大话成像之

数字成像系统 32讲

ISP信号处理基础

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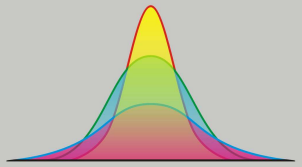
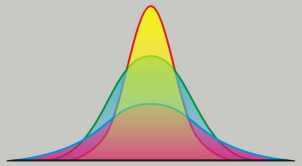
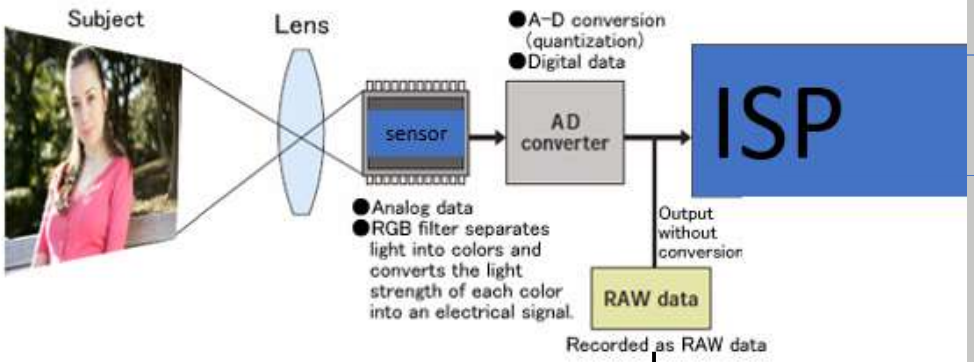


数字图像处理的基本概念与操作

1. 图像的数字化与定点数，浮点数
2. 直方图（histogram）/积分直方图 （cumulative histogram） /图像的直方图均衡
3. 查找表（lookup table）
4. 图像滤波（高通，低通滤波）



图像的数字化+数字信号处理（ISP）



色彩重建

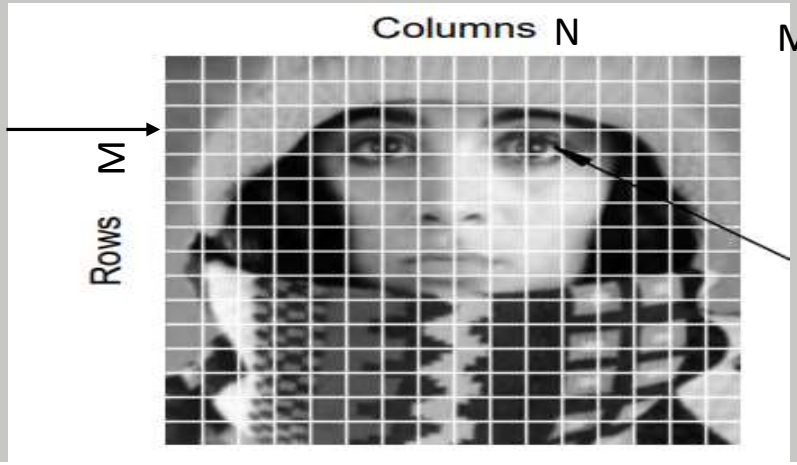
图像重建

https://en.wikipedia.org/wiki/Floating-point_arithmetic

https://en.wikipedia.org/wiki/Fixed-point_arithmetic

M行 N 列 2D离散数字信号

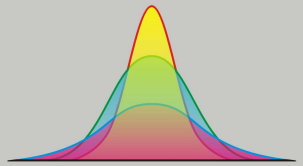
原始2D连续信号
a(x,y)



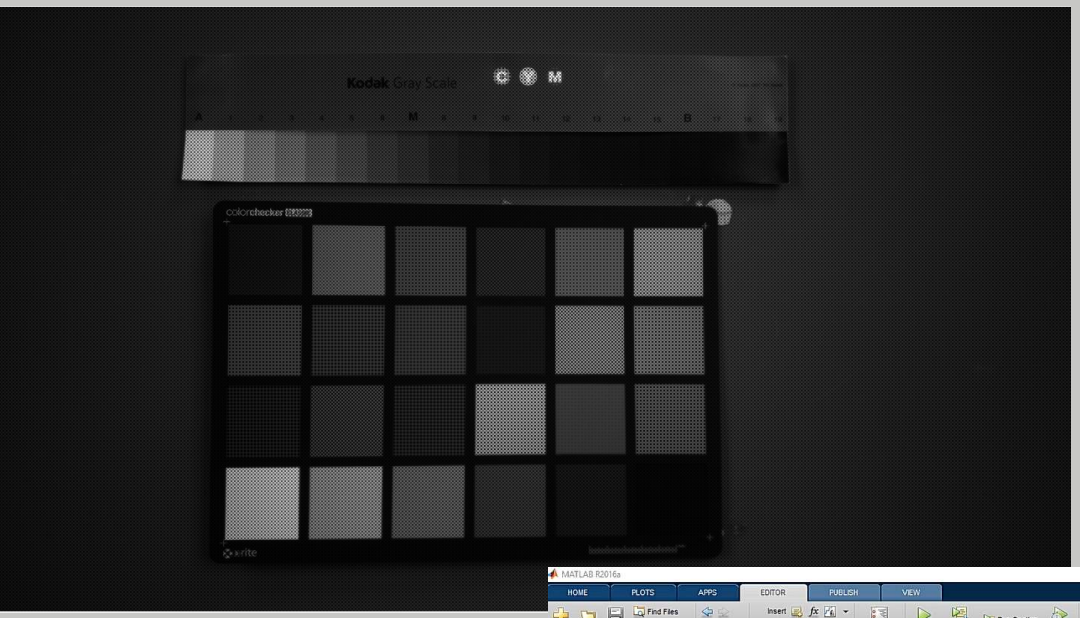
P(i,j)= L;

L= 0 ~ 1 ； float
L=0~255; 8 bit fix point
L=0~1023; 10 bit fix point
L=0~4095; 12 bit fix point

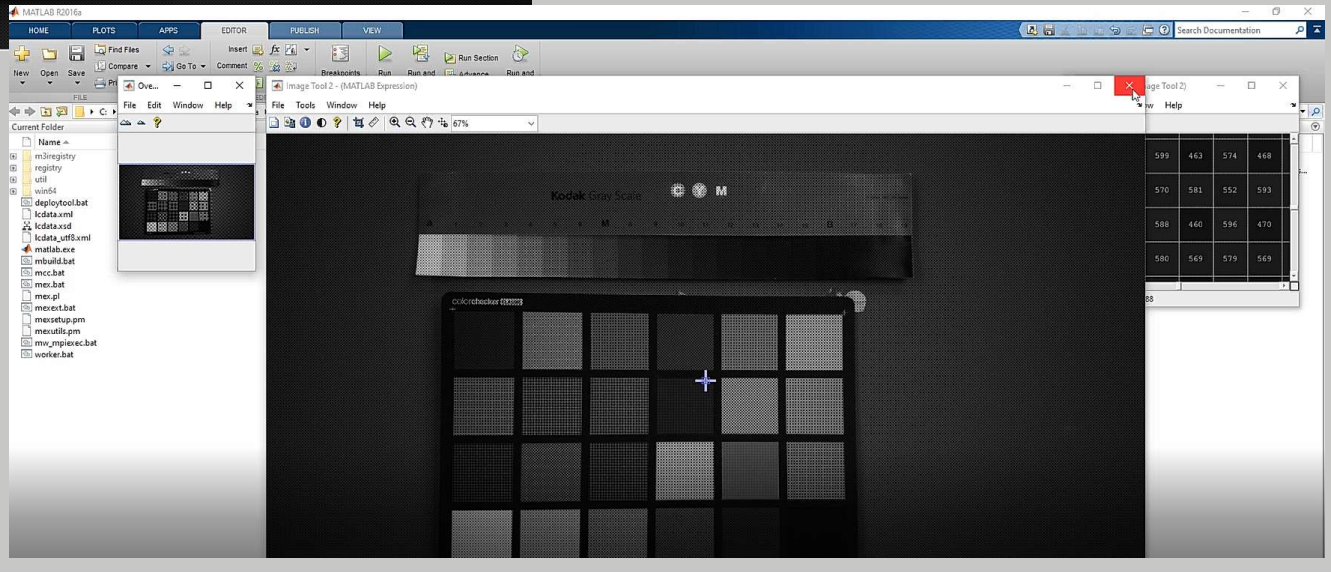
P(i,j)= F(L,D,T,C,...);

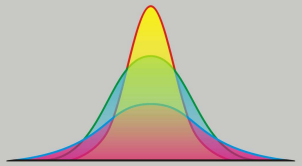


数字图像处理的基本操作:图像读取

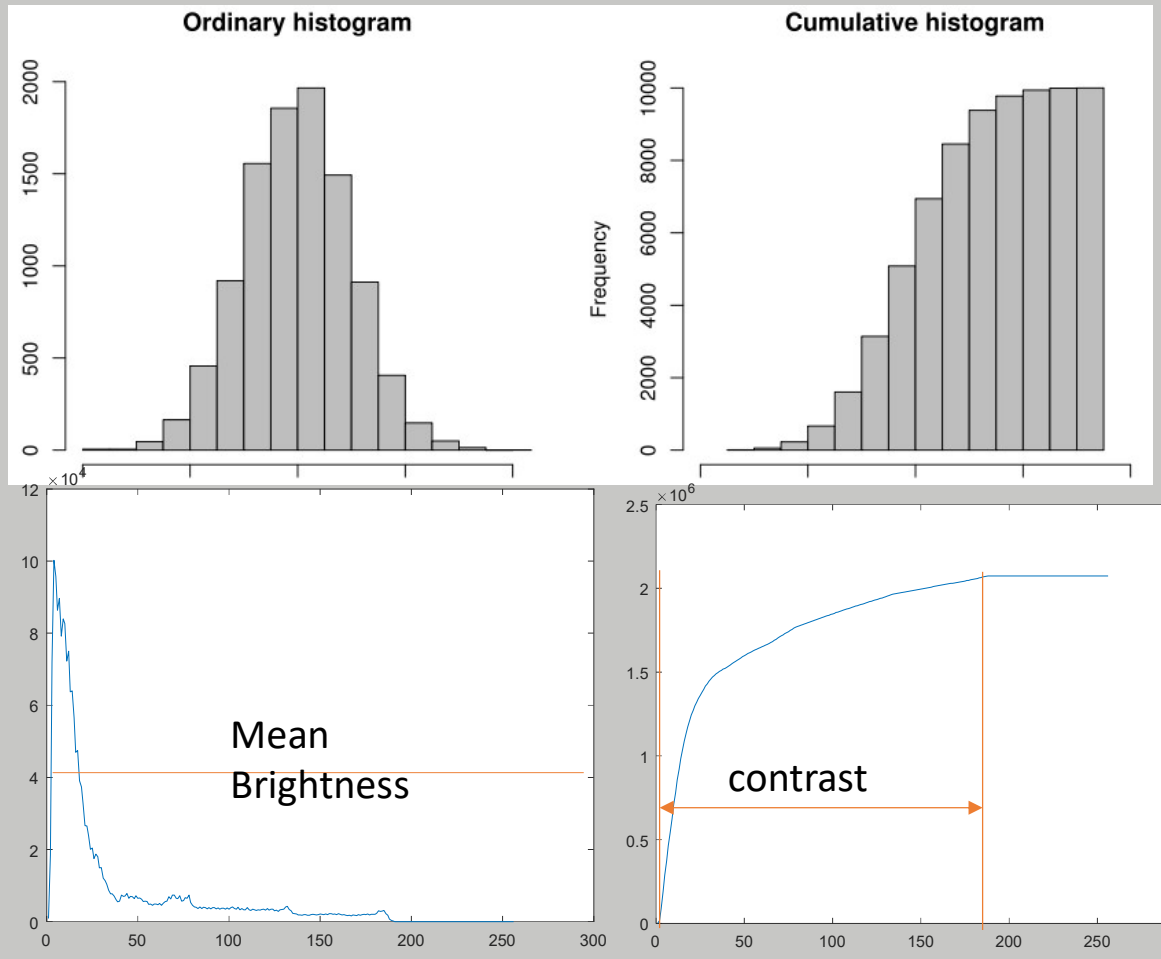


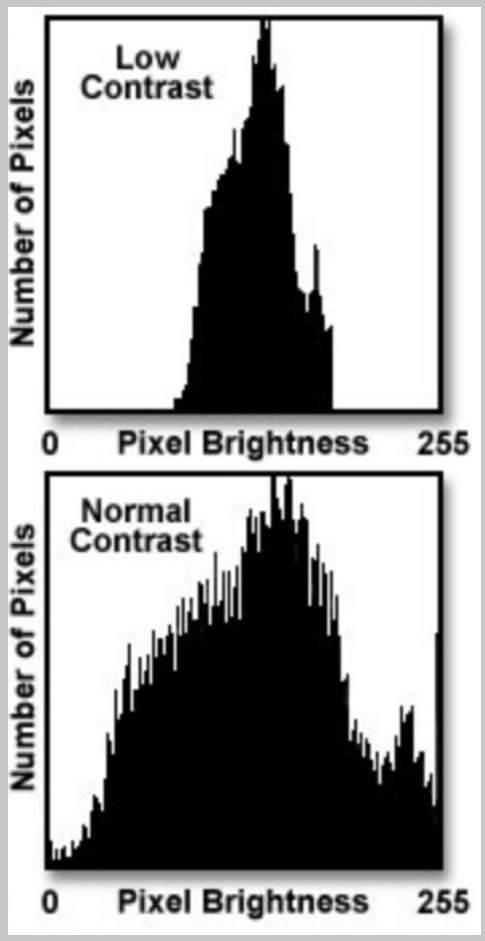

```
filename = 'C:\raw_plain16_test.raw’;
f=fopen(filename);
frame = fread(f,[1920 1080],’uint16=>uint16’);
imtool(frame,[]);
```



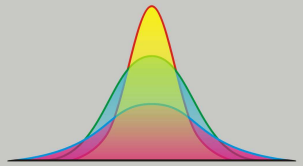


直方图 histogram 与 积分直方图 Cumulative histogram

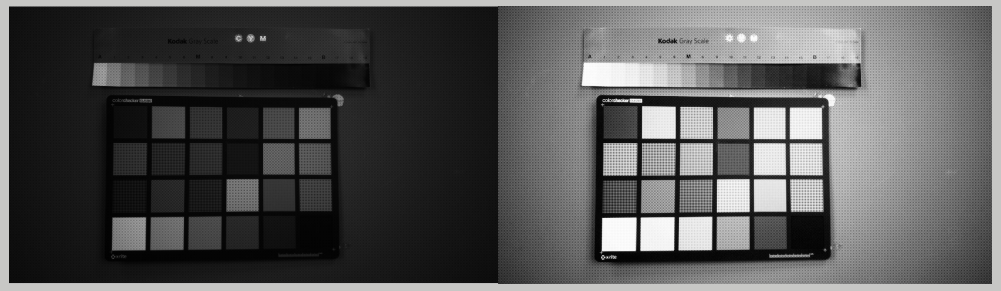


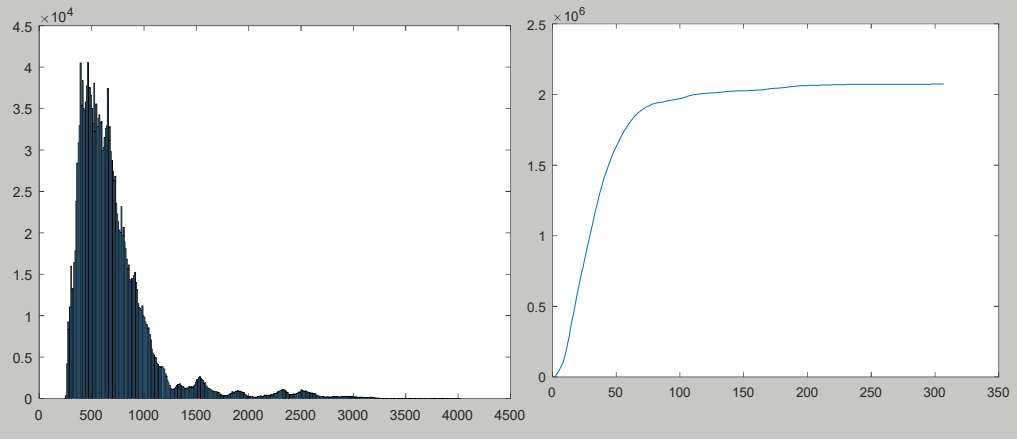


https://en.wikipedia.org/wiki/Image_histogram



数字图像处理的基本操作:直方图





显示直方图

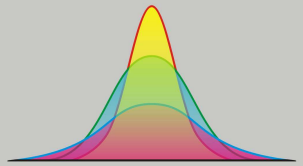
```
filename = 'C:\raw_plain16_test.raw’;
f=fopen(filename);
frame = fread(f,[1920 1080],'ubit16=>uint16’);
imtool(frame’,[]);
figure(11),histogram(frame);
```

显示积分直方图

```
image = double(image);
image = image./4096;
h = histogram(frame);
cum = cumsum(h.Values);
figure(22),plot(cum);
```

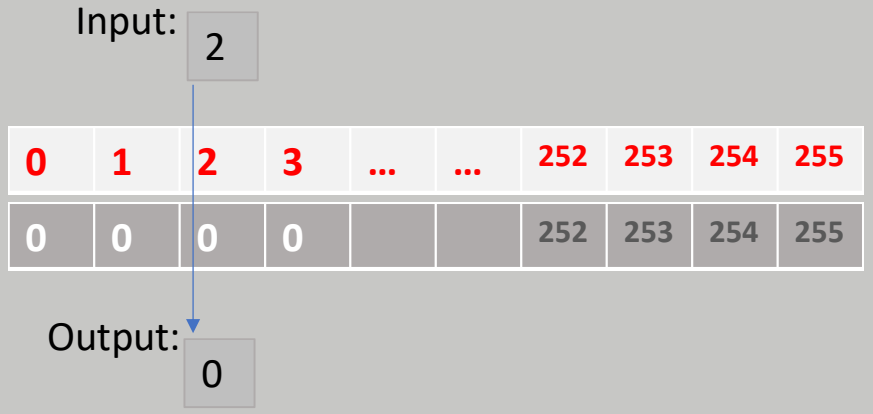
直方图均衡

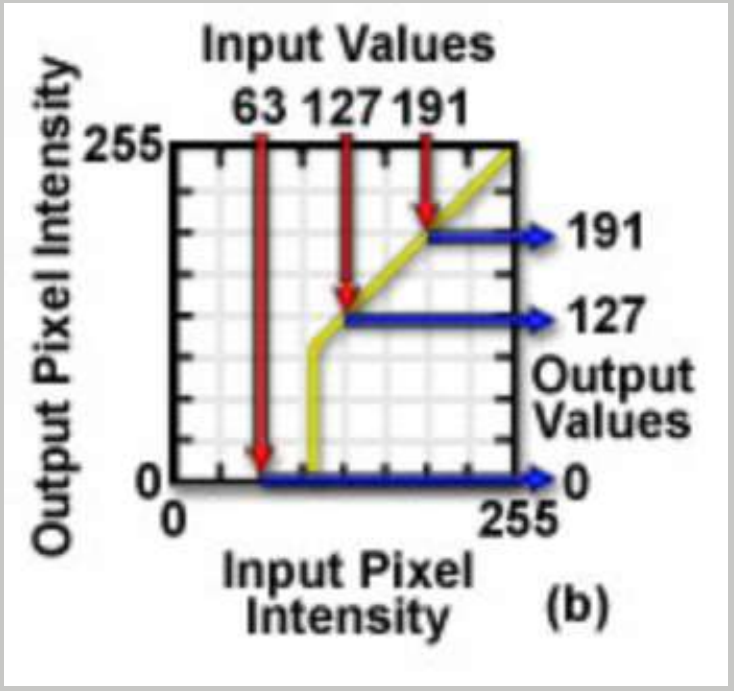
```
jj = histeq(image);
imtool(jj’,[]);
```

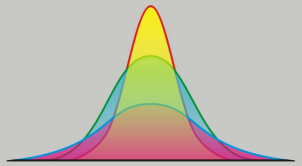


查找表 lookup table

应用1： thresholding

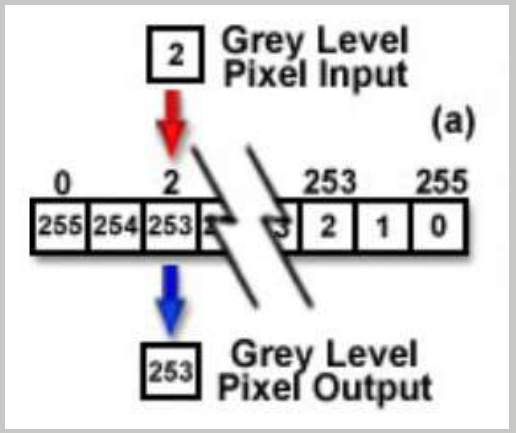


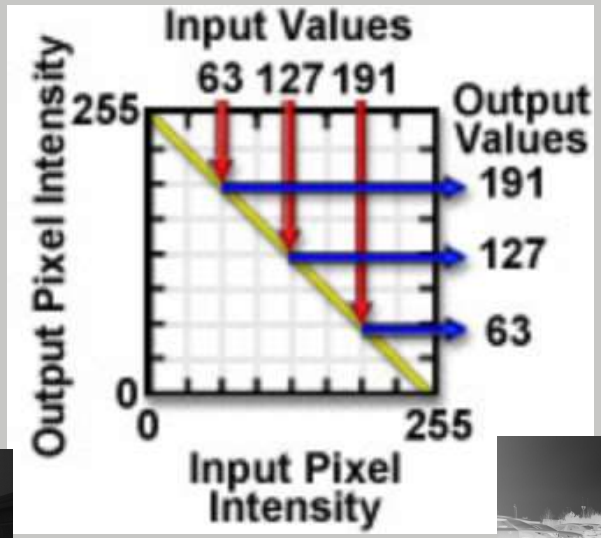




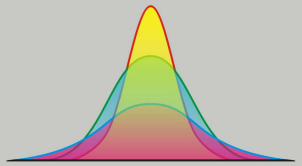
查找表 lookup table

查找表练习：取反

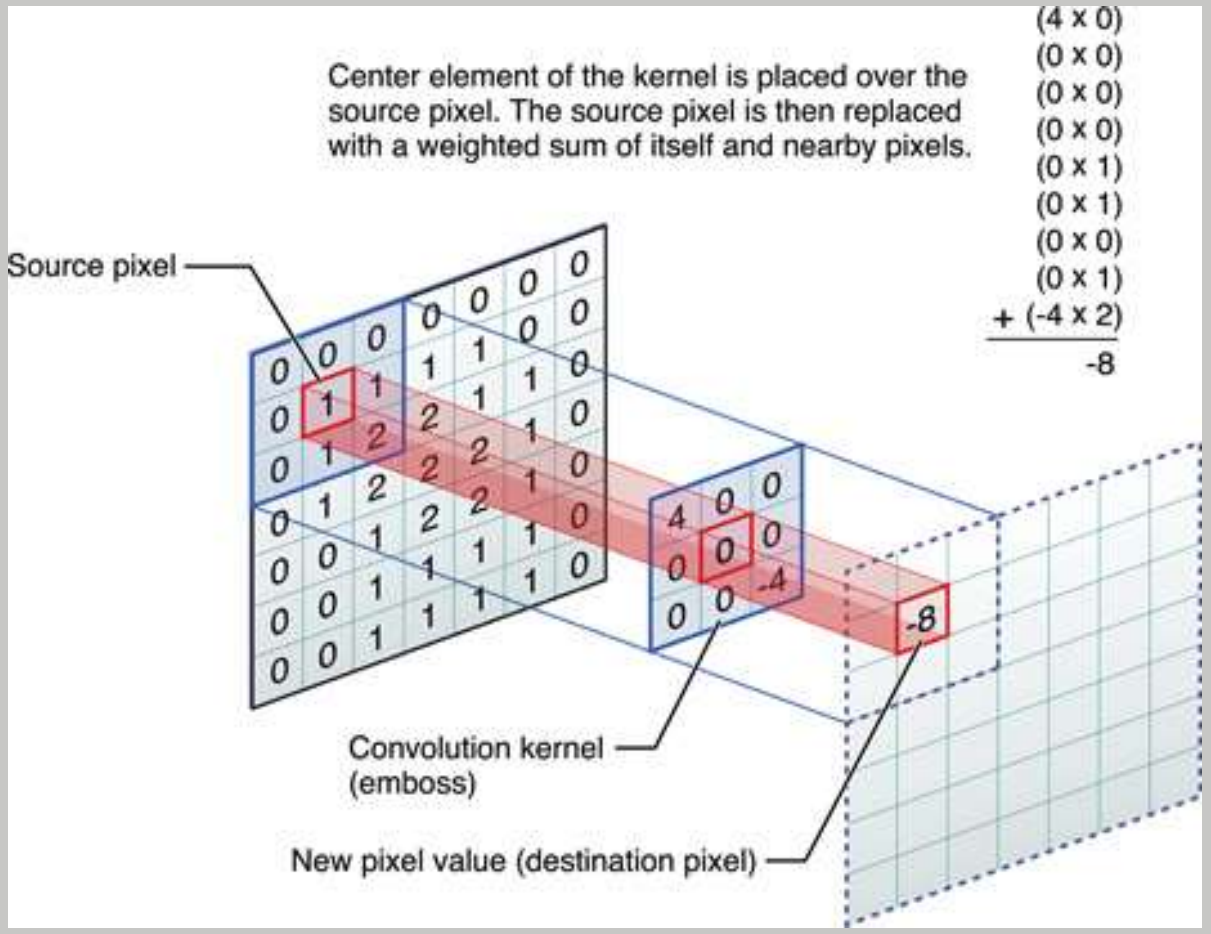




```
clear all
clc

I=rgb2gray(imread('sample.jpg'));
I=imresize(I,0.1);

i=255:-1:0;
lut=i;


out=zeros(size( I));

for i=1:size(I,1)
   for j=1:size(I,2)

      out(i,j)=lut(I(i,j)+1);
   end
end

imtool(uint8(I));
imtool(uint8(out));
```

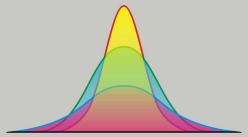


Filter convolution：滤波 卷积



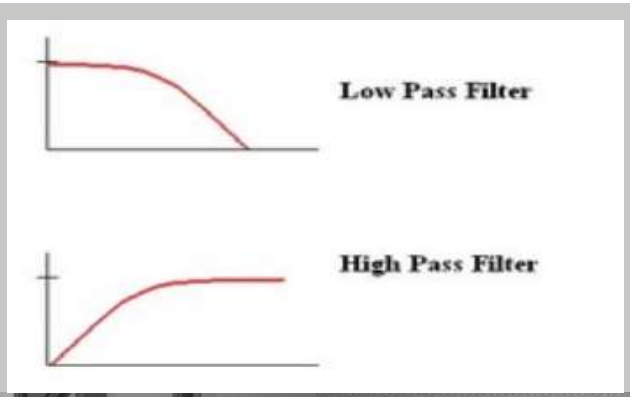
Operation	Kernel	Image result
Identity	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	
Edge detection	$\begin{bmatrix} 1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & 1 \end{bmatrix}$	
	$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$	
	$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$	
Sharpen	$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{bmatrix}$	
Box blur (normalized)	$\frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$	

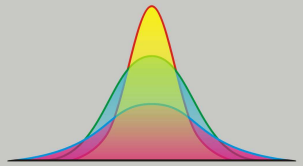
https://en.wikipedia.org/wiki/Kernel_(image_processing)



Filter 练习：低通，高通滤波器

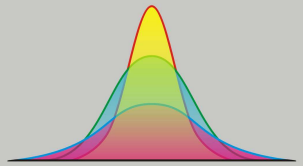
```
 h = ones(3,3)./9;
%h=[-1 -1 -1;-1 9 -1;-1 -1 -1];
ff = imfilter(image,h);
imtool(ff);
```





THANKS

本课程由 Maver Jiang提供



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