Color Image Representation

The image processing toolbox handles color images either as indexed images or RGB images.

RGB Images:

An RGB color image is an M x N x 3 array of color pixels, where each color triplet corresponding to the red, green and blue components of an RGB image at a specific spatial location.

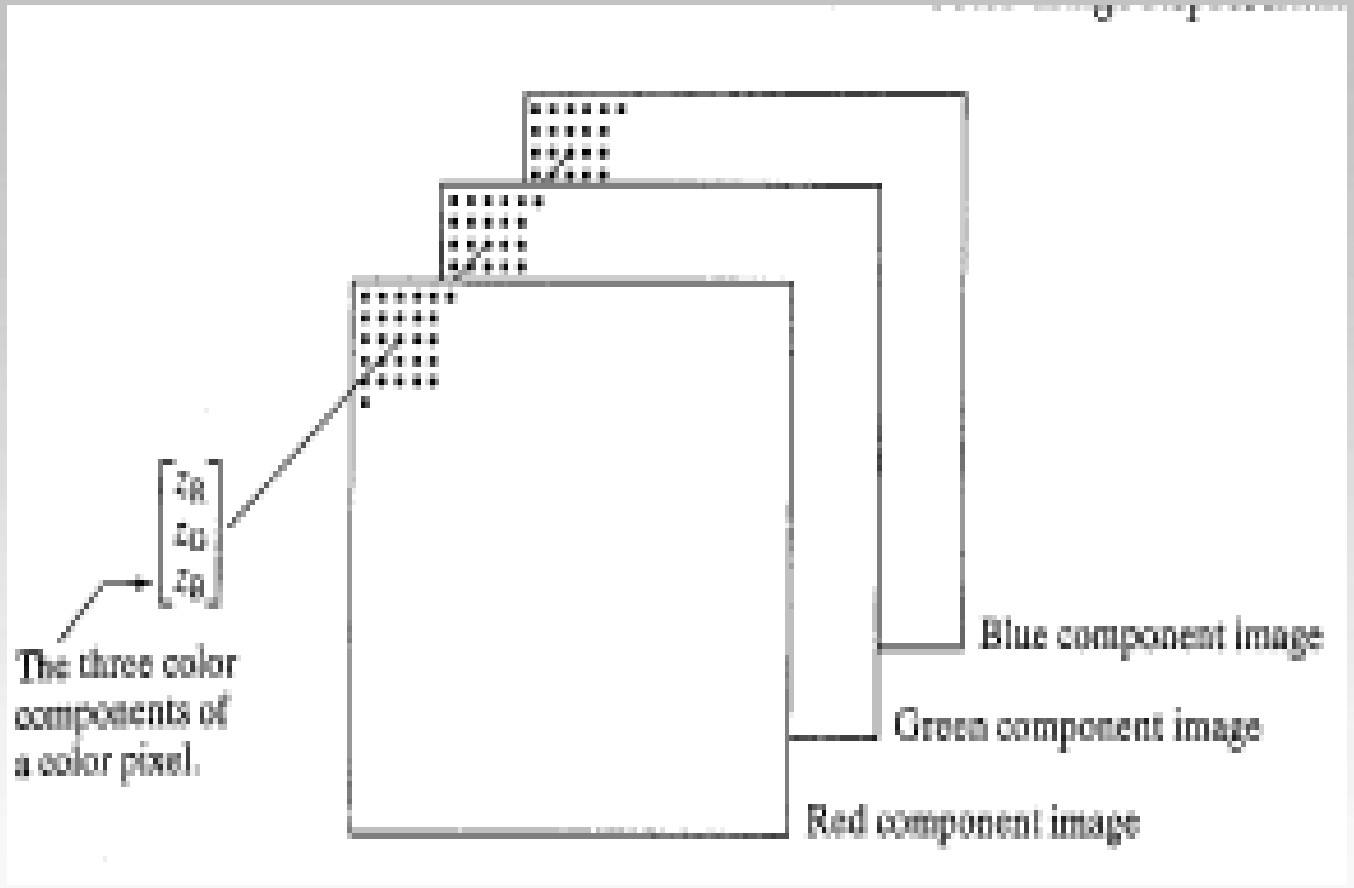
RGB Image

An RGB image may be viewed as a stack of three gray scale images that, when fed into the red, green and blue input of color monitor, produce a color image on the screen.

By convention, the three images forming an RGB color image are referred to as the red, green and blue component image.

An RGB image is of class double, in the range of values is [0,1]. Similarly the range of values is [0, 255] or [0, 65535] for uint8 or uint16.

RGB Image



RGB Image

Let fR,fG and fB represent three RGB image components, the RGB image formed from these image by using the cat operator to stack the image.

```
rgb_image=cat(3,fR,fG,fB);
```

The image components can be identify using

```
fR=rgb_image(:,:,1);
fG=rgb_image(:,:,2);
fB=rgb_image(:,:,3);
```

RGB Image

Plotting RGB color cubes:

>>rgbcube(vx,vy,vz);

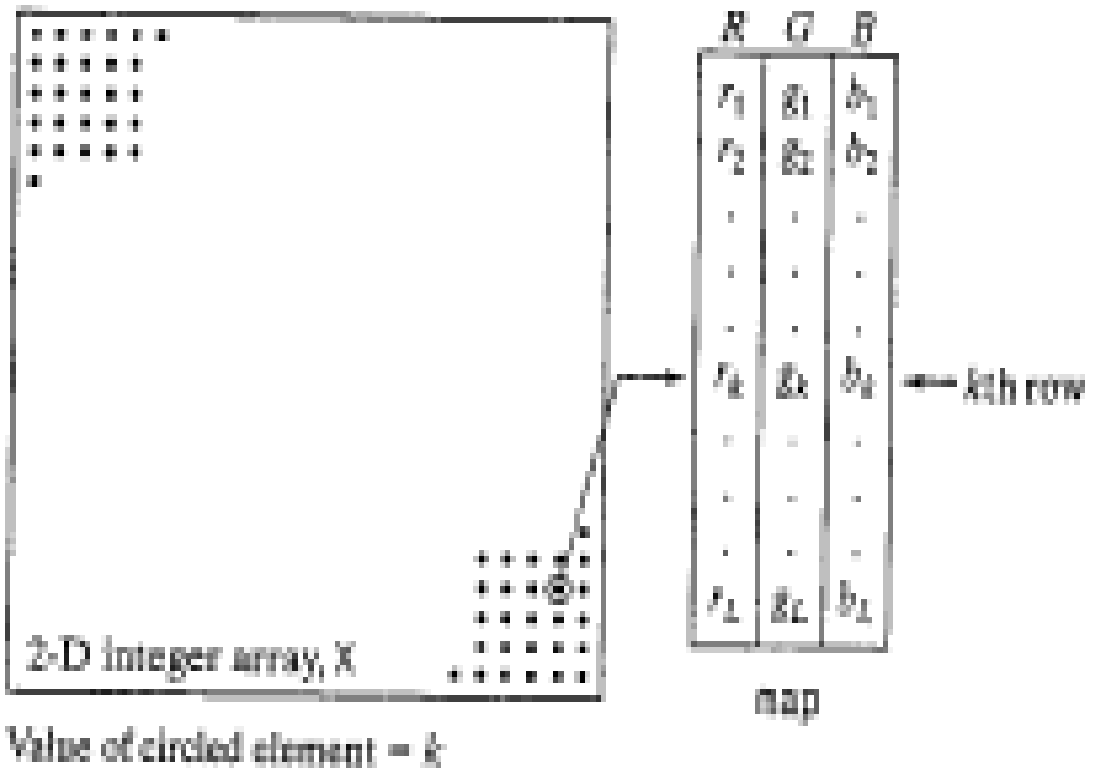
COLOR PLANE	**(vx, vy, vz)**
Blue-Magenta-White-Cyan	(0, 0, 10)
Red-Yellow-White-Magenta	(10, 0, 0)
Green-Cyan-White-Yellow	(0, 10, 0)
Black-Red-Magenta-Blue	(0, -10, 0)
Black-Blue-Cyan-Green	(-10, 0, 0)
Black-Red-Yellow-Green	(0, 0, -10)

Indexed Image

An indexed image has two components: a data matrix of integers, X and a color map matrix map. A Matrix map ia an m x 3 array of class double containing floating point values in the range [0, 1]. The map matrix each row specifies the red, green and blue color component of a single color.Processing an rgb image to indexed image:

```
>>[X, map]=rgb2ind(rgb,128);
>>imshow(X,map);    or
>> image(X)
>>colormap(map)
```

Indexed Image



Indexed Image

The background color of the image show box can be changed by using the function whitebg and has the following syntax:

whitebg('g) or whitebg('green') or whitebg([0 1 0])

Long name	Short name	RGB values
Black	k	[0 0 0]
Blue	b	[0 0 1]
Green	g	[0 1 0]
Cyan	c	[0 1 1]
Red	r	[1 0 0]
Magenta	m	[1 0 1]
Yellow	y	[1 1 0]
White	w	[1 1 1]

IPT Functions

Function	Purpose
dither	Creates an indexed image from an RGB image by dithering.
grayslice	Creates an indexed image from a gray-scale intensity image by multilevel thresholding.
gray2ind	Creates an indexed image from a gray-scale intensity image.
ind2gray	Creates a gray-scale intensity image from an indexed image.
rgb2ind	Creates an indexed image from an RGB image.
ind2rgb	Creates an RGB image from an indexed image.
rgb2gray	Creates a gray-scale image from an RGB image.

IPT Functions

```
I=imread('cameraman.tif');
Bw=dither(I);
Imshow(Bw)
I=imread('snowflakes.png');
x=grayslice(I,16);
Imview(I)
Imview(x,jet(16))
```

Converting to other color spaces

NTSC color space:

The NTSC (National Television System Committee) color space is used in television in the united states. The main advantage of this format is that gray-scale information is separate form color data, so the same signal can be used for both color and monochrome television set. The NTSC format image consists of three components, luminance (Y), hue (I) and saturation (Q) where the choice of the letters YIQ is conventional.

Converting to other color spaces

NTSC color space:

The YIQ components can be obtained from RGB as follows:

$$\begin{bmatrix} Y \\ I \\ Q \end{bmatrix} = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ 0.596 & -0.274 & -0.322 \\ 0.211 & -0.523 & 0.312 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

The function rgb2ntsc performs the transformation

yiq_image=rgb2ntsc(rgb_image)

Converting to other color spaces

NTSC color space:

```
>> f=imread('rgb.jpg');
>> I=rgb2ntsc(f);
>> imshow(I)
>> figure, imshow(f)
>> y=I(:,:,1);
>> figure, imshow(y)
>> i=I(:,:,2);
>> q=I(:,:,3);
>> figure, imshow(i)
>> figure, imshow(q)
>> R=ntsc2rgb(I);
>> figure, imshow(R)
```

Converting to other color spaces

HSV Color space:

HSV (hue, saturation, value) used by people to select color form a color wheel or palette.

This is a way in which humans experience and describe color sensations.

Image colors can be transformed by

H=rgb2hsv(rgb_image)

R=hsv2rgb(hsv_image)

Converting to other color spaces

CMY and CMYK color space:

Cyan, Magenta and Yellow are the secondary colors of light or primary color pigments.

$$\begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

The function imcomplement used to convert RGB to CMY and vise versa.

```
cmy=imcomplement(rgb_image)
rgb=imcomplement(cmy_image)
```