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CSC47100-E

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Assignment 1

1. Writing Assignments

(1). How does an image change (e.g., objects' sizes in the image, field of view, etc.) if the focal length of a pinhole camera is varied?

If the focal length of a pinhole camera is varied, then it's focal length varies by the given ratio of the image dimension I to the distance of pinhole from image I.

(2). Give an intuitive explanation of the reason why a pinhole camera has an infinite depth of field.

We can assume it emits one ray that passes through the role into the image plane in every view point of scene. Every independent P of the distance Z create a picture shape (image) W. It need to say every point(p)/unit has only one ray. That is why a pinhole camera has an infinite depth of field.

(3). In the thin lens model, 1/o + 1/i = 1/f, there are three variables, the focal length f, the object distance o and the image distance i (please refer to Slide # 19 of the Image Formation lecture). If we define Z = o-f, and z = i-f, please write two a few words to describe the physical meanings of Z and z, and then prove that Z*z = f*f given 1/o + 1/i = 1/f.

$(o+i)/(o \cdot i)=1/f$

$f \cdot o+f \cdot i =o \cdot i$

$f \cdot i=o \cdot (i-f)$

$(f \cdot i)/o=z$

$(z=i-f)$

In other way:

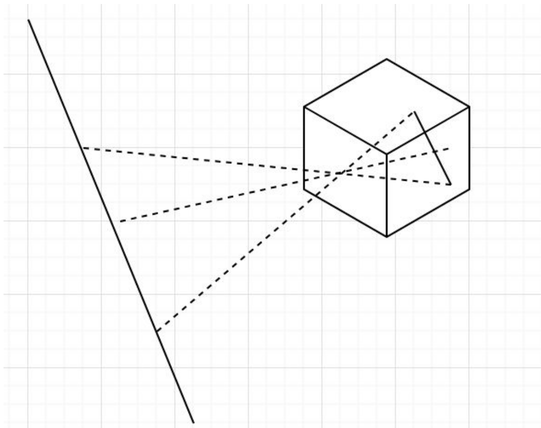
$(f \cdot o)/i=Z$

$(Z=o-f)$

$Z \cdot z=((f \cdot i)/o) \cdot ((f \cdot o)/i)$

So $Z \cdot z=f \cdot f$

(4). Prove that, in the pinhole camera model, three collinear points (i.e., they lie on a line) in 3D space are imaged into three collinear points on the image plane. You may either use geometric reasoning (with line drawings) or algebra deduction (using equations).



These points on a straight line transfer to other straight line. In other words we could say the all collinear points are imaged to the straight line. In first step, you can also choose two 3D scene points, project them into the image plane, then choose a third scene point that lies on the line behind by 2 points. The whole image will show the image of 3rd point indeed is part of a line through the image of points 1&2.

Straight Line: X(1)=Xo+1U, U is (X2-X1)

Pinhole Camera: X=-f(X/2)

Image Space: X=-f(Xo+1U)(Zo+1W)

In next step, we could change the equation of 3D space parameter into equation of pinhole camera.

2. Programming Assignments

Figure 1 shows how we display the color image to RGB format in Matlab. Then other three pictures is R-band graph, G-band graph and B-band graph. Red graph is more brighter pixel than Green graph and Blue graph. Then the Blue graph is more dark pixel.

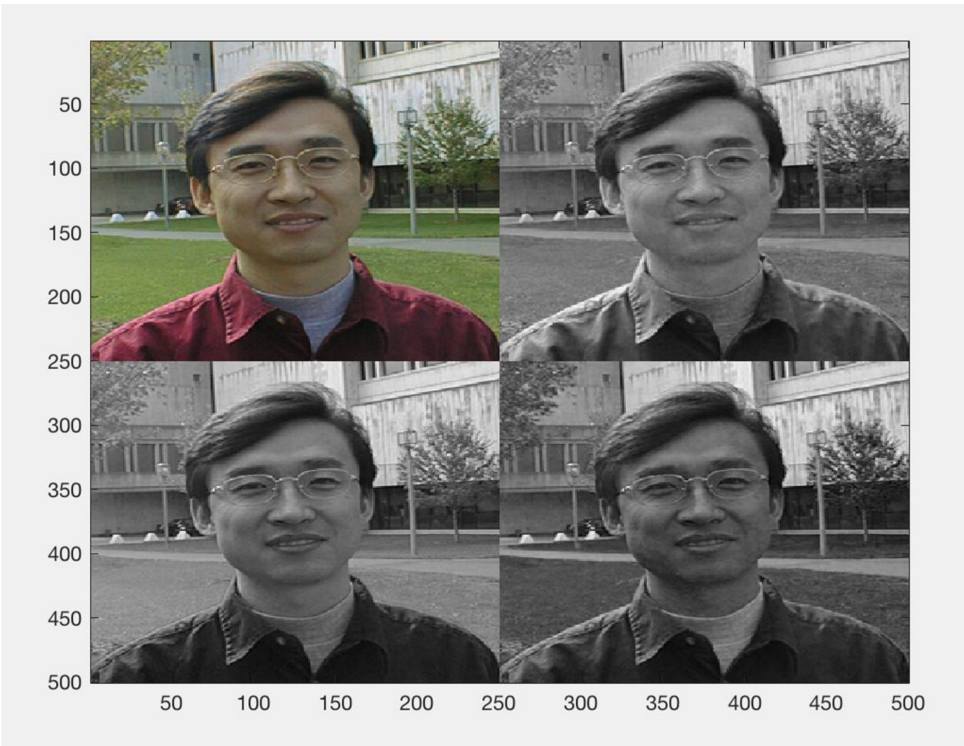


Figure 1

In figure 2, it uses the equation MAP(i,band) = (i-1)/255, then convert scale 0-255 into 0-1. The colormap() function shows the original color property of the image.

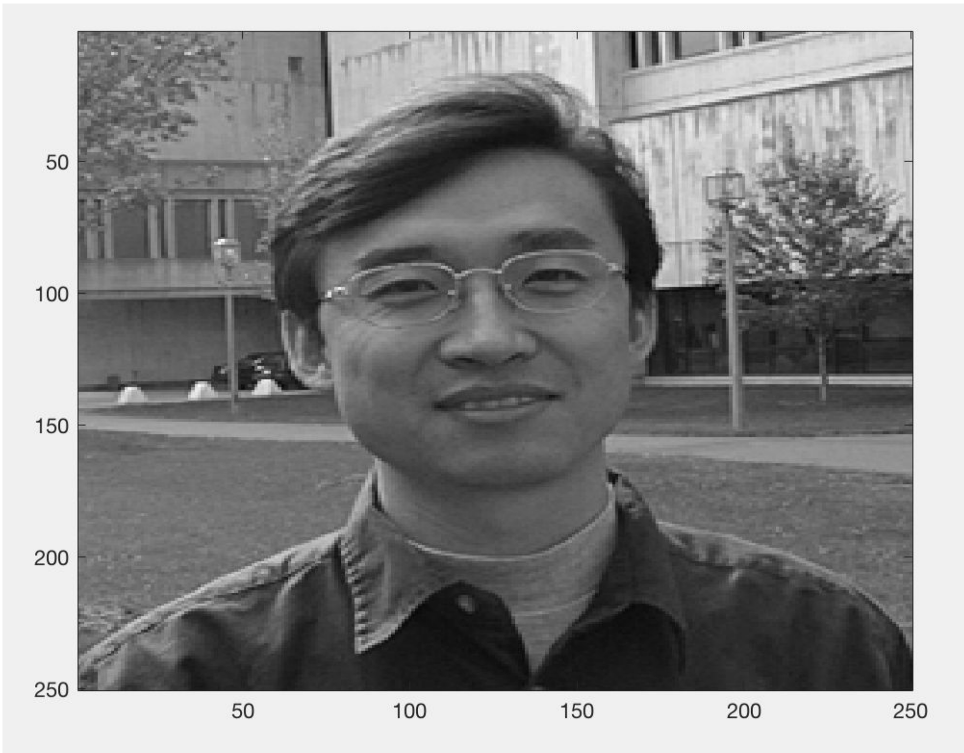


Figure 2

In figure 3, the graph become yellow color. we use equation sum(C1,3)/3 to display the gray image from original. When the image is RGB three channels, assuming that A is a three-channel image, then sum (A, 3) after the operation of the value of each channel corresponding to the value of the respective points, such as the position p three channel pixel values were r, g, b, the value after the p-position operation is r + g + b.

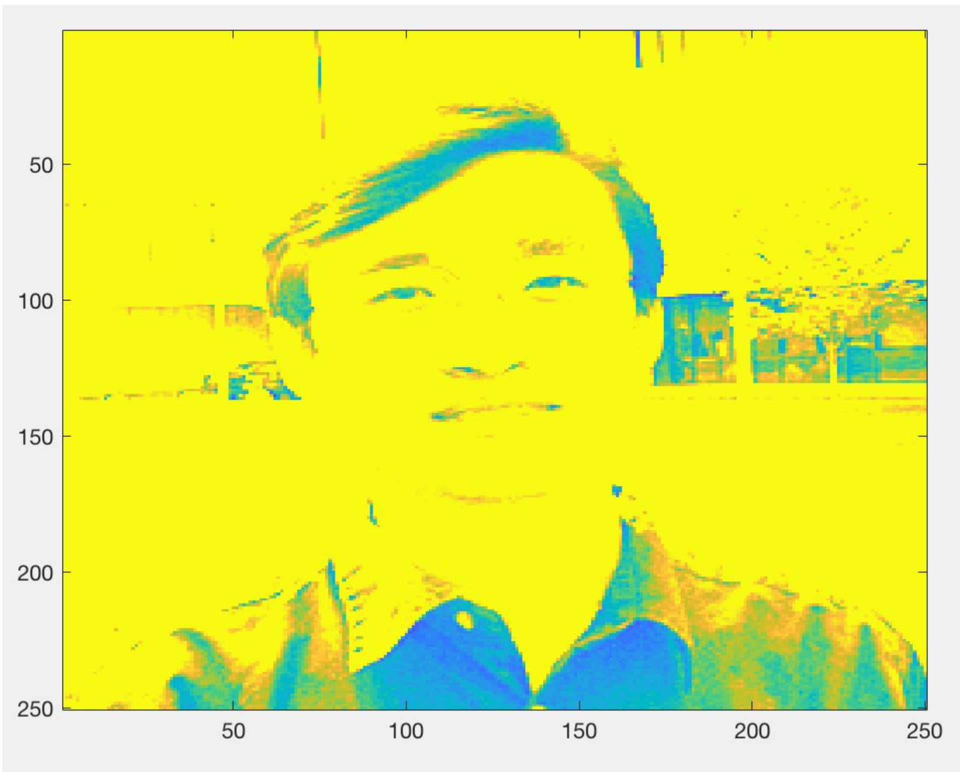


Figure 3

Figure 4 is part C which require us to use the equation I = 0.299R + 0.587G + 0.114B (the NTSC standard for luminance) to display an intensity image I(x,y). We called it as Luminance (perceived option 1). It emphasize the physiological aspects: the human eyeball is most sensitive to green light, less to red and least to blue. It is probably for linear 0-1 RGB, and it have gamma-corrected 0-255 RGB.

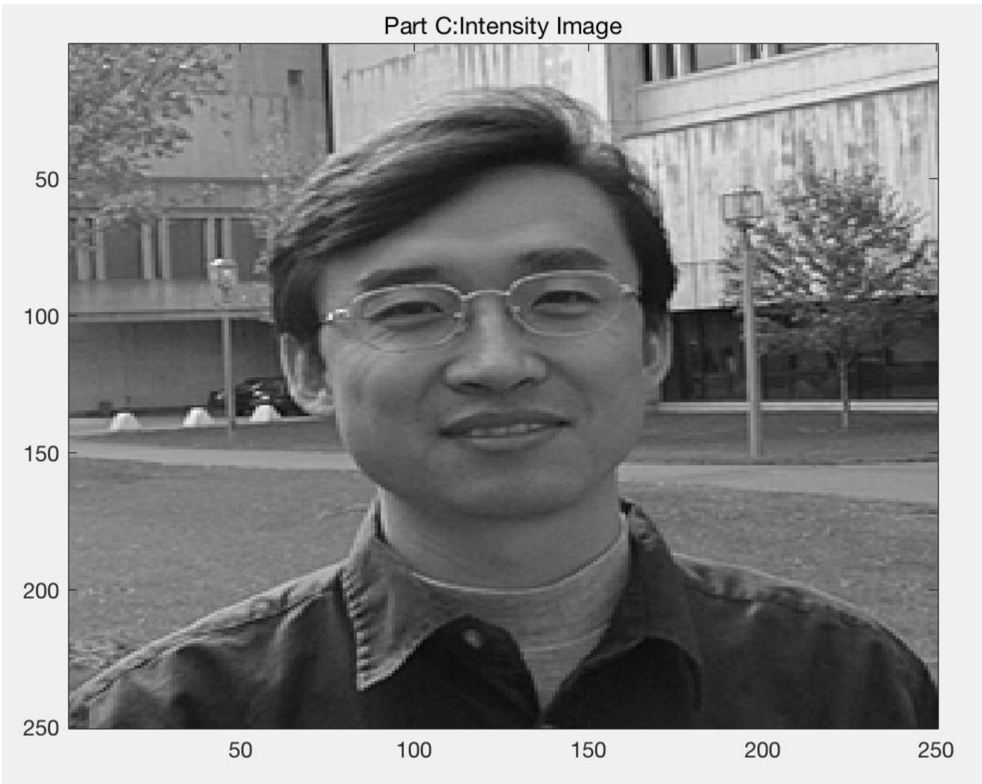


Figure 4

In figure 5, we need to quantize 256 gray levels image into K levels (with K=4, 16, 32, 64). As the pictures show, the pixel will be more lower or the picture will be more darker than others, when K level is lower.

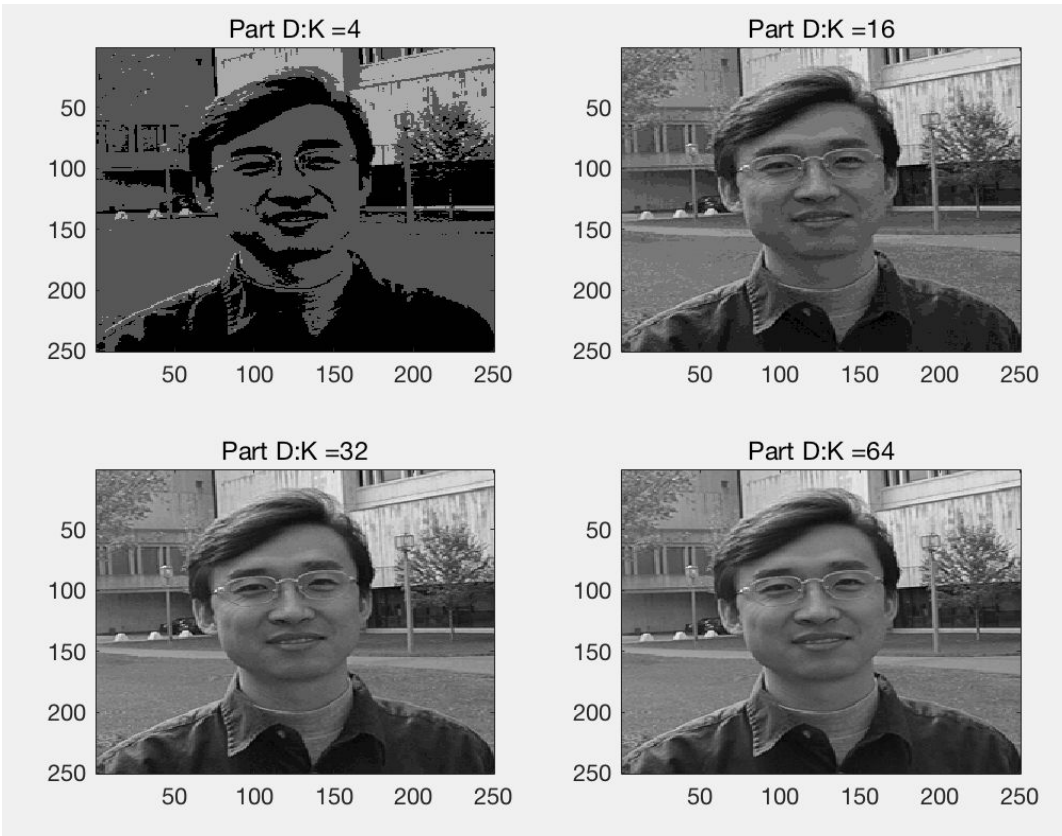


Figure 5

In figure 6, we need quantize the original three-band color image into K level color image. Then I choose K equal to value 2 and 4. When K value is smaller, the color image will be more darker. Because in K=2, pixel values smaller 128 will return to 0. When K=4, pixel values smaller 64 will return to 0.

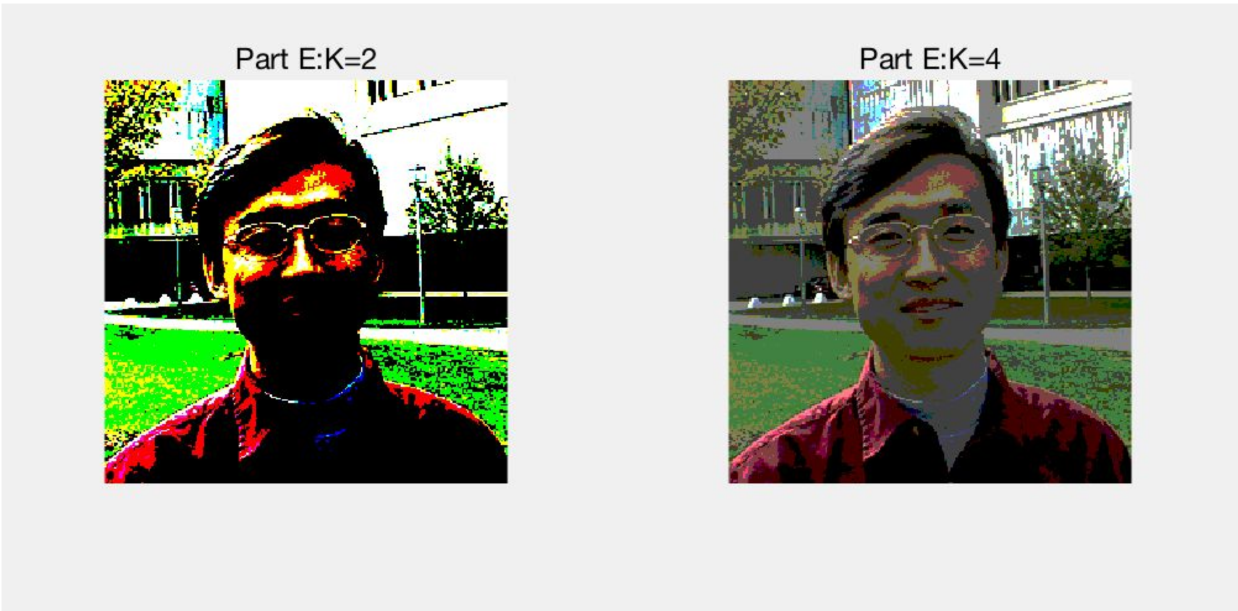


Figure 6

In figure 7, we need to quantize the original three-band color image into a color image. Then I apply a logarithmic function I' =C ln (I+1) to each band. The value of C will be equal to 0.15. These pictures slowly fades when C value become more larger.

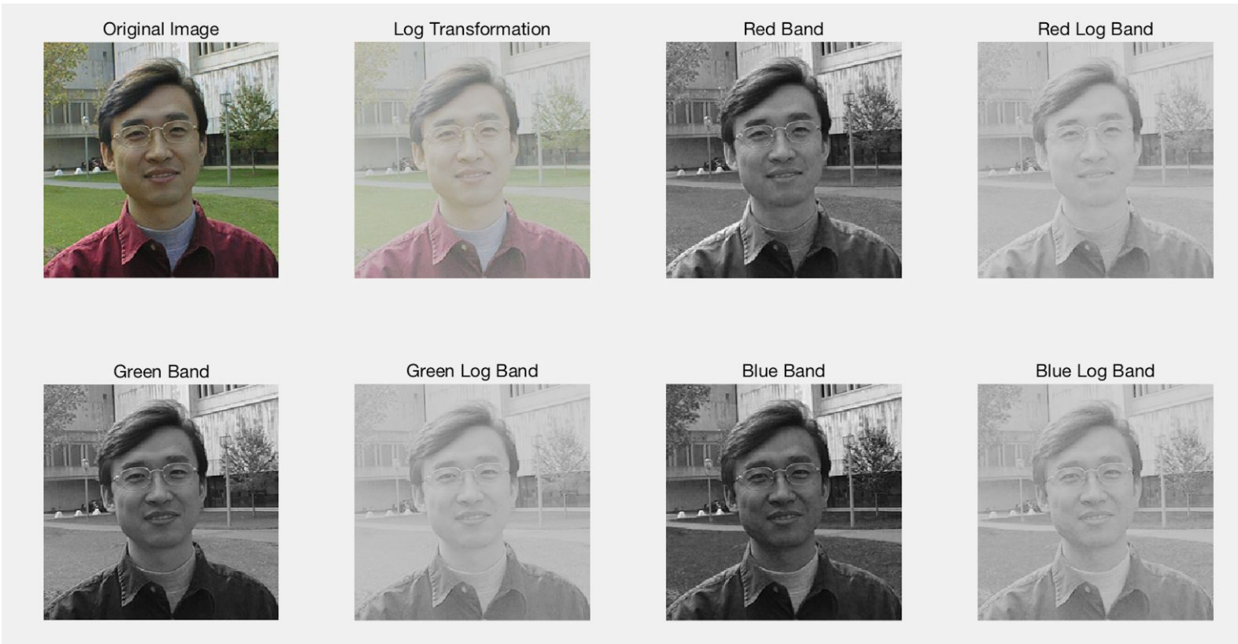


Figure 7