images with representative wavelengths and the combined image

TABLE 2 THE CONTRAST DATA BETWEEN THE TWO IMAGES

items	$\Delta E^* ab$	ΔL^*
Origin image	10	8
Calibrated image	12	11

Ⅳ CONCLUSION

The chromatism and the luminance contrast of biology image are improved through the calibration using the calibration model and MSI. After calibration,better images with high precision and contrast are achieved for identification which is benefit for co-recognition and remote research.[7]

The standard of biology image is the tendency of biology images development in the future. The calibration model of biology image provides a kind of approach for the realization of the biology images standard.

Ⅴ ACKNOWLEDGE

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