

# DTI 516 Multimedia Processing

## Chapter: 2

### Image Characteristic

Dr. Paween Khoenkaw  
Digital Technology Innovation : Maejo University

Download slide @ <http://www.drpaween.com>



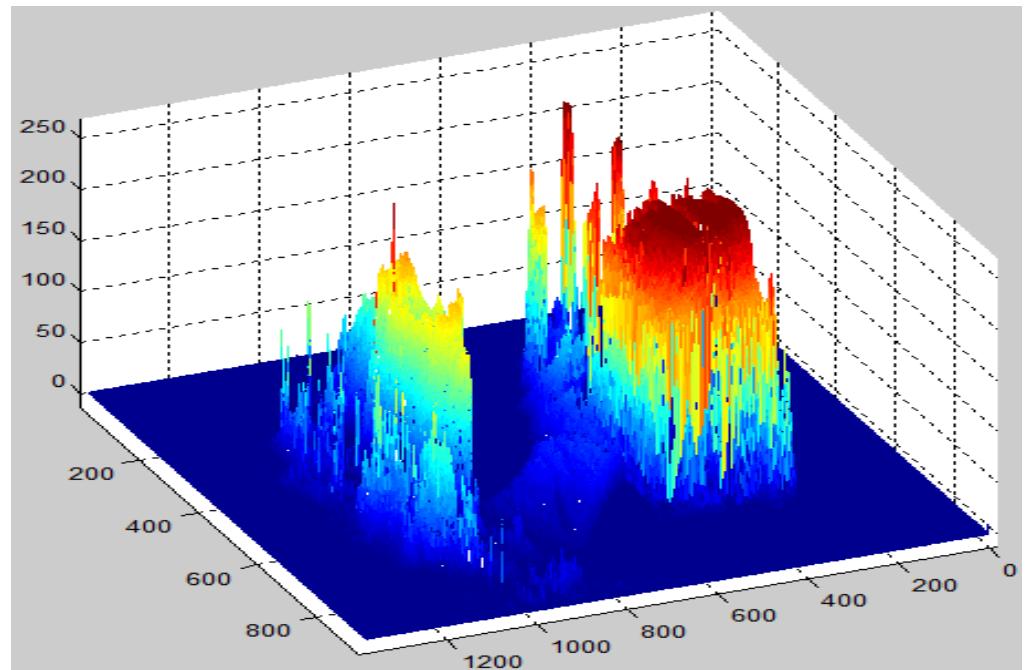
# Good photograph and Bad photograph



# Image Intensity



# Image Intensity



```
mesh(double(im));
```

# Image Brightness



**Brightness** is an attribute of visual perception in which a source appears to be radiating or reflecting light.

# Image Brightness



Color Image



$(R+G+B)/3$

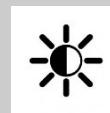


$0.299R+0.587G+0.114B$

# Brightness Adjustment



$I$

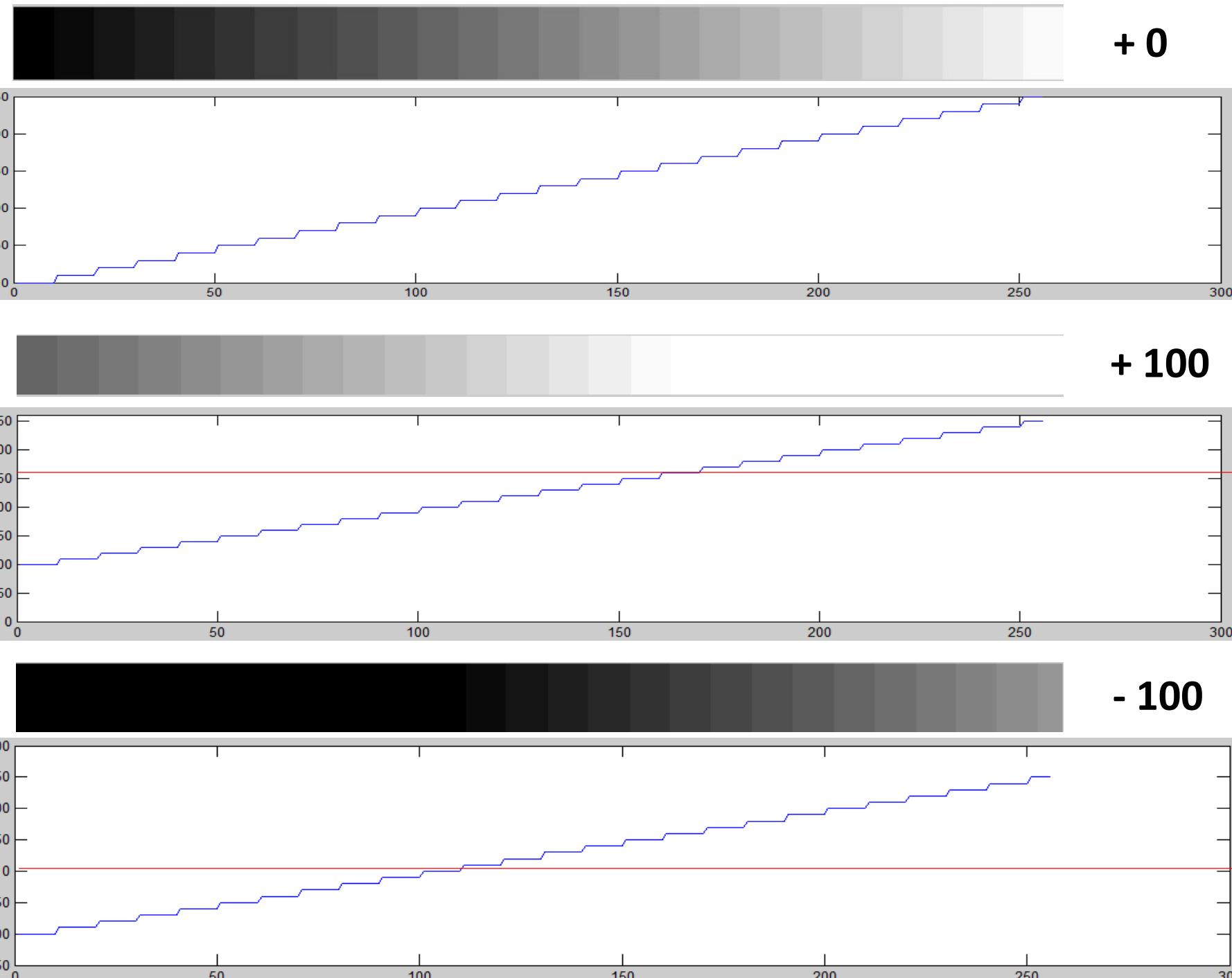


$I'$

$$I' = I - c$$

**im2 = im - 40**

# What is the good brightness ?



# Question !

207	24	40	36	167
230	71	247	107	9
32	139	244	233	216
232	244	123	202	238
161	246	204	244	173

$I$

Image  $I$  is represented in Uint8.  
Please determine the  
final value of image  $I$  after adjust  
brightness to +50 ?

$$I = [ \dots ]$$

$$c = 50$$

$$I' = ?$$

$$Sol. \quad I' = I + c$$

255	74	90	86	217
255	121	255	157	59
82	189	255	255	255
255	255	173	252	255
211	255	254	255	223

# Image Contrast

**Contrast** is the difference in luminance or color that makes an object (or its representation in an image or display) distinguishable



Low contrast

High contrast

# Image Contrast



# Contrast Adjustment

$$f = \frac{259 \times (c + 255)}{255 \times (259 - c)}$$

$$I' = (f \times (I - 128)) + 128$$

Where  $c$  = contrast level

$f$  = contrast correction factor

$I$ = source image

$I'$ = contrast corrected image



-128



0



+128

13

# Question !

207	24	40	36	167
230	71	247	107	9
32	139	244	233	216
232	244	123	202	238
161	246	204	244	173

*I*

*Sol.*

Image *I* is represented in Uint8.  
 Please determine the  
 final value of image *I* after adjust  
 contrast to +50 ?

$$I = [ \dots ]$$

$$c = 50$$

$$I' = ?$$

$$f = \frac{259 \times (c + 255)}{255 \times (259 - c)}$$

$$f = \frac{259 \times (50 + 255)}{255 \times (259 - 50)} = 1.4822$$

$$I' = (f \times (I - 128)) + 128$$

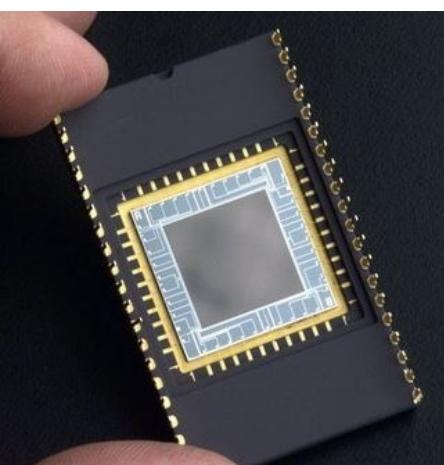
245	0	0	0	185
255	43	255	96	0
0	144	255	255	255
255	255	120	237	255
176	255	240	255	194

# Sensor efficiency

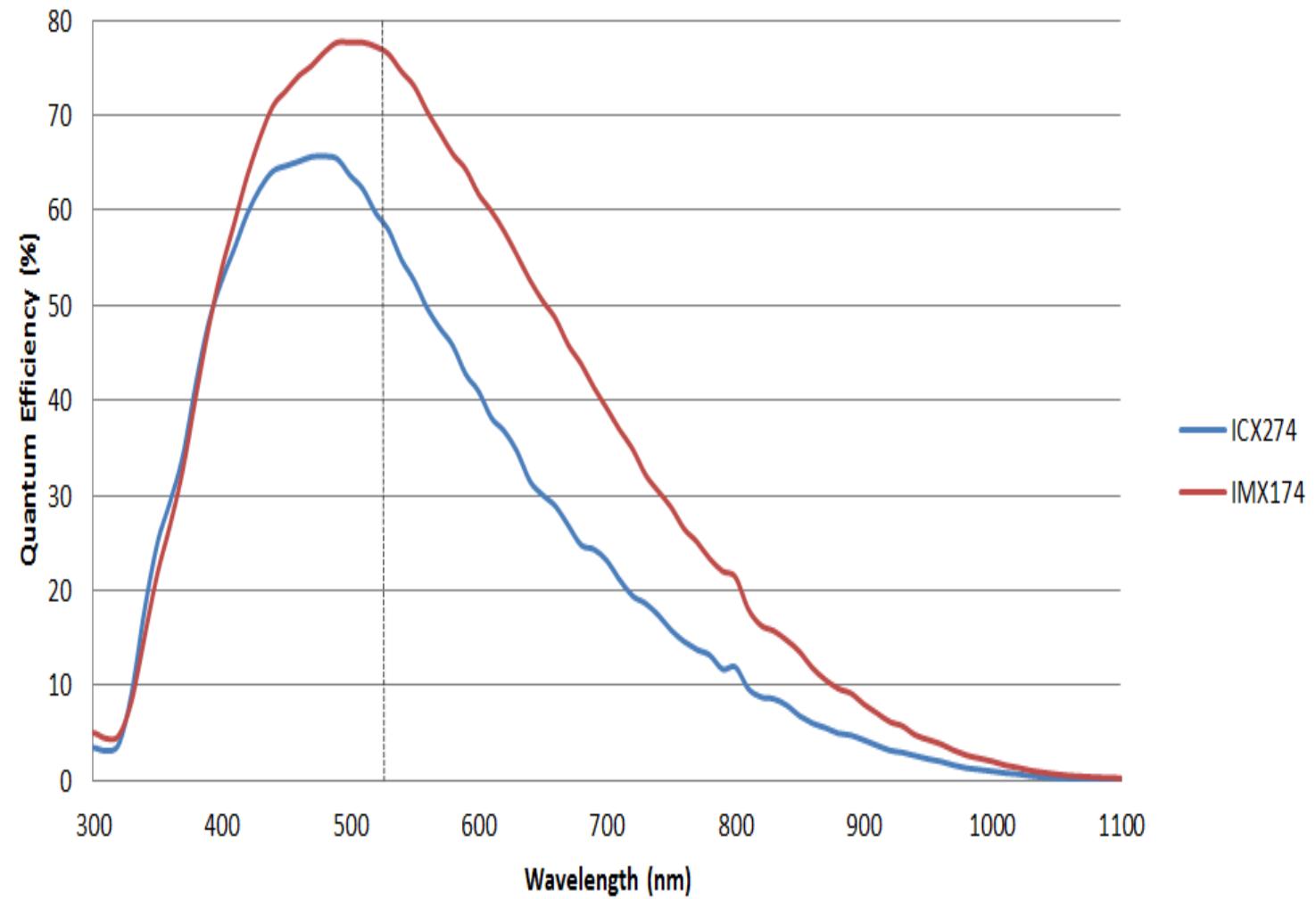
SONY



IMX 174

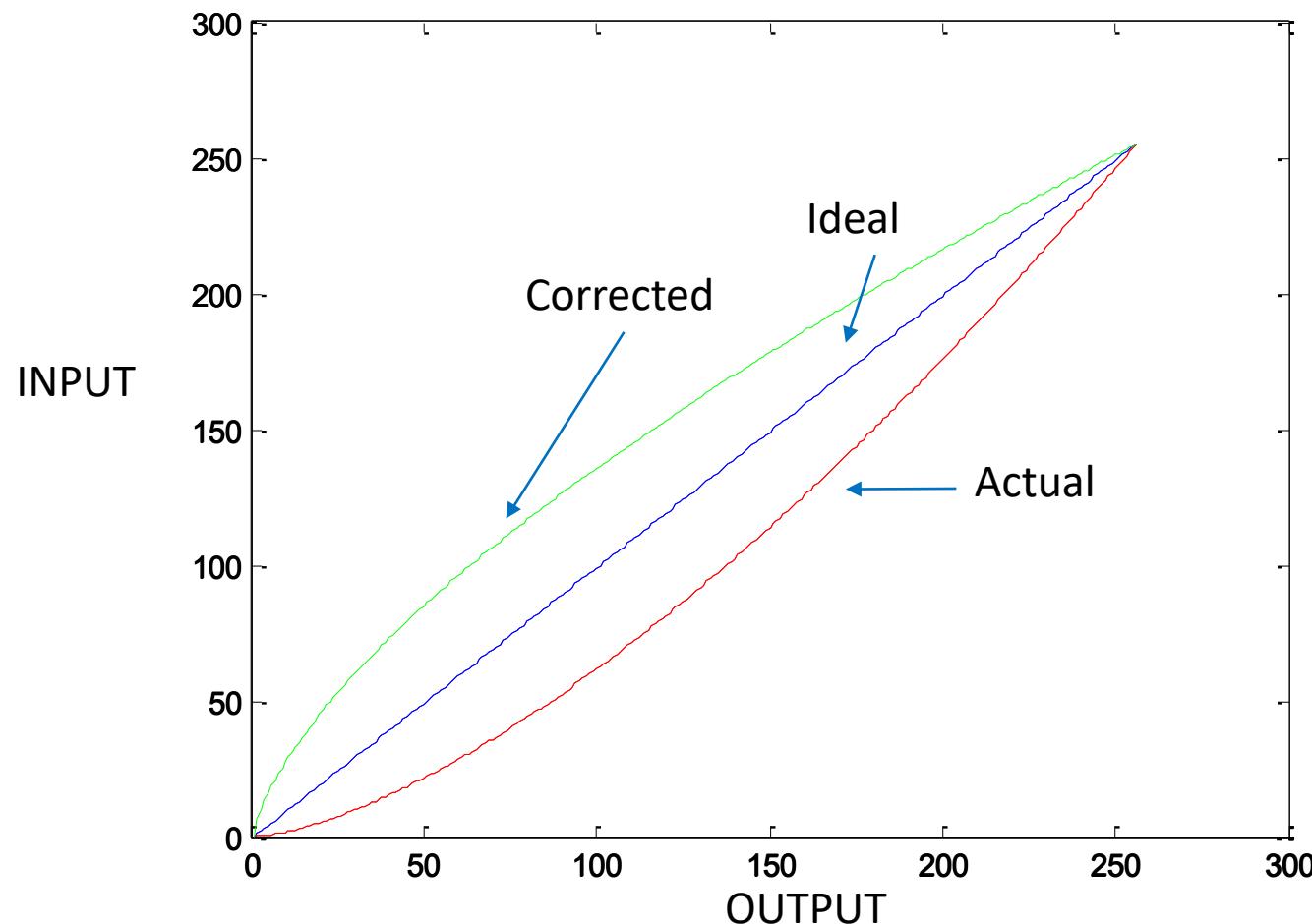


ICX 274



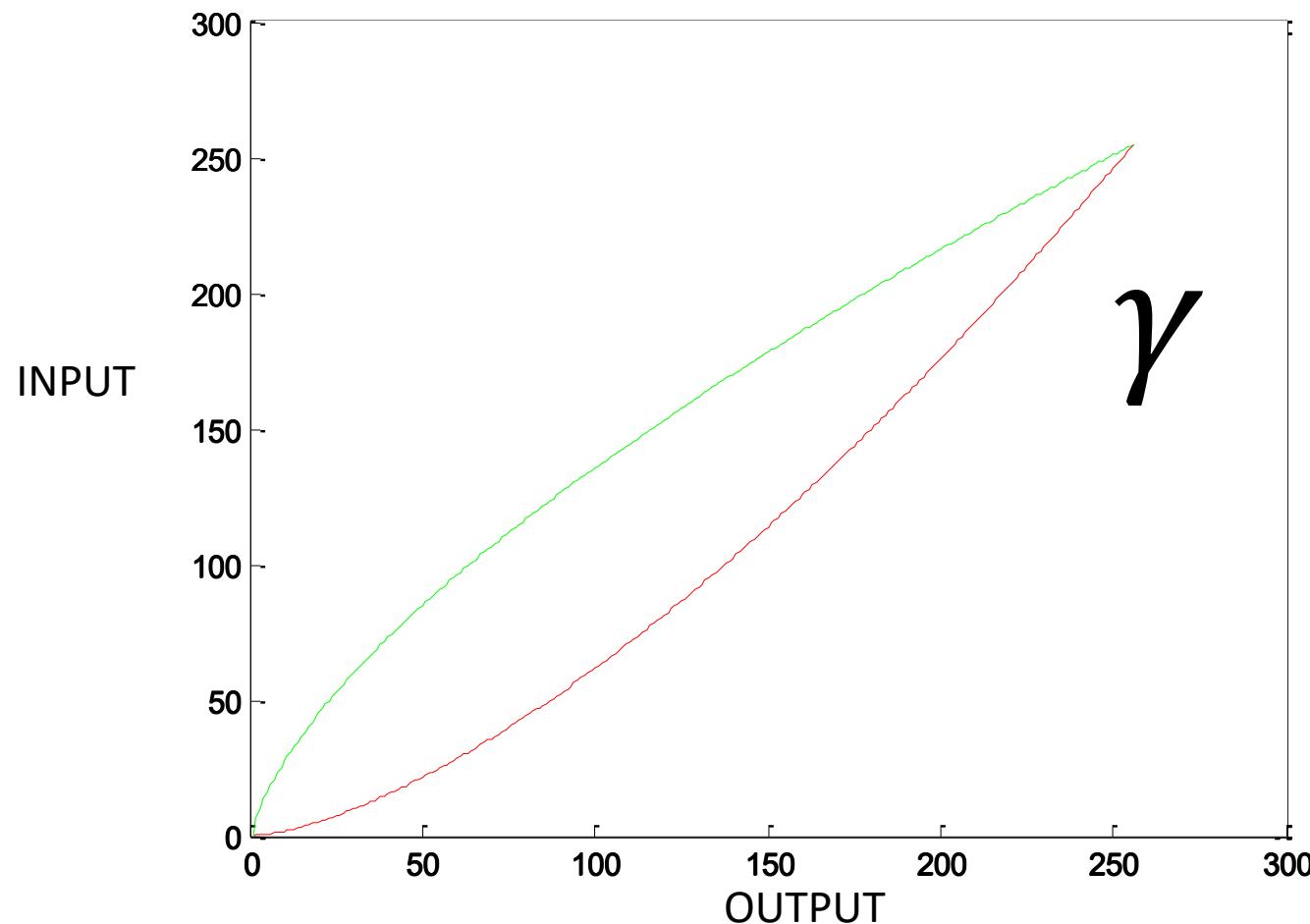
# Gamma Correction

**Gamma correction, gamma nonlinearity, gamma encoding, or often simply gamma**, is the name of a nonlinear operation used to code and decode luminance or tristimulus values in video or still image systems



# Gamma Correction

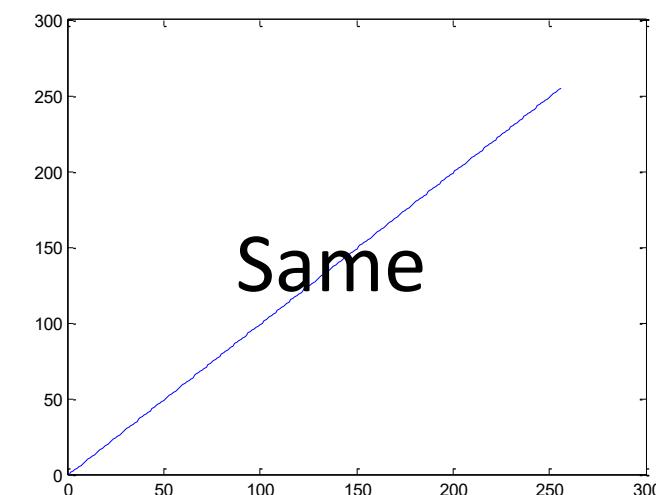
**Gamma correction, gamma nonlinearity, gamma encoding**, or often simply **gamma**, is the name of a nonlinear operation used to code and decode luminance or tristimulus values in video or still image systems



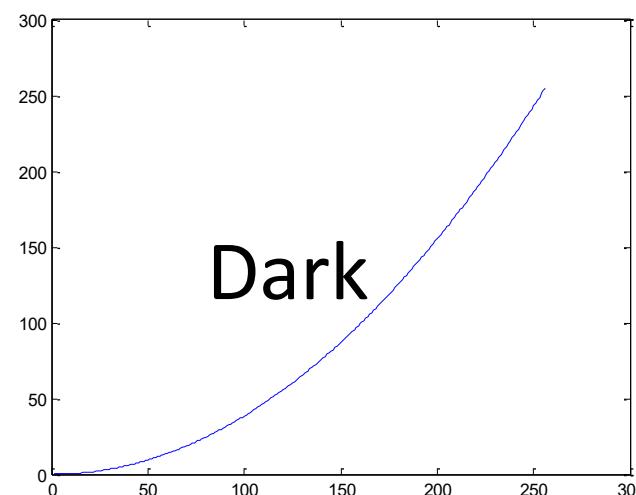
# Gamma Correction

$$I' = 255 \times \left( \frac{I}{255} \right)^\gamma$$

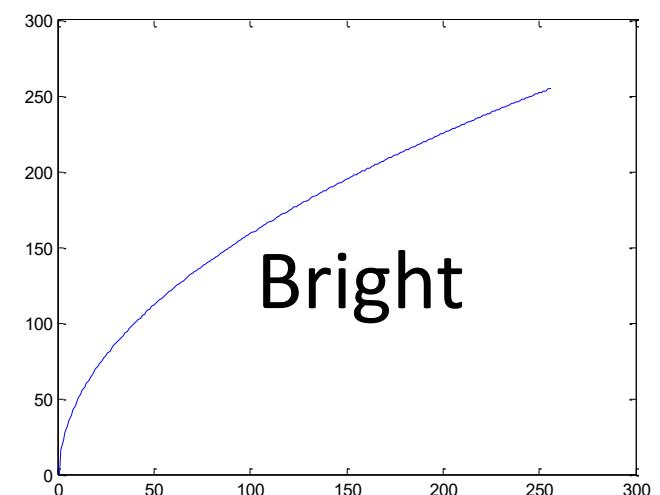
Where  $\gamma = \text{Gamma Value}$



$$\gamma = 1$$

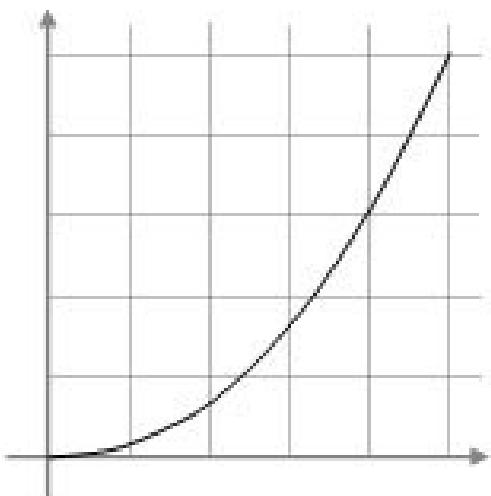


$$\gamma = 2$$

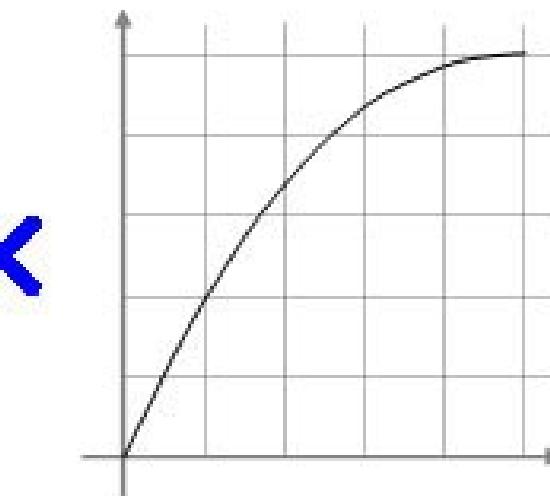


$$\gamma = \frac{1}{2}$$

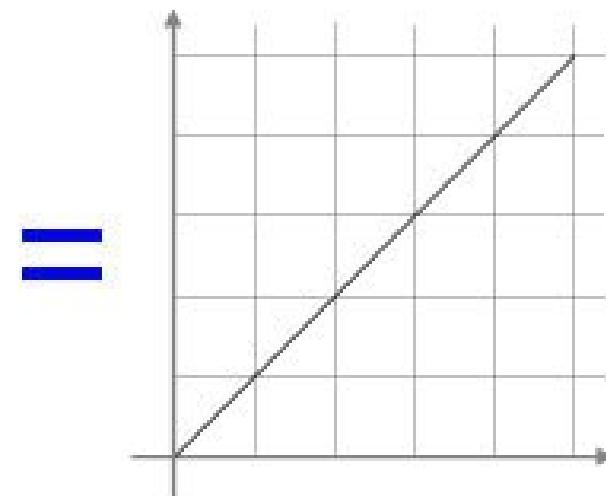
# Gamma Correction



*Gamma characteristics  
of monitors*



*Color information adjusted  
to match gamma characteristics*



*Color handling approaching  
the " $y = x$ " ideals*

# Gamma Correction



Brightness



+20



+50



+100

Contrast



+20



+50



+100

Gamma



1/1.5



1/2



1/3

# Question !

207	24	40	36	167
230	71	247	107	9
32	139	244	233	216
232	244	123	202	238
161	246	204	244	173

$I$

*Sol.*

$$I = [ \dots ]$$

$$\gamma = 2$$

$$I' = ?$$

Image  $I$  is represented in Uint8.  
Please determine the  
final value of image  $I$  after adjust  
gamma to 2?

$$I' = 255 \times \left( \frac{I}{255} \right)^\gamma$$

168	2	6	5	109
207	19	239	44	0
4	75	233	212	182
211	233	59	160	222
101	237	163	233	117

## Average of Intensity Value

**Arithmetic mean of all pixel**

$$k = \sum_{X} \sum_{Y} I(x, y) / (|X| \times |Y|)$$

Where

$I(x, y)$  = Pixel at coordinate  $x, y$

$|X|$  is the width of image

$|Y|$  is the height of image

$k$  is an averaged image

# What is the good brightness and contrast ?

Too dark

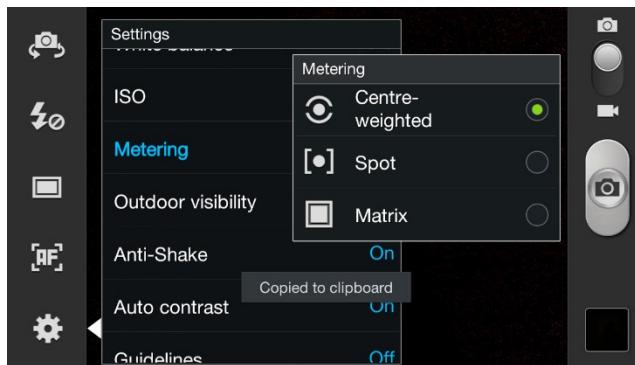


0

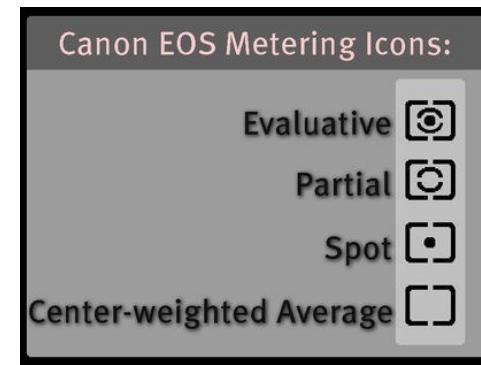
127

255

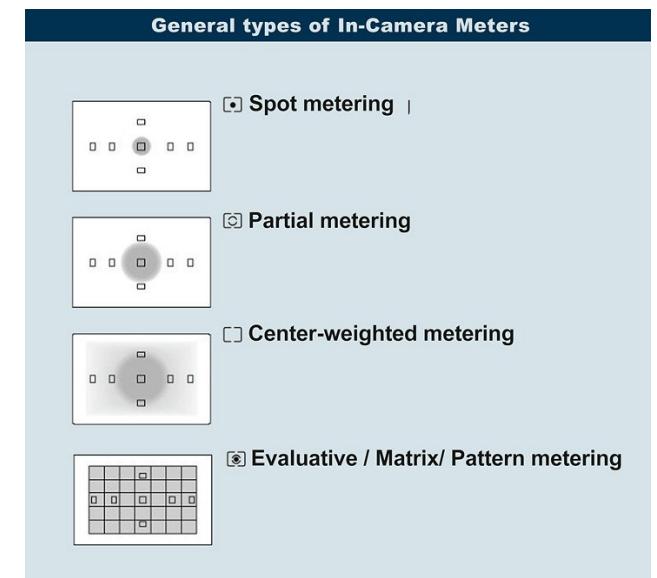
Too bright



Galaxy S3



Canon EOS



# Average of Intensity Value



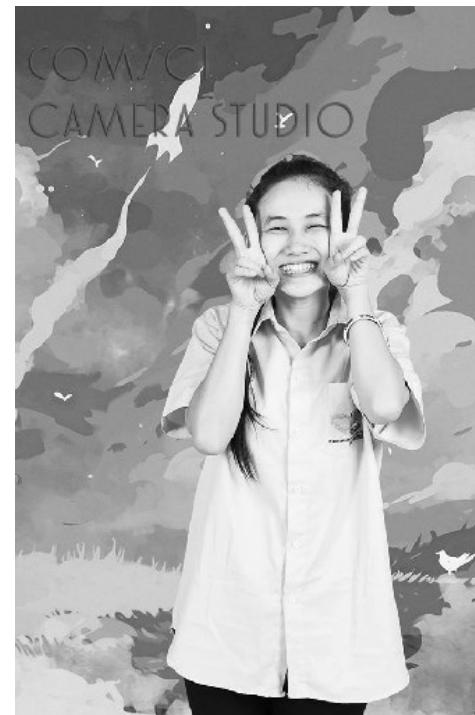
124



15

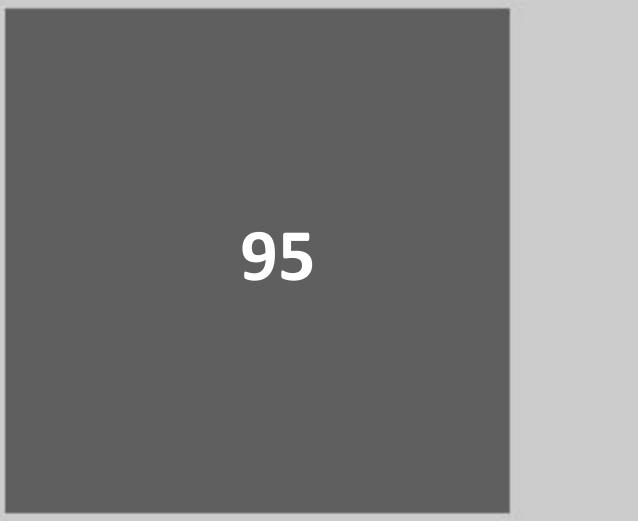


139



166

# Image correction (brightness)



☀ +33



$\gamma$  1/1.6



# Question !

203	112	120	118	183
215	135	223	154	105
116	169	222	216	208
216	222	162	201	219
180	223	202	222	186

$I$

Image  $I$  is represented in Uint8.  
This image is too bright, so please  
adjust the brightness using average  
method.

*Sol.*

$$k = 181$$

$$c = 181 - 127 = 54$$

$$I' = I - 54$$

$$I = [ \dots ]$$

$$c = ?$$

$$k = ?$$

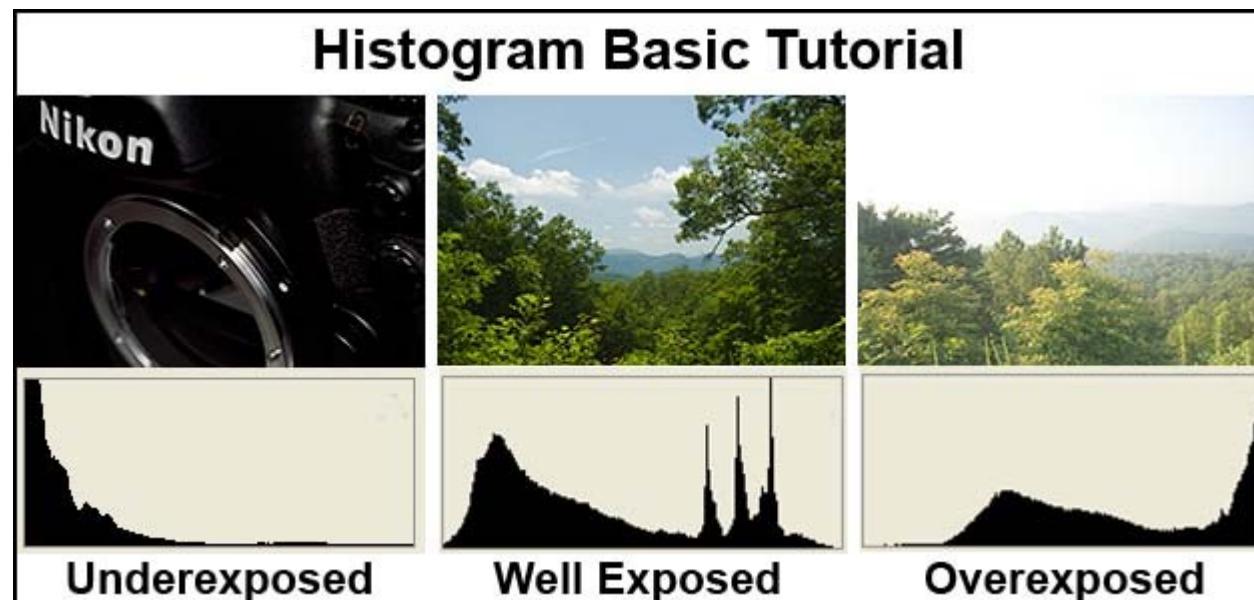
149	58	66	64	129
161	81	169	100	51
62	115	168	162	154
162	168	108	147	165
126	169	148	168	132

# Gray card



# Image Histogram

An **image histogram** is a type of [histogram](#) that acts as a [graphical representation](#) of the [tonal](#) distribution in a [digital image](#).<sup>[1]</sup> It plots the number of [pixels](#) for each tonal value.



# Matlab image processing function

Floor the number:

**im2=floor(im);**

Round the number:

**im2=round(im);**

Change type to double precision:

**im2=double(im);**

Show double precision matrix as image:

**imshow(im,[0 255]);**

Arithmetic mean:

**c= mean(mean(im));**

# Light metering method

<http://digital-photography-school.com/metering-modes-and-how-your-camera-meter-works/>

