ที่กำลังออกแบ และเมื่อได้สร้างต้นแบบแล้วจะนำมาพิจารณาเปรียบเทียบกับแบบจำลองเพื่อปรับปรุงสมรรถนะของแบบจำลอง

ตารางที่ 1: สรุปค่าลักษณะเฉพาะของการออกแบบ

Item	Unit	Modeled	Target
Gram load	Gram	2.5	2.5
Suspension Spring Rate	N/m	17.5	16.607
Free state angle	deg	13.455	16.3
B1 (Arm)		888 Hz	1170 Hz
B2 (Arm)		5072 Hz	
T1 IP (In Phase)		8.5 dB @ 6067 Hz	22 dB @ 7700 Hz
B1 (Suspension)		3636 Hz	3700 Hz
T1 OOP (Out Of Phase)		10.8 dB @ 11592 Hz	35 dB @ 11100 Hz
Sway (Arm)		38.1 dB @ 10219 Hz	60 dB @ 9700 Hz
T2		8.87 dB @ 14648 Hz	20 dB @ 16300 Hz
LB Sway		32.1 dB @ 18376 Hz	65 dB @ 21100 Hz
Flexure pitch stiffness (Flexure level)	uN-m/deg	0.84	0.85
Flexure roll stiffness (Fexure level)	uN-m/deg	0.91	0.83
Flexure lateral stiffness (Flexure level)	N/mm	4.75	
Flexure vertical stiffness (Flexure level)	N/m	32.3	
Dimple contact force	mN	3.613	
Hinge stress @ 1.0 mm lifter BB	Mpa	2842	
Static lift off	g/gm	139	
Lifter Stiffness	N/m	1391	

จากตารางที่ 1 บอกลักษณะเฉพาะที่ได้จากการคำนวณด้วยวิธีการไฟไนท์เอลิเมนต์เพื่อเทียบกับค่าวัดจริงเพื่อให้เกิดความมั่นใจในการออกแบบ

4. สรุป

การออกแบบชุดหัวอ่านเขียนสำเร็จจะต้องพิจารณาทั้งสภาวะสถิตย์ศาสตร์และสภาวะพลศาสตร์การศึกษาด้วยแบบจำลองก่อนการผลิตทำให้สามารถทราบตำแหน่งที่สร้างมุมอิสระซึ่งมีผลต่อลักษณะเฉพาะของชุดอ่านเขียนสำเร็จและไม่เสียเวลาจากการทดลองสร้างมุมอิสระซึ่งเป็นการทดลองแบบทำลายทำให้ได้ชุดอ่านเขียนที่มีคุณภาพตามต้องการแต่อย่างไรก็ตามในการประกอบจริงของของชุดอ่านเขียนสำเร็จจะมีพิกัดความเผื่อดังนั้นจะเกิดเลื่อนของความถี่ในการวิเคราะห์การสั่นพ้องต้องพิจารณาว่าอยู่ในสภาวะการทำงานที่เหมาะสมไม่หลุดออกนอกค่าที่ต้องการและตระหนักถึงความเค้นที่เกิดขึ้นบริเวณการสร้างมุมอิสระต้องออกแบบให้ไกลจากจุดคราก (Yield stress) มากที่สุด ถึงแม้ว่าจะพบจุดเล็กๆที่มีค่าความเค้นเกินจุดครากแต่ถ้าเป็นจุดที่เล็กมากสามารถละทิ้งได้เสมือนเข็มกดลงบนโต๊ะไม่มีผลต้อการแอ่นตัวของโต๊ะ แม้กระนั้นก็ตามเมื่อชุดอ่านเขียนสำเร็จได้ประกอบเข้ากับแขน E-Block (HSA) จำเป็นต้องพิจารณาอีกครั้งว่าลักษณะเฉพาะของระบบได้เปลี่ยนแปลงไปอย่างไรเพื่อให้ได้ฮาร์ดดิสไดร์ฟที่มีคุณภาพตามต้องการในการออกแบบสามารถละทิ้งชุดสัญญาณกิมบอลได้ซึ่งในโมเดลนี้ชุดกิมบอลมีผลต่อความแข็งเพียง 4.11 เปอร์เซ็น อย่างไรก็ตามควรพิจารณาก่อนตัดชุดกิมบอลออกทุกครั้งซึ่งในบางโมเดลชุดกิมบอลที่มีหลายแพดจะทำให้มีความหนามากขึ้นอาจจะส่งผลต่อค่าความเป็นสปริงมากกว่า

เอกสารอ้างอิง

[1] ศันสนีย์ ขุนทิพย์ทอง ,"งานวิจัยนี้เป็นการศึกษาลักษณะการเสียรูปของ HGA ที่มีผลต่อการบิดตัวของ slider ในแกน pitch และแกน roll อันเนื่องมาจากค่าแรงจับยึด 7 ปอนด์ และ 9 ปอนด์ ตามลำดับ", วารสารวิจัย มข

[2] นภดนัย อาชวาคม,"การศึกษาการสั่นสะเทือนที่มีผลต่อเสียงของสปินเดิลมอเตอร์ในฮาร์ดดิสก์ไดร์ฟโดยการกระตุ้นทางไฟฟ้า",การประชุมวิชาการเครือข่ายวิศวกรรมเครื่องกลแห่งประเทศไทย ครั้งที่ 21 หน้า DRC 27

[3] Michael R Hatch,"Vibration Simulation Using MATLAB and ANSYS", 1th edition. Chapman and Hall, 2000.

[4] ANSYS Training Manual: Introduction to ANSYS, release 7.1, Edition2.

[5] S.P. Timoshenko and J.N. Goodier, Theory of Elasticity, Third Edition, McGraw Hill,1970

[6] A.P. Boresi and O.M. Sidebottom, Advanced Mechanics of Materials, John Wiley and Sons, 1985, pp 515-518

Biomedical Image Enhancement Using Artificial VLSI Model together with Linear Least Squares Deconvolution Processing

Khammapun Khantanapoka

Department of Multimedia Technology, Faculty of Science
Chandrakasem Rajabhat University
Bangkok, Thailand.
e-mail: doramon86@hotmail.com

Abstract— The optical microscope has seen steady improvement and increasing use in biomedical research and clinical medicine as well as in many other fields. Microscope imaging and image processing are of increasing interest to scientific and medical engineering communities. At dark scenes and under no uniform lighting conditions, either the low intensity areas or the high intensity areas of photon which cannot be clearly seen such as noise, blurring and loss of details. It is the important information for patient's treatment as well as medical science. Microbiology is an indicator for severity of the disease. In detecting the spread of infection will identify period of the disease. Image processing techniques have been developed to reconstruction the insignificant information under obscure visible. It has various advantages about check the operating room, plague, evidence in court proceedings, public health, genetic engineering and working in the biological warfare.

The most method of enhancement dark image uses calculates contract color level with mathematics model. It returns result for change intensity value at each pixel of original image, and those pixel will brightly than formerly trade lose color in fact. This paper proposes dark image enhancement using Virtual Lights Source Integration (VLSI) model together with Linear Least Squares Deconvolution Processing (LLSD) . It is able to enhance dark image become to brightly and retrieve color in fact of image which are hiding. VLSI will not change directly value of original image, this method to copy vision of human viewer. It is creating new light source and calculate intensity value of each pixel by reflects illumination to visible. This method reduces noise and image enhancement both are medical image and biology. It is robust to over whitening problem. The experiment uses compare between two methods. First, uses a transition function for increasing the dynamic range which is unlimited two hundred fifty five levels color palette of an image and proposes solve a problem an over whitening already. Second, uses VLSI combine LLSD method which is optimal vision and can add information of dark image under less lighting conditions extremely. Result of the experiment, the image enhanced using Virtual Lights Source Integration model together with Linear Least Squares Deconvolution Processing (LLSD) has brightness to good vision and natural colors than previous method which prove using result from equilibrium point of histogram value. VLSI can make up brightness than normality 71.03%-88.06%

Keywords- image deconvolution, microscope processing

I. INTRODUCTION

The important factors that can degrade an image in the digitizing process are (1) loss of detail,(2) noise, (3)aliasing,(4) shading,(5)photometric nonlinearity, and (6) geometric distortion. If the level of each of these is kept low enough, then the digital images obtained from the microscope will be usable for their intended purpose.
A variety of image enhancement algorithm have previously been developed and utilized for microscopy applications.

Figure 1. Structure of biomedical image by digital microscope

Image Deconvolution is conventional wide field microscopes are designed to image specimens at the focus plane of the objective lens, but they also collect light emanating from out of focus planes. This reduces the contrast of in-focus image structures. In confocal microscopes, this out-of focus light is largely rejected by the use of pinholes, resulting in clearer images and increased resolution, both laterally and axially. In either case, however, diffraction occurs as the light passes through the finite-aperture optics of the microscope, blurring effect. For a well-designed imaging system, this blurring can be modeled mathematically as a convolution of the true incident light distribution with the point spread function (psf) of the system. If the psf is know, it is possible in principle to reverse this operation, at least partially.

Most algorithms based on integrated neighborhood dependency of pixel characteristics and based on the luminance reflectance model perform well for improving the visual quality of digital images captured under no uniform and extremely low lighting conditions. It is envisage that new technique would be useful for improving the visibility of scenes of air force night time gear landing, car driving in the night time and no uniform lighting activities. Virtual Lights Source are mathematic projection model used reflects texture of light in picture plane. In this paper emphasize improve night vision image or extreme less light source.

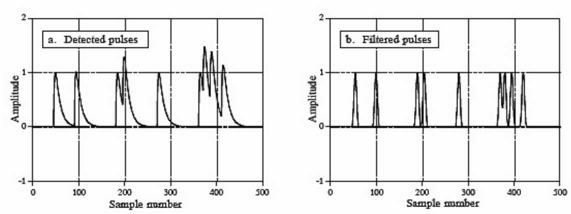

Figure 2. (Left)Shows the output signal from a gamma ray detector in response to a series of randomly arriving gamma rays. The deconvolution filter is designed to convert(a) into (right), by reducing the width of the pulse. This minimize the amplitude shift when pulse land on top of each other.

A diverging spherical wave of the light radiating from a point source at the origin of the focus plane is refracted by a convex lens to produce a converging spherical exit wave. The light converges to produce a small spot at the origin of the image plane. The shape of that spot is point spread function (psf)

II.PROCEDURE OF SYSTEM

A. Image Enhancement by the dynamic range.

The night in the dark light images can be brightened while the local intensity contrast will be degraded using equation[1]:

$$I_{x,y} = \frac{2}{1+e^{-2\tau_{x,y}/p}} - 1 \qquad (1)$$

which $I_{x,y}$ will enhance the dark part of the image while preserving the light part of the image based on:

$$\rho = (255-k)\left[\frac{\tau_{x,y}}{255}\right] + k \qquad (2)$$

Where τ (x,y) is the V component pixel value in HSV color space and 0 $\le$ τ (x,y) $\le$ 255 at (x,y) location of the image, ρ is the statistics of the image, and I (x,y) is the enhanced pixel value which is normalized. The parameter ρ controls the curvature of the hyperbolic tangent function. This means that when the processing image is dark, ρ should be small and therefore the curvature of the hyperbolic tangent function will be steep and this will help the darker pixels to have brighter values. ρ can be expressed as:

$$\rho = (255+(\omega)-k)\left[\frac{\tau_{x,y}}{255+(\omega)}\right] + k \qquad (3)$$

Where τ (x,y) is the local mean of an image and k is the bias pixel intensity value. The local mean of each pixel is calculated based on the center surrounded property (k = 3) of a perceptual field and perceptual processes of night vision.

Display devices commonly have a limited range of gray levels over which the image features are most visible. We can use global methods to adjust all the pixels in the image so as to ensure that the features of interest fall into the visible range of the display. If I_1 and I_2 define the intensity range of interest, a scaling transformation can be introduced to map the image intensity I to the image g with the range of I_{min} to I_{max} as

$$g = \left(\frac{I-I_1}{I_2-I_1}\right)^{\alpha}(I_{\max}-I_{\min}) + I_{\min} \quad \text{by } 0<\alpha<\infty \qquad (4)$$

Where α is an adjustable parameter.

B. Motion Deblurring with Wiener Deconvolution .

Figure 3. Compare in (a) Original (b) Observation BSNR40 dB (c) Wiener estimate ISNR5.6 dB (d) ForWaRD estimate ISNR7.3 dB.

This method used image restoration technique in research. Unlike simple inverse filtering, it attempts to reduce noise while restoring the original signal. It implement a balance between inverse filtering and noise smoothing that is optimal in the mean square error sense. Assuming the white Gaussian noise model as follows;

$$g(x,y,z) = f(x,y,z) * H(x,y,z) + n(x,y,z) \qquad (5)$$

when $x,y,z \in R$

Where n(x,y,z) represents the additive Gaussian noise. The background term is omitted because it can be estimated and then removed.

The orthogonality principle implies that the Wiener filter can be expressed in the Fourier domain.

$$H(u,v,w) = \frac{H^*(u,v,w)}{\left\{|H(u,v,w)|^2 + \left(\frac{P_w(u,v,w)}{P_f(u,v,w)}\right)\right\}} \qquad (6)$$

when $H(u,v,w)$ is the Fourier transform of $H^*(u,v,w)$ by multiple is complex conjugation operation. $P_w(u,v,w)$ and $P_f(u,v,w)$ are the power spectral densities of the noise .

$$H(u,v,w) = \frac{1}{H(u,v,w)}\left[\frac{|H(u,v,w)|^2}{|H(u,v,w)|^2+\frac{1}{SNR(u,v,w)}}\right] \quad (7)$$

when $$SNR(u,v,w) = \frac{P_f(u,v,w)}{P_w(u,v,w)} \quad (8)$$

If we given a degraded image M' of some original image *M* and a restored version *R*. we would like *R* to be as close as possible to the correct image M and measuring the closeness of *R* to *M* is by adding the squares of all difference:

$$\sum (m_{i,j} - r_{i,j})^2 \quad (9)$$

where the sum is taken over all pixels of *R* and *M*. This sum can be taken as a measure of the closeness of *R* to *M*. Filters that operate on this principle of least squares are called wiener filters. We can obtain *X* by

$$X(i,j) \approx \left[\frac{1}{F(i,j)} \frac{|F(i,j)|^2}{|F(i,j)|^2+K}\right]\Upsilon(i,j) \quad (10)$$

Where *K* is a constant. This constant can be used to approximate the amount of noise.

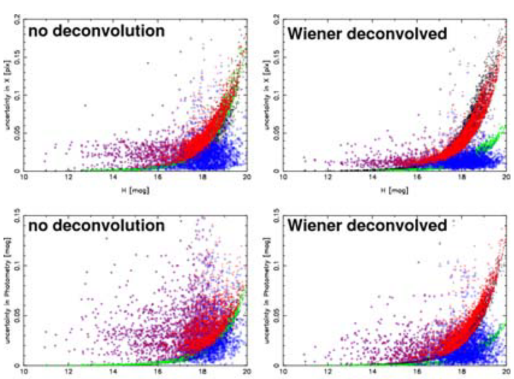

Figure 4. Distribution of pixel color by compare in (left-on, left- lower) (right-on, right- lower) show Wiener deconvolved algorithm

III.RESULT OF THE EXPERIMMENTAL

A. Dynamic range model unlimited 255 palette color

where ω adaptive follow pixels dark range. If most average intensity of the dark range may be used number of color level than 255 colors in the palette. Result is bright than previously. But, it happens over whitening phenomenon.

B. Deconvolution Using least Squares Approach

This method is also used to restore images corrupted with additive white Gaussian noise. It used principle of linear algebra. It can be rewritten in discrete form as matrix vector equation. From observed medical image, we can be expressed in a matrix from as;

$$g = Hf + n \quad (11)$$

where *g,f* and *n* are N^2x1 column vectors; *H* is an($(N^2)^2$)matrix ; f is the original image; n is the noise, and *H* stands for blurring. When the blurring is shift-invariant, the matrix *H* becomes a block-circulant matrix. If n=0,we can find the approximate solution by minimizing the mean square error.

In this formulation *f,g* and *n* are vector formed by stacking the columns of the respective images. If W=0 of if we known nothing about the noise, we can set up the restoration as a least squares minimization problem in the following way. We wish to select f so that if it is blurred by *H*, and result will differ from the observed image g, in the mean square sense. by as little as possible. Since g itself is simply f blurred by *H*, this is a satisfying approach. If F and F, both having been blurred by *H*, are nearly equal, then hopefully f is a good approximation to f. This formulation is distinctly different from that used in the Wiener filter. There were sought to minimize the difference between the restored signal and the original. Here we are satisfied to minimize the difference between the blurred original and a similarly blurred estimate of the original. We cannot expect the result of these two formulations to be the same.

Let $e(f)$ be a vector of residual errors that results from using f as an approximation to f previous equation.

$$g = Hf = H\hat{f} + e(\hat{f}) \text{ or } e(f) = g - H\hat{f} \quad (12)$$

We seek to minimize the function.

$$\phi(f) = \|e(f)\|^2 = (g - Hf)^2 = (g - Hf)^t (g - Hf) \quad (13)$$

where $\|a\| = \sqrt{a^t a}$ denotes the Euclidean norm of a vector, that is, the square root of the sum of the squares of its elements. Then, setting to zero the derivative of $\phi(f)$ with respect to F and solving for f

$$e(f) = \|g - Hf\|^2 = (g - Hf)^t (g - Hf) \quad (14)$$

by setting the derivative of e($\hat{f}$) in respect to $\hat{f}$ to zero:

$$\frac{\partial e(\hat{f})}{\partial \hat{f}} = -2H^t (g - Hf) = 0 \quad (15)$$

The solution for $\hat{f}$ becomes

$$f = (H^t H)^{-1} H^t g = H^{-1} g \quad (16)$$

If n is nonzero, the problem can be formulated as one of constrained optimization;

$$e(f) = \|Qf\|^2 + \lambda(\|g - Hf\|)^2 - \|n\|^2 \quad (17)$$

where the first term is a regularization term, such that solution is smooth and the matrix Q is usually taken to be the first or second difference operation of $\hat{f}$. λ is a constant *Lagrange Multiplier*. Similarity, we can set the derivative of $e(f)$ in respect to $\hat{f}$ to zero, as fallows;

$$\frac{\partial e(\hat{f})}{\partial \hat{f}} = 2Q^t Q\hat{f} - 2\lambda H^t (g - H\hat{f}) = 0 \quad (18)$$

and find the solution for

$$f = (H^t H + \frac{1}{\lambda} Q^t Q)^{-1} H^t g \text{ or } f = (H^t H)^{-1} H^t g \quad (19)$$

It turn out this solution is the general form of solution for the deconvolution technique.

Where the matrix H can be constructed from the discrete psf and has a Toeplitz structure. The variance and the error depend on the eigenvalues, which are used for the matrix-inversion operation. The algorithm searches the optimal number of eigenvalues.

C. Structure of Artificial VLSI Model together with Linear Least Squares Deconvolution model.

In Pre-Processing with motion deblurring will help increase clearly enhancement of image. First, input biomedical photographic from digital microscope device transfer to memory computer. Second, evaluate color processing and training system. Third, we use image enhancement using dynamic range method. Forth, Wiener Deconvolution for reduce noise and deblurring technique. Deconvolution using least Squares Approach. Fifth, Create new light source and calculate Artificial Virtual Lights Source Integration (VLSI). Finally, return nature color.

D. Artificial Virtual Lights Source Integration

This algorithm is base of adding new light source to image. It is light source have not size but is refer a point in three dimension coordinate which spread out from light point. It use calculate optimum to each pixel on the image.

$$I = \frac{1}{L^2} I_S \quad (20)$$

where I is intensity of any light source which is distance L

I_S is perpendicular between distance of image to new light source.

L is distance from light source to each pixel on image. This algorithm control decrease of intensity color while L increase.

$$f = \min\left(\frac{1}{c_1 + c_2 L + c_3 L^2}, 1\right) \quad (21)$$

In each pixel can find intensity value from this equation

$$I = \min\left(\frac{1}{c_1 + c_2 L + c_3 L^2}, 1\right) I_s \quad (22)$$

where C is constant use calculates decrease of intensity color when far out from center of light point which C difference follows illuminate rule.

All modern graphics hardware implements perspective correct texturing. In computer graphics, ray tracing is a technique for generating an image by tracing the path of light through pixels in an image plane. The technique is capable of producing a very high degree of photorealism; usually higher than that of typical scanline rendering methods, but at a greater computational cost. This makes ray tracing best suited for applications where the image can be rendered slowly ahead of time, such as in still images and film and television special effects, and more poorly suited for real-time applications like computer games where speed is critical. Ray tracing is capable of simulating a wide variety of optical effects, such as reflection and refraction, scattering, and chromatic aberration. Optical ray tracing describes a method for producing visual images constructed in 3D computer graphics environments, with more photorealism than either ray casting or scanline rendering techniques. It works by tracing a path from an imaginary eye through each pixel in a virtual screen, and calculating the color of the object visible through it. Scenes in ray tracing are described mathematically by a programmer or by a visual artist (using intermediary tools). Scenes may also incorporate data from images and models captured by means such as digital photography. The light intensity of this pixel is computed using a number of algorithms, which may include the classic rendering algorithm and may also incorporate techniques such as radiosity.

F. Set position of virtual camera related with Lighting

Illumination model find density of reflect light from opaque surface follows equation as lambertian Illumination Model;

$$I = k_a I_a + k_a (\vec{N} \cdot \vec{L}) I_s \quad (23)$$

$$I_r = \rho_a I_a + \sum_n I_{i,n} (\bar{N}.\bar{L}_n) d\omega_{i,n} (k_d \rho_d + k_s \rho_s) \quad (24)$$

II. Result of The Experimental

From experiment, the result is good vision and natural colors. This paper tested the performance of the proposed technique on result of experiment follows as:

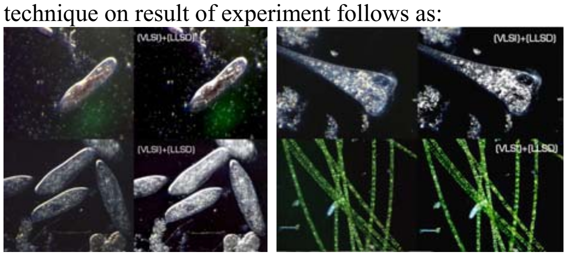

Figure 5.(Left,on-Left,lower) Dark image : Original, (Right,on- Right, lower) Image enhancement with contract unlimited 255 palette color is ω =1250 color palette and over whitening protection. (lower) VLSI+LLSD Model.

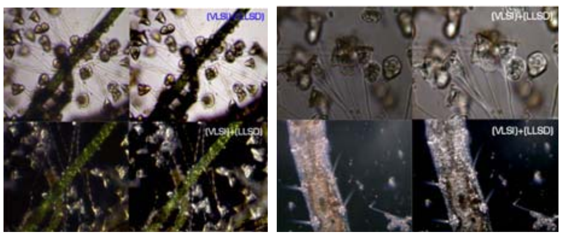

Figure 6.(Left,on-Left,lower) Dark image : Original, (Right,on- Right, lower) Image enhancement with contract unlimited 255 palette color is ω =1550 color palette and over whitening protection. (lower) VLSI+LLSD Model.

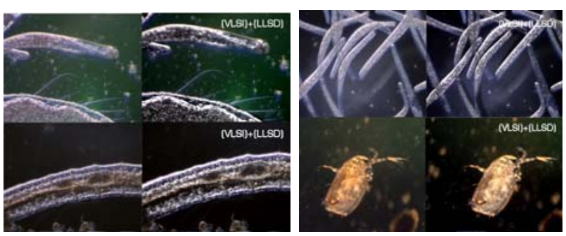

Figure 7.(Left,on-Left,lower) Dark image : Original, (Right,on- Right, lower) Image enhancement with contract unlimited 255 palette color is ω =1250 color palette and over whitening protection. (lower) VLSI+LLSD Model.

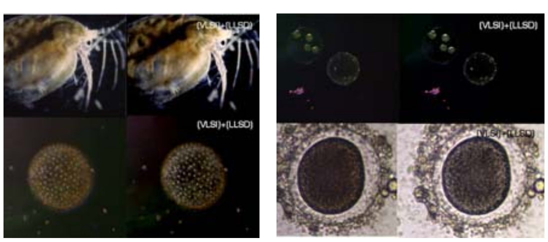

Figure 8 .(Left,on-Left,lower) Dark image : Original, (Right,on- Right, lower) Image enhancement with contract unlimited 255 palette color is ω =1450 color palette and over whitening protection. (lower) VLSI+LLSD Model.

From experiment, Image enhancement is the process of enhancing the appearance of an image or a subset of the image for better contrast or visualization of image features and to facilitate more accurate subsequent image analysis. The operation used to increase contrast in the image.We uses operations sharpen image feature and reduce noise. Nonlinear filter, such as the median filter,can reduce noise without blurring edges. It use reflect property cooperate with equilibrium spread of color and make up color with new color which image processing type two dimension can not. VLSI together with Linear Least Squares Deconvolution Processing technique can use reflecting between light colors. It enhance pixel of image using add new virtual light source to image and destroy color in fact a little more which difference Infrared vision that destroy color in fact completely. VLSI together with Linear Least Squares Deconvolution Processing can make up brightness than normality 78% from histogram rate. Lights Source Integration (VLSI) model, together with Linear Least Squares Deconvolution Processing, It is able to enhance extremely dark image become to brightly and retrieve color in fact of image which are hiding. It showed the output images better than use different values of the contrast factor with transition function and method based on sigmoid function. VLSI together with Linear Least Squares Deconvolution Processing can make up brightness than normality 78%-84%.

Reference

[1] S. Mezouari and A. Harvey, “Phase pupil functions for reduction of defocus and spherical aberrations,” Opt. Lett. 28, 771–773 (2003).

[2] S. Somalingam, K. Dressbach, M. Hain, S. Stankovic, T.Tschudi, J. Knittel, and H. Richter, “Effective spherical aberration compensation by use of a nematic liquid-crystal device,” Appl. Opt. 43, 2722–2729 (2004).

[3] A. Diaspro, F. Federici, and M. Robello, “Influence of refractive-index mismatch in high-resolution threedimensional confocal microscopy,” Appl. Opt. 41, 685–690 (2002).

[4] G. Luo, N. M. Rensing, E. Weststrate and E. Peli, "Registration of an on-axis see- through head mounted display and camera system," Opt. Eng. 44(2) (2005), 024002

[5] C. Preza and J. Conchello, “Image estimation accounting for point-spread function depth variation in threedimensional fluorescence microscopy,” in Proc. SPIE 4964,135–142 (2003).

[6] J. Tang, J. Kim and E. Peli, "Image enhancement in the JPEG domain for people with vision impairment," IEEE Trans. Biomed. Eng. 51(11) (2004), 2013-2023.

[7] Z. Salleh, M.Y. Mashor, N. AbdulRahim, A.S.W. Wahab, S.S. Md Noor, F. M. Idris, and H. Hasan,"Colour Contrast Enhancement Based On Bright and DarkStretching For Ziehl-Neelsen Slide Images," in Third International Conference on Intelligent Information Hiding and Multimedia Signal Processing, 2007. IIHMSP 2007. , 2007, pp. 205-208.

[8] M. Fullerton and E. Peli, "Post-transmission digital video enhancement for people with visual impairments," J. SID 14(1) (2006), 15-24.

[9] J. Markham and J. Conchello, “Fast maximum-likelihood image-restoration algorithms for three-dimensional fluorescence microscopy,” J. Opt. Soc. Am. A 18, 1062–1071 (2001)