ივანე ჯავახიშვილის სახელობის
თბილისის სახელმწიფო უნივერსიტეტი

ლექცია 6

Visualization

N dimensions – observer

M dimensions – information

No Information Lost: N = M+1

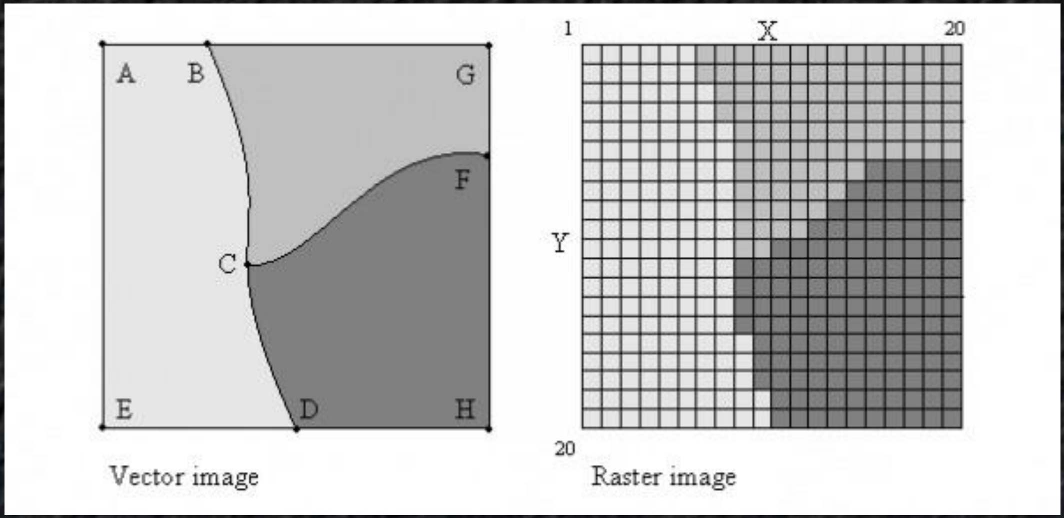
2D visualization

3D – intrinsic information loss;

choose important visual information (3D->2D)

Digital Images: Grayscale

Raster image:



X(M,N)

8 bit: 2^8=256 levels

0-255, normalized(1/255): 0-1

```
X = imread('your_image','jpg');
```

Astronomical images: 8bit, 16bit, 32bit;

Grayscale

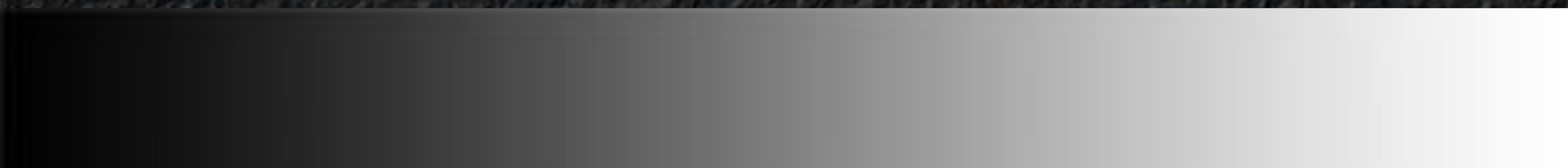
8 bit grayscale

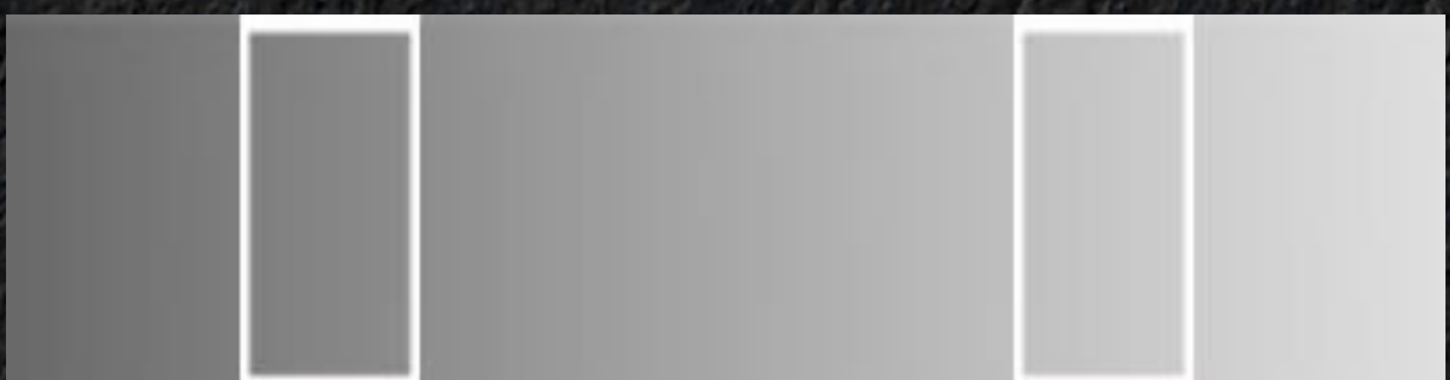
BW (1 bit)

Gray Perception

Human perception limits 1:

Levels in gray: 20?

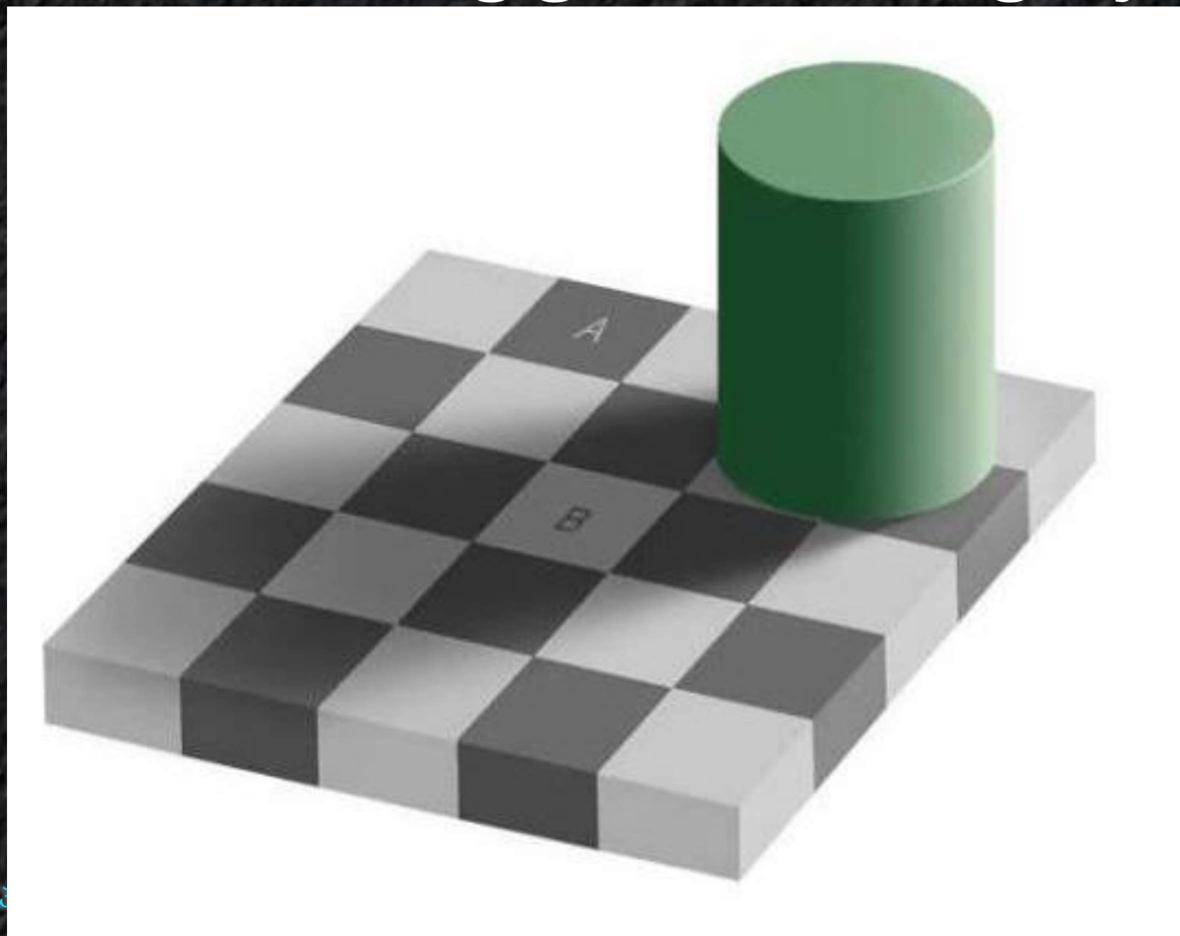




Gray Perception

Human perception limits 2:

smooth vs strong gradients in grayscale



Gray Perception

Human perception limits 2:

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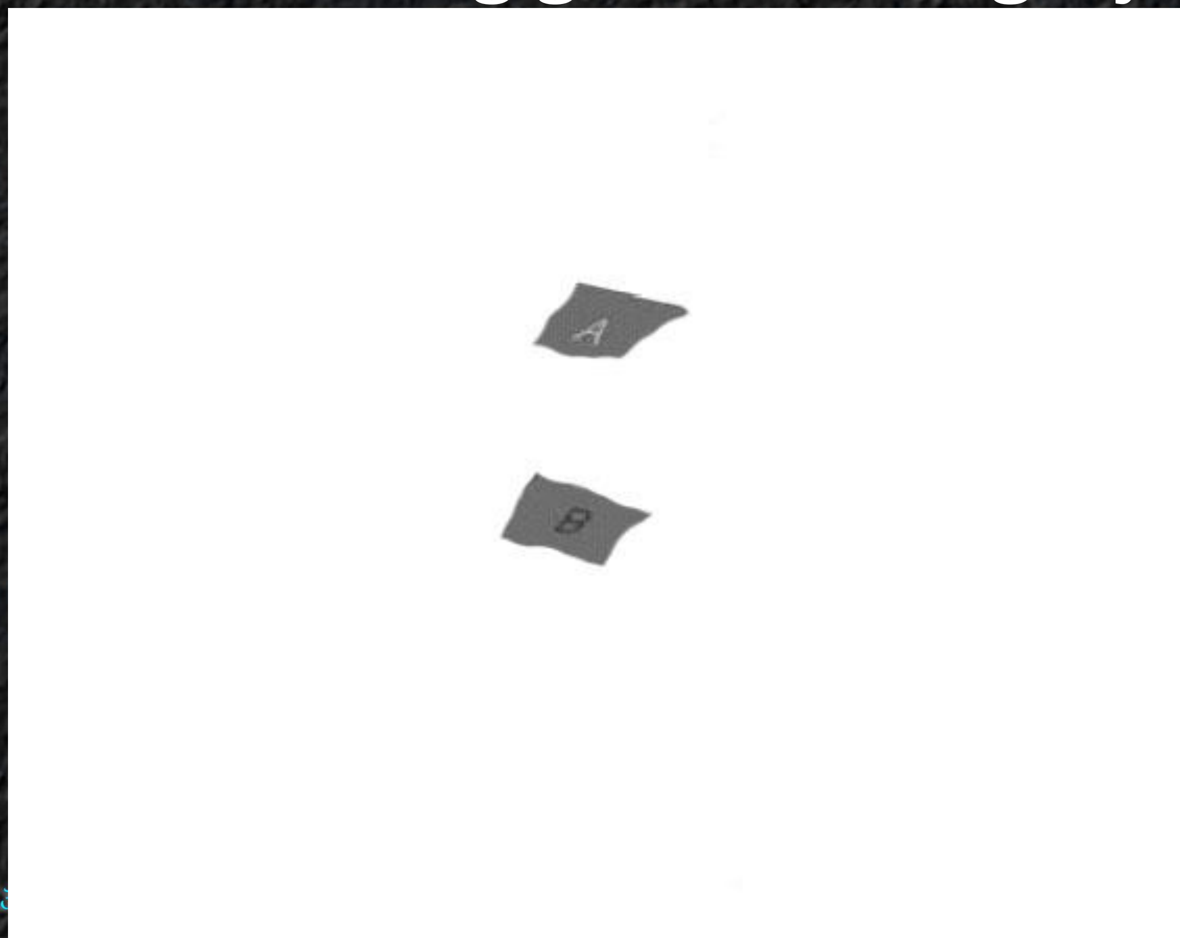


Digital Color: RGB

X(M,N,3)

Red Channel: **X(M,N,1)**

Green Channel: **X(M,N,2)**

Blue Channel: **X(M,N,3)**

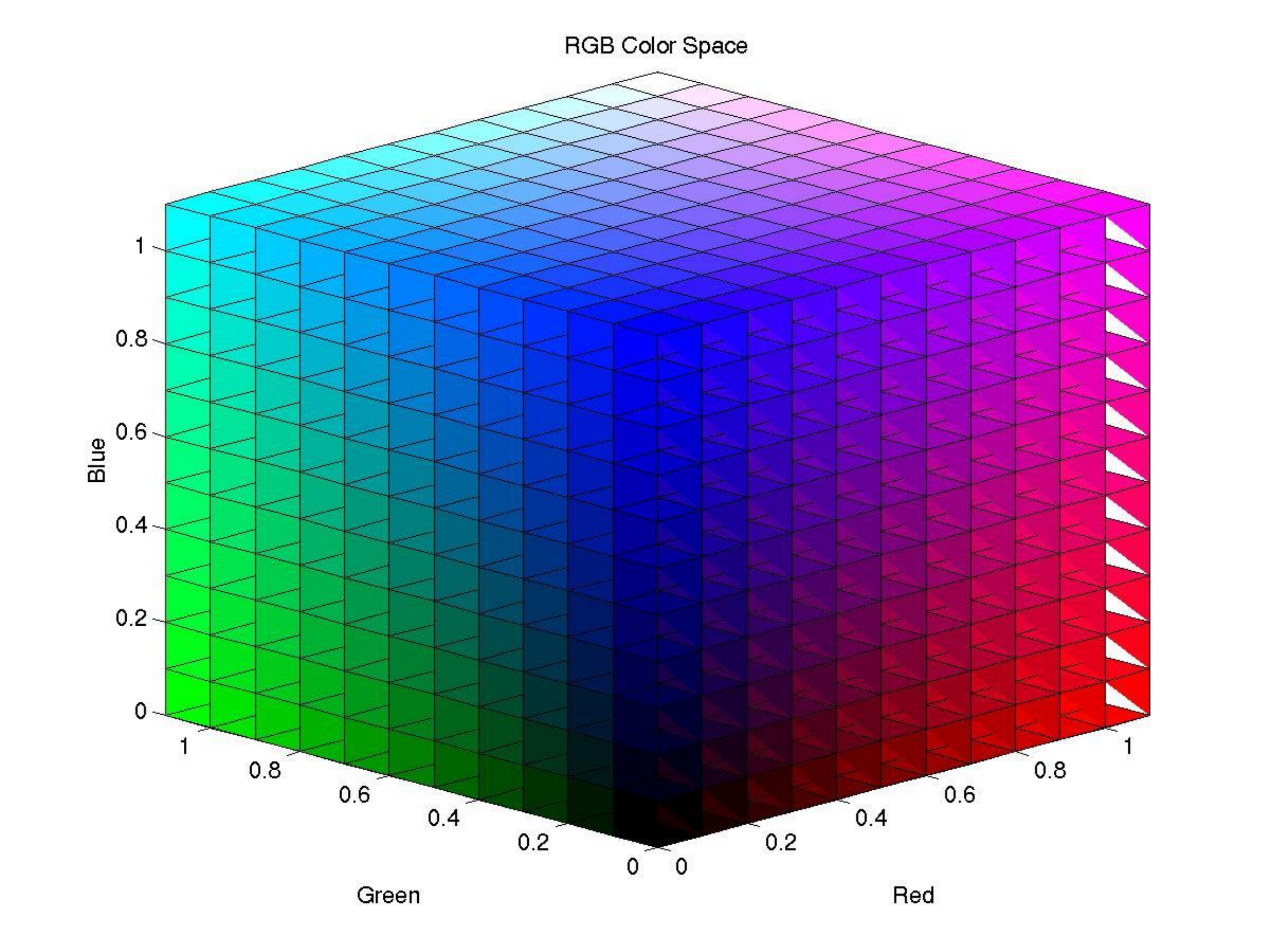
24 bit color: [8 red, 8 green, 8 blue]

Total number = 256^3 = 16 777 216 “colors”

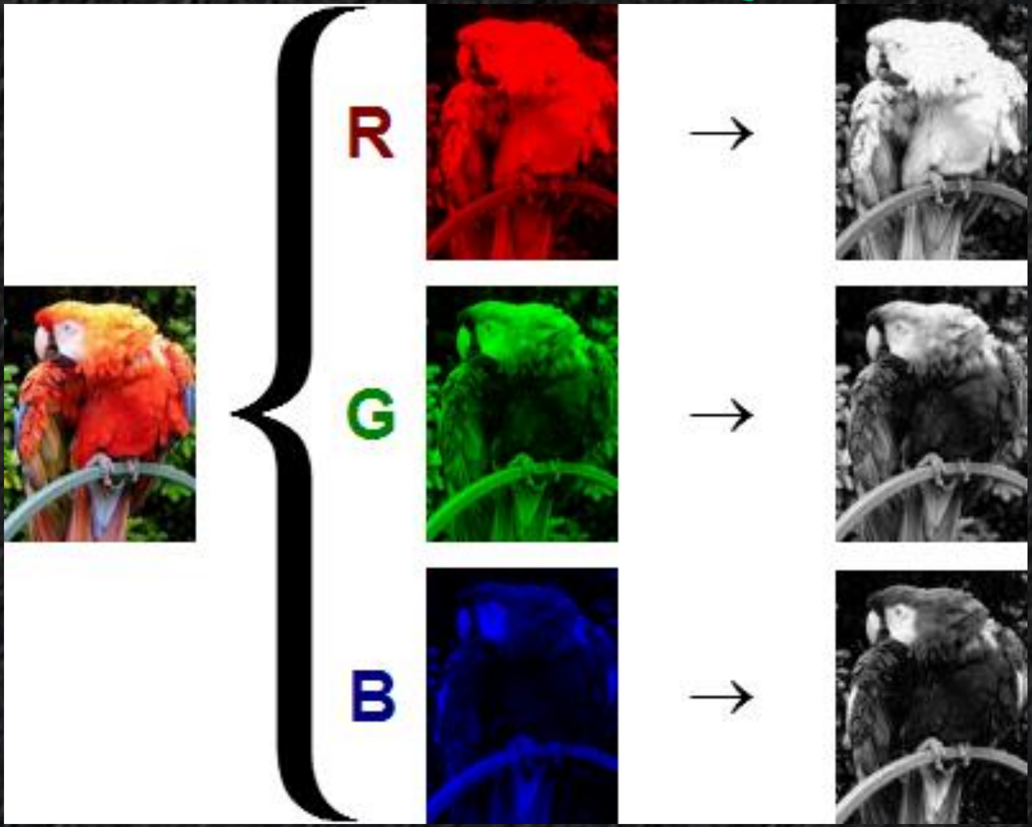
RGB

RGB Colorspace

Color Coordinates



RGB to Gray



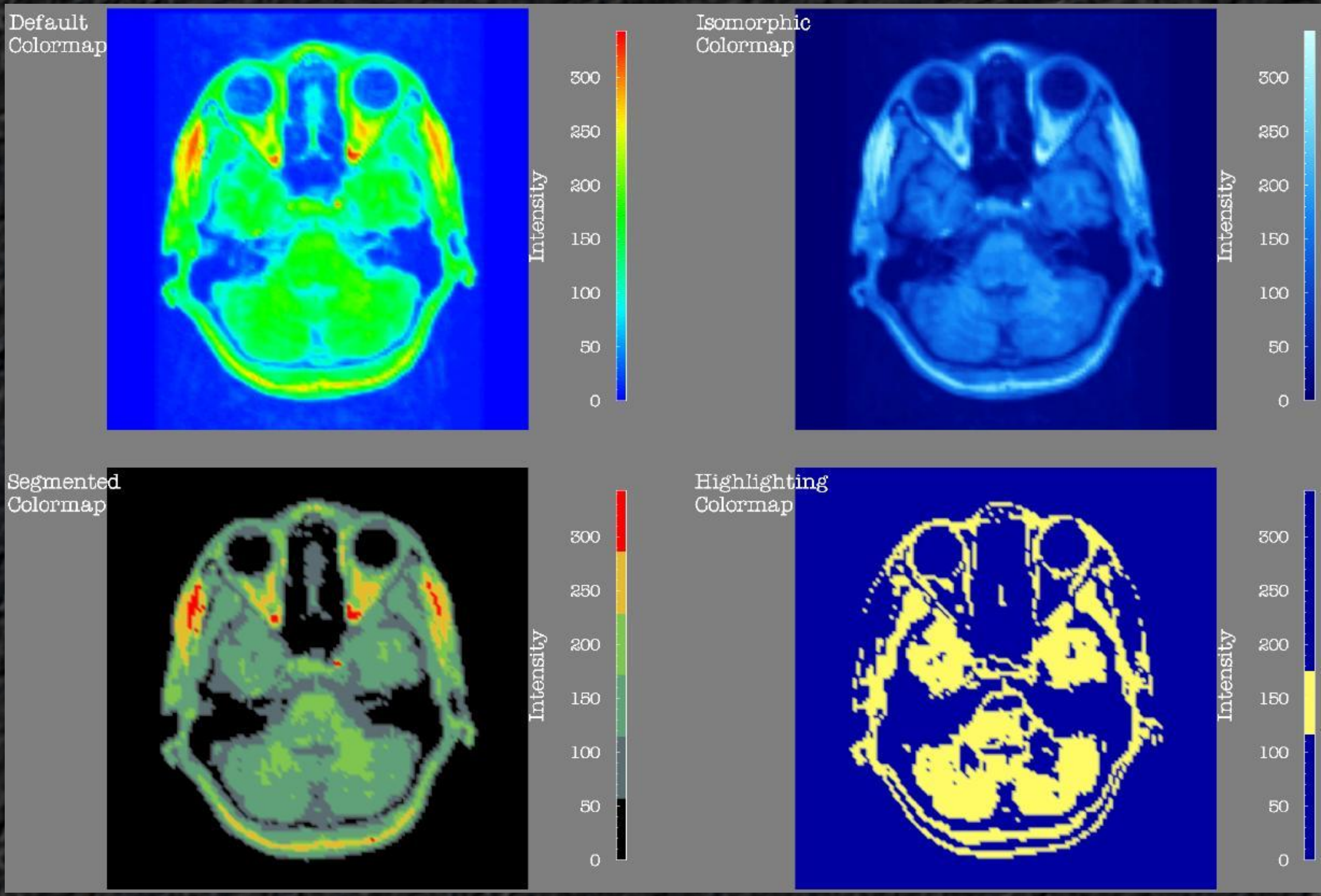
sensitivity response curve of the detector to light as a function of wavelength

Craig's formula: GRAY = 0.3 R + 0.59 G + 0.11 B

Matlab function: `rgb2gray`

Colormaps

Choosing Colormap

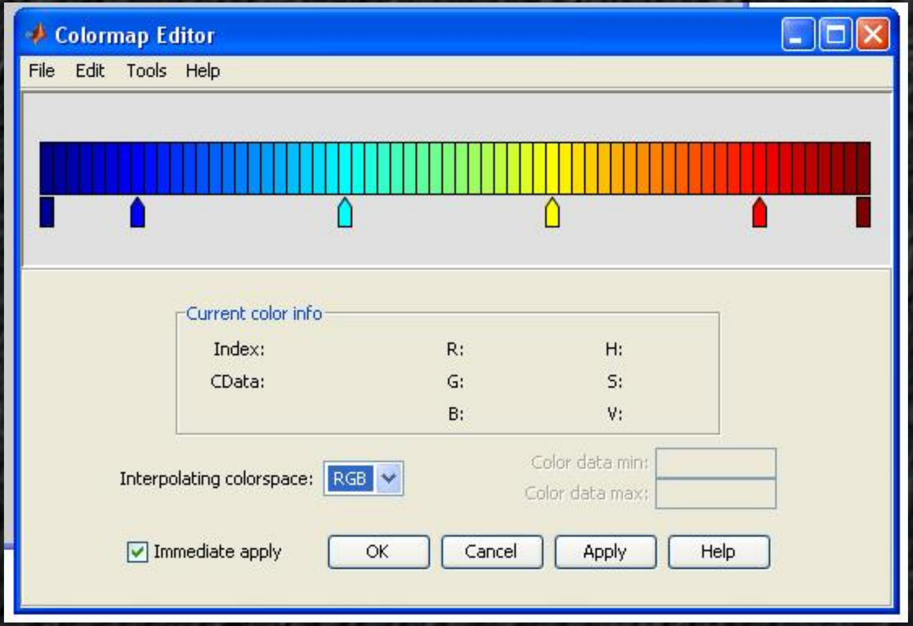


maximize eye sensitivity in target area

Colormaps

Matlab:

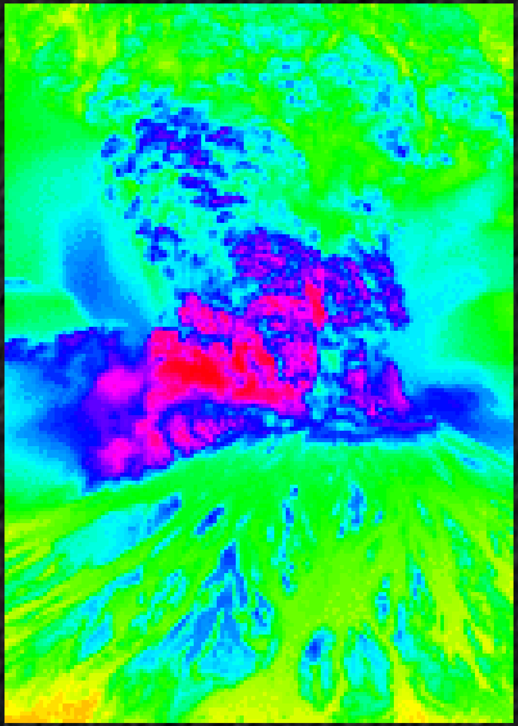
Standard colormaps



`colormapeditor`

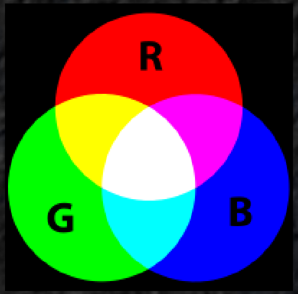
Color Rrange

Maximize human perception gradients



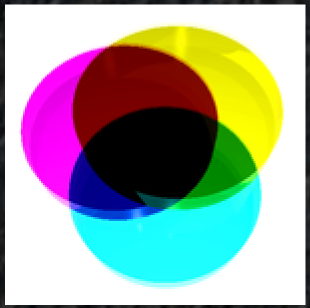
Color Spaces

RGB (pc, digital format)



CMYK (cyan, magenta, yellow, key black)

printers



NTSC (TV)

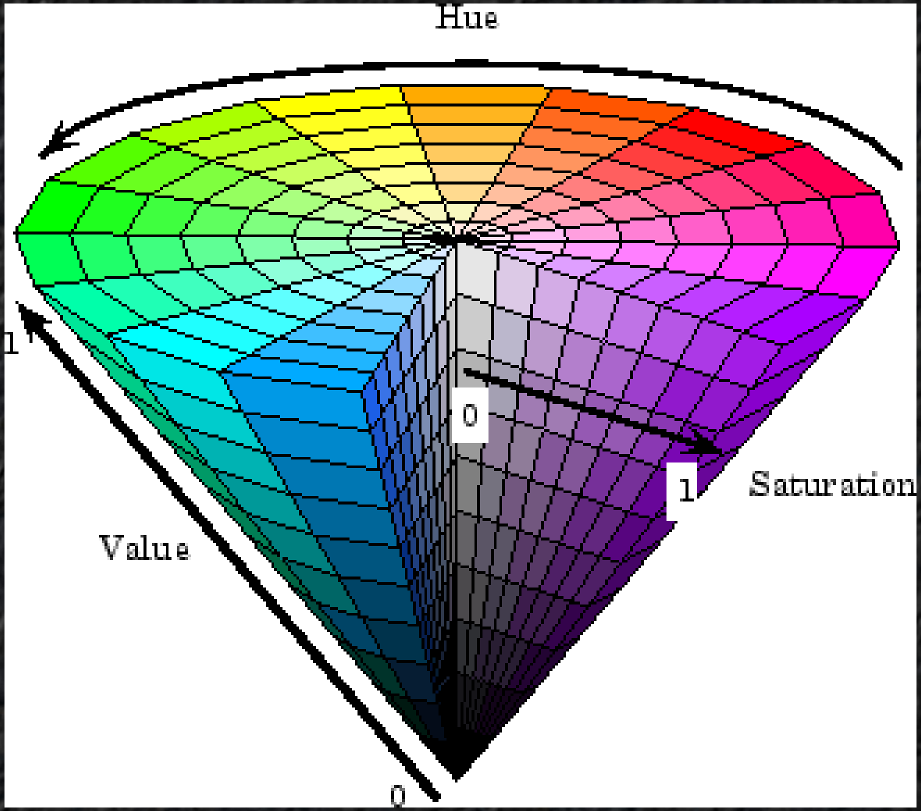
HSV (Hue Saturation Volume)

HSV

Human Perception Color Space

R G B

H S V



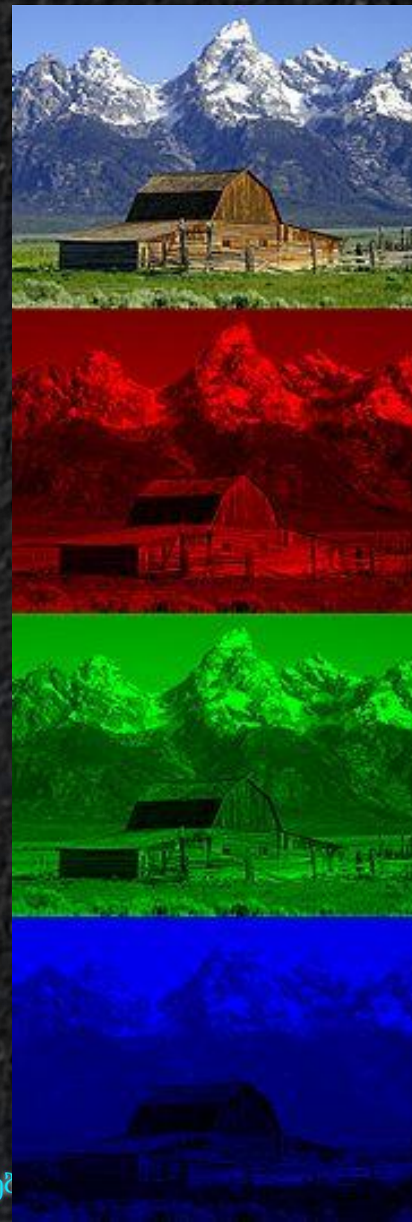
Matlab: `rgb2hsv, hsv2rgb`

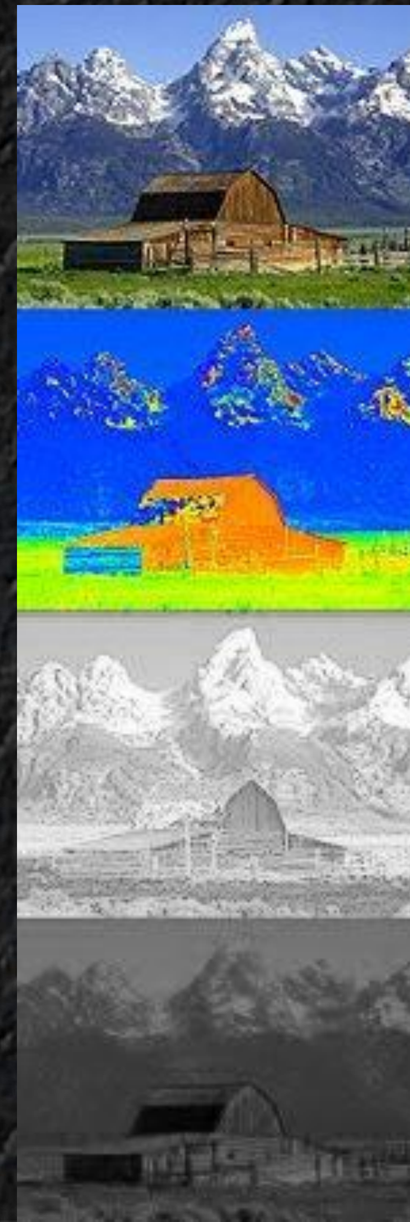
RGB vs HSV

Sensitivity max:

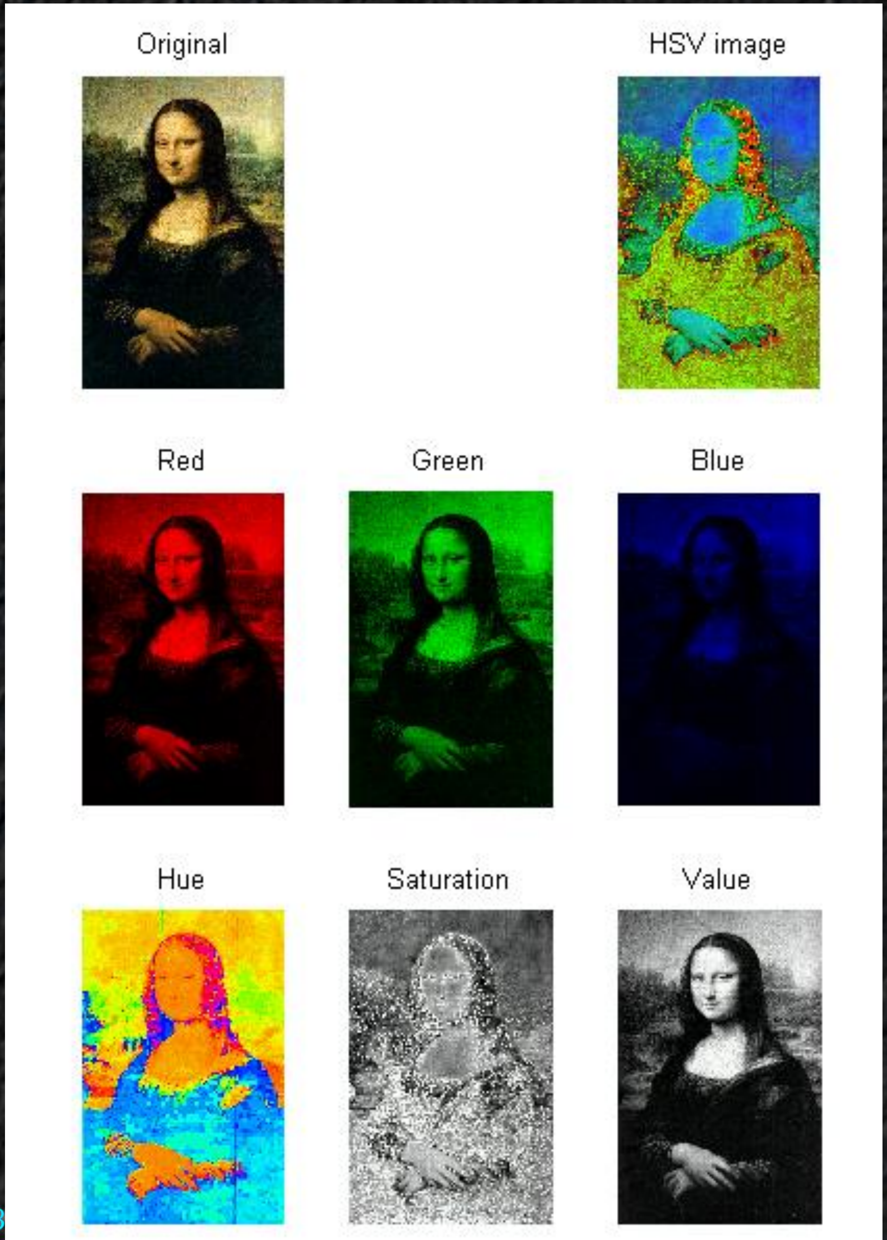
Hue

- Reduce bitrate
- Filter
- Track
- Recognition





RGB vs HSV



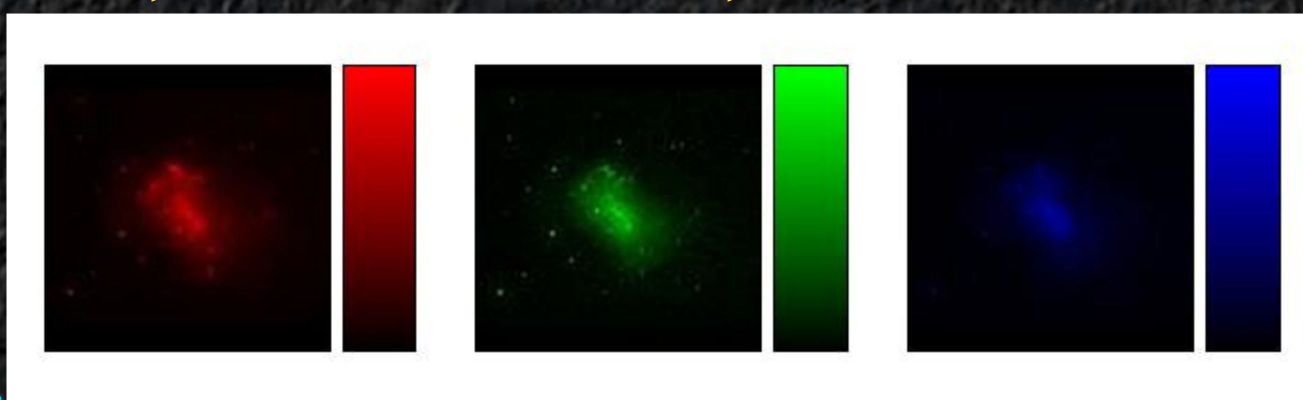
False-color

image + image + image = color image

Color Image: [λ(red) , λ(green) , λ(blue)]

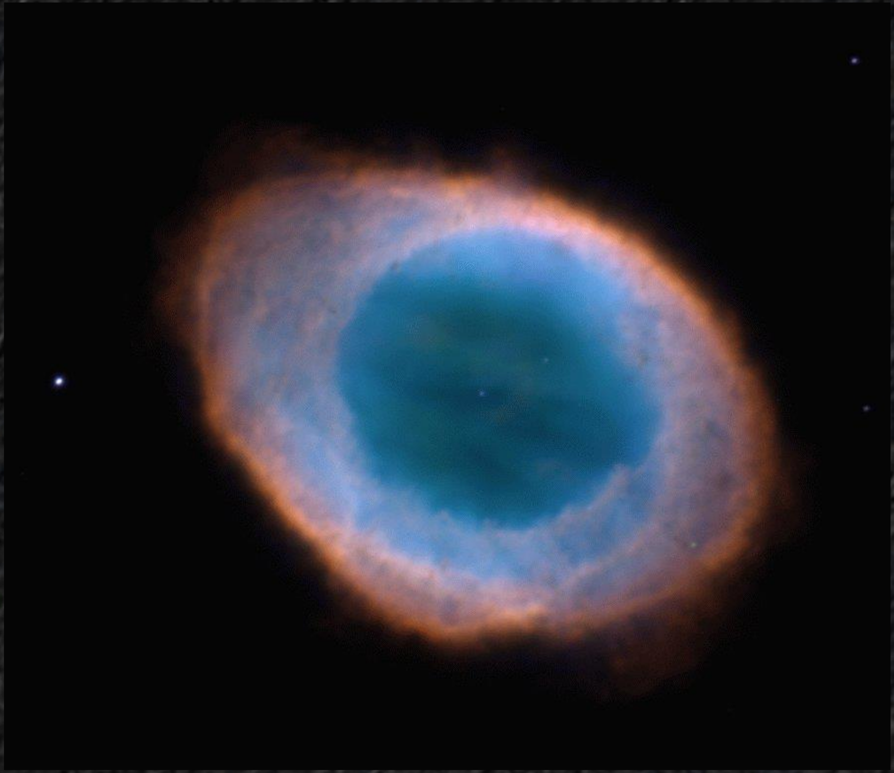
False-Color: [λ1 , λ2 , λ3]

λ1, λ2, λ3



False-color

NGC 6720 (the Ring Nebula)

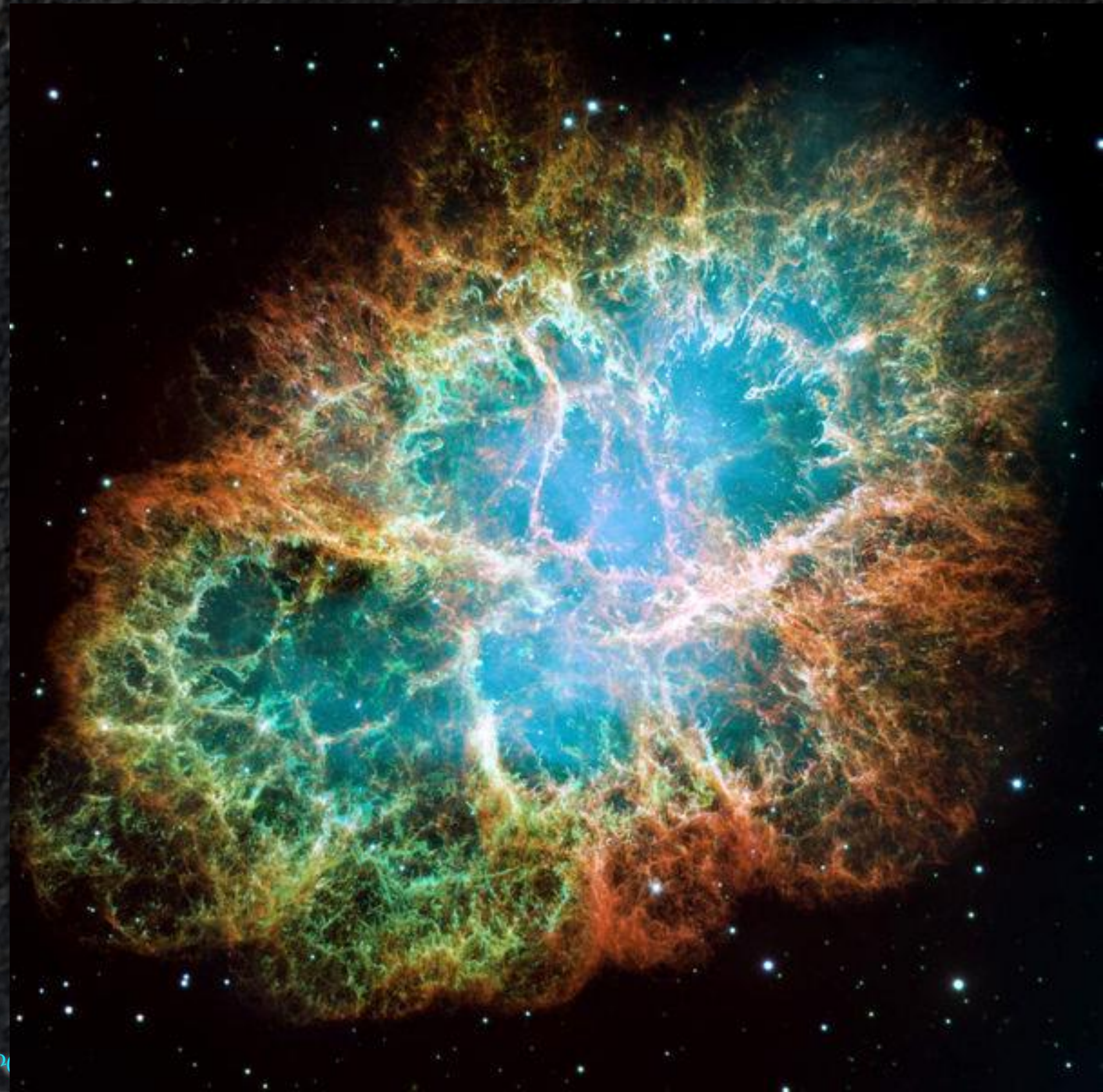


NGC 6720 (the Ring Nebula)

False-color

Crab nebula

multi band emission



False-color

Galaxy dust

Pseudo-color

image + idea + … + idea = color image

technique for artificially assigning colors

visualize ideas

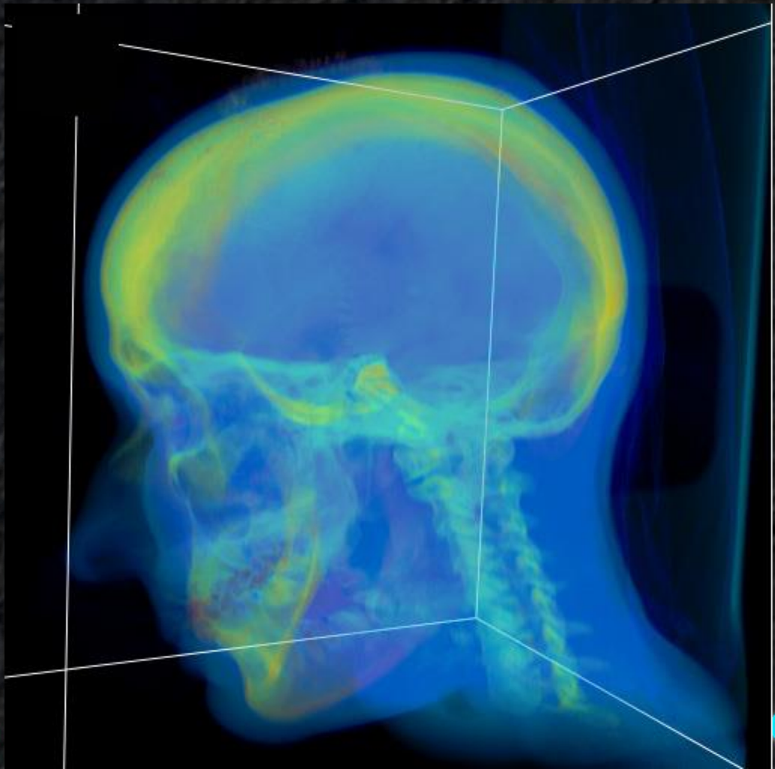
Image_gray -> Image_color

```
rgb2gray(Image_color) = Image_gray
```

Pseudo-color

Goal: increasing the distance in color space between successive gray levels.

changing the colors in order to ease image understanding



Pseudo-color

Grayscale image

Ideas:

Strong gradient: blue

Smooth gradient: red

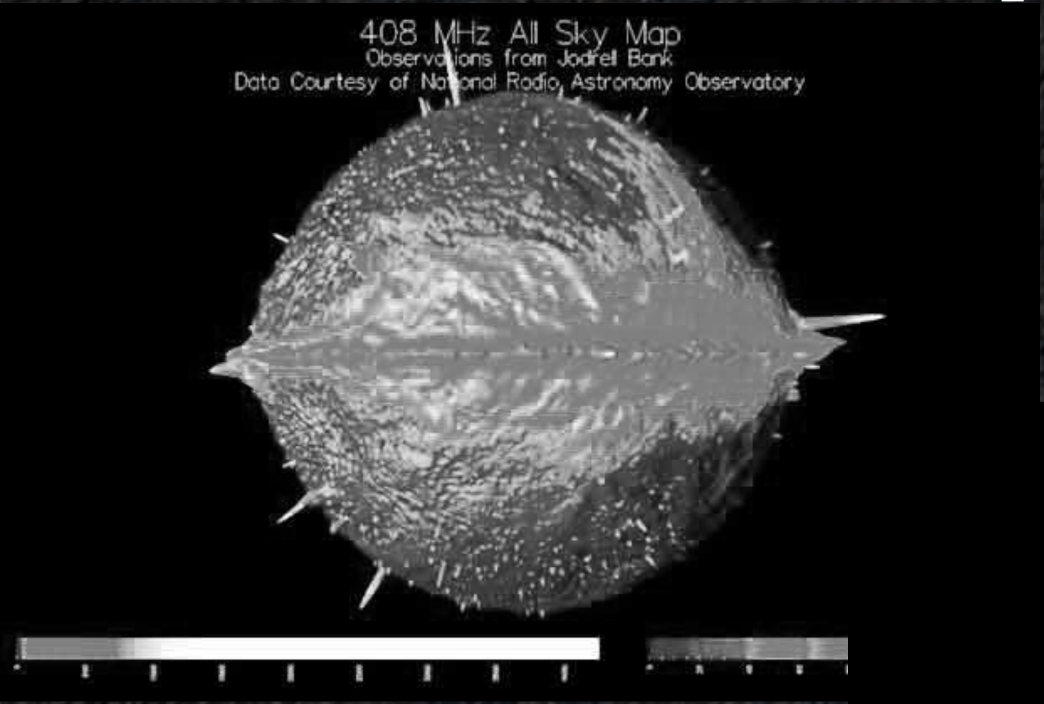
Morphology coloring (pixel based filtering, pixel geometry, blobs, holes, etc.)

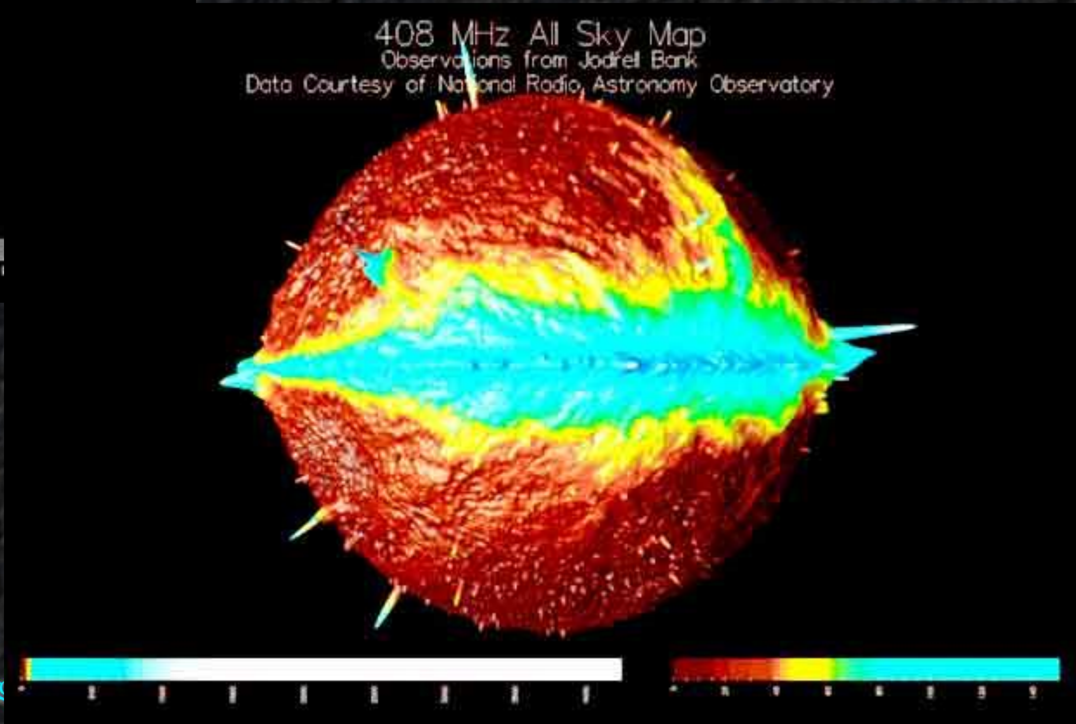
Egde detection: (harder edges, outer glow, inner glow …)

Color Image

Pseudo-color

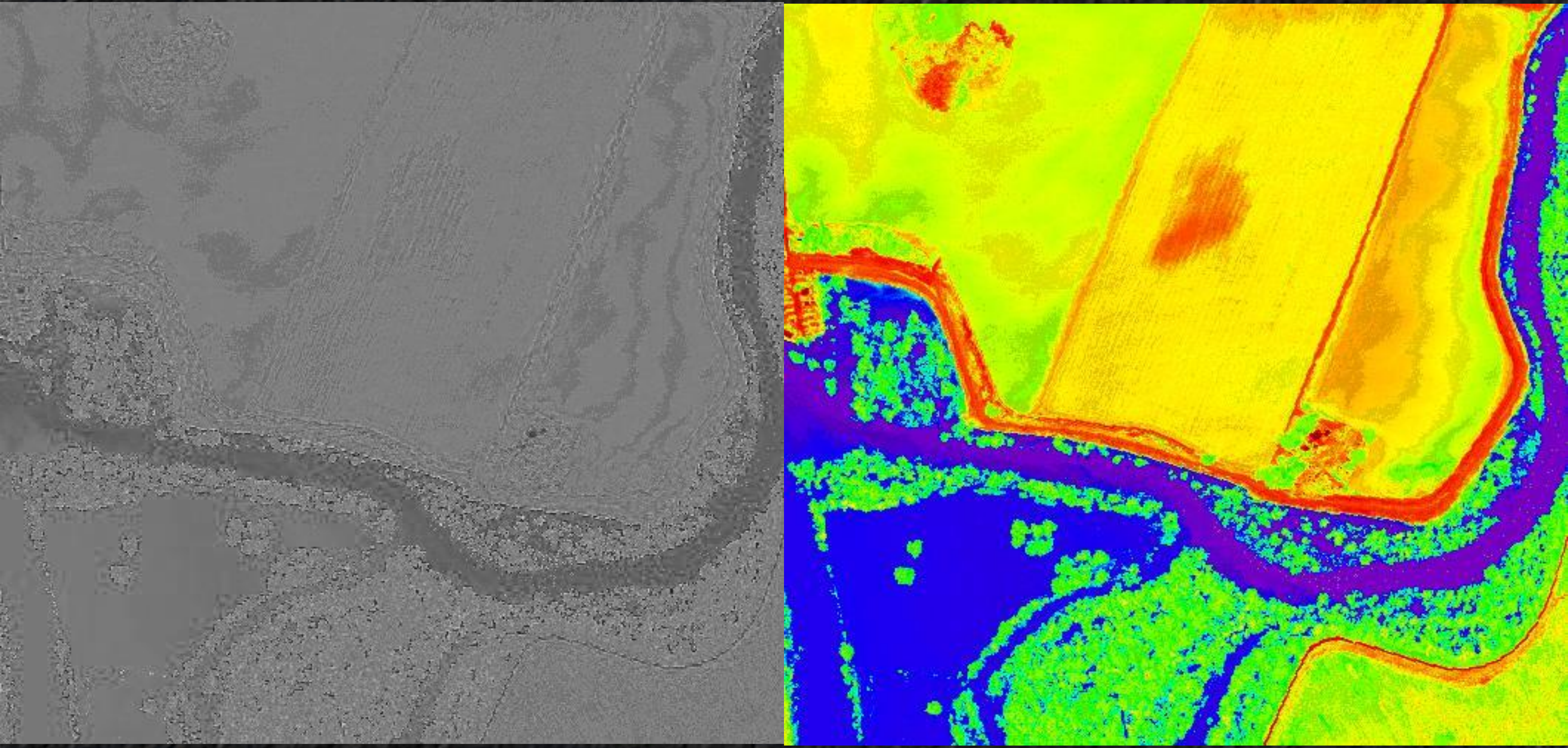
Radio sphere



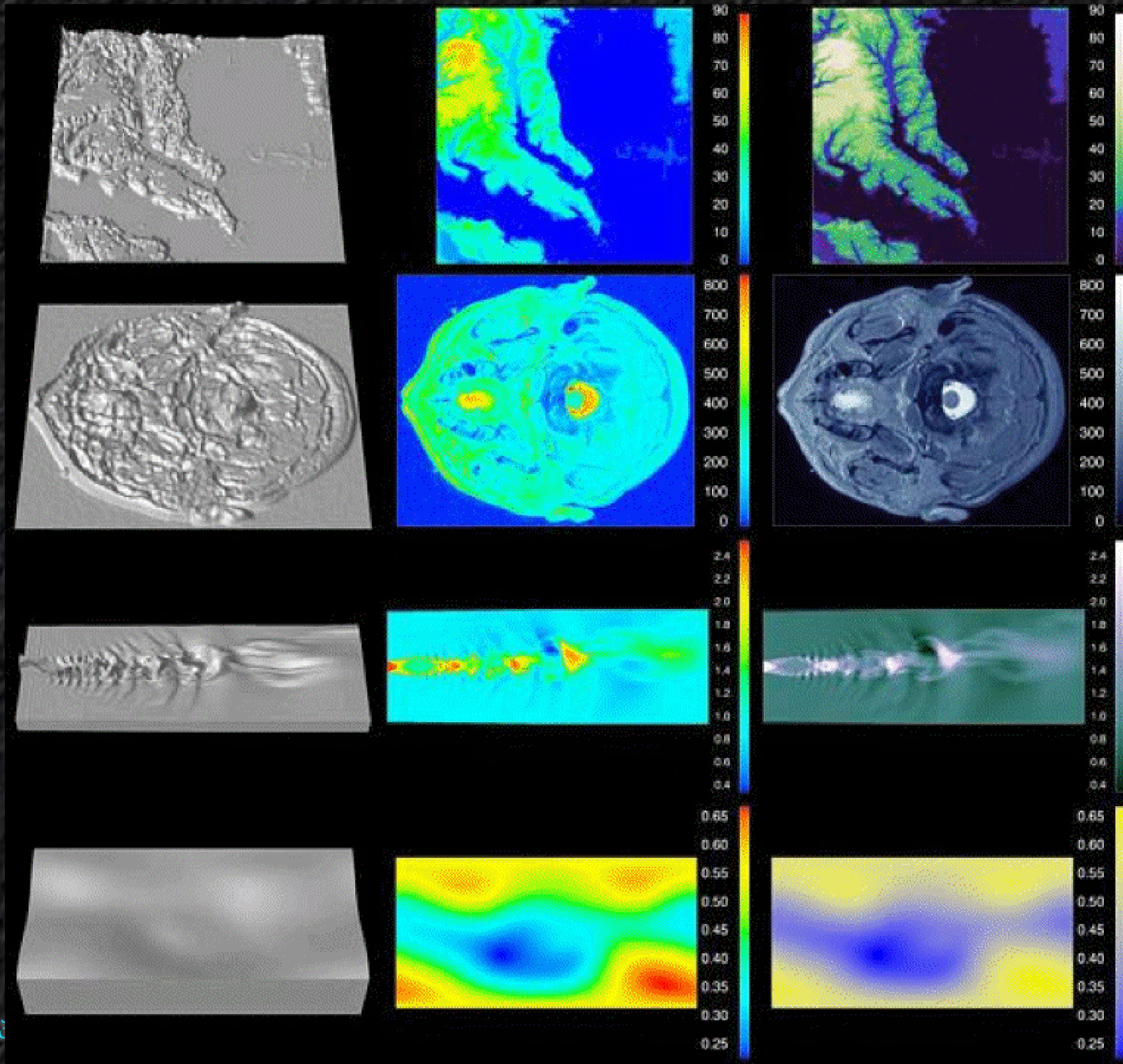


Pseudo-color

Morphologic enhancement



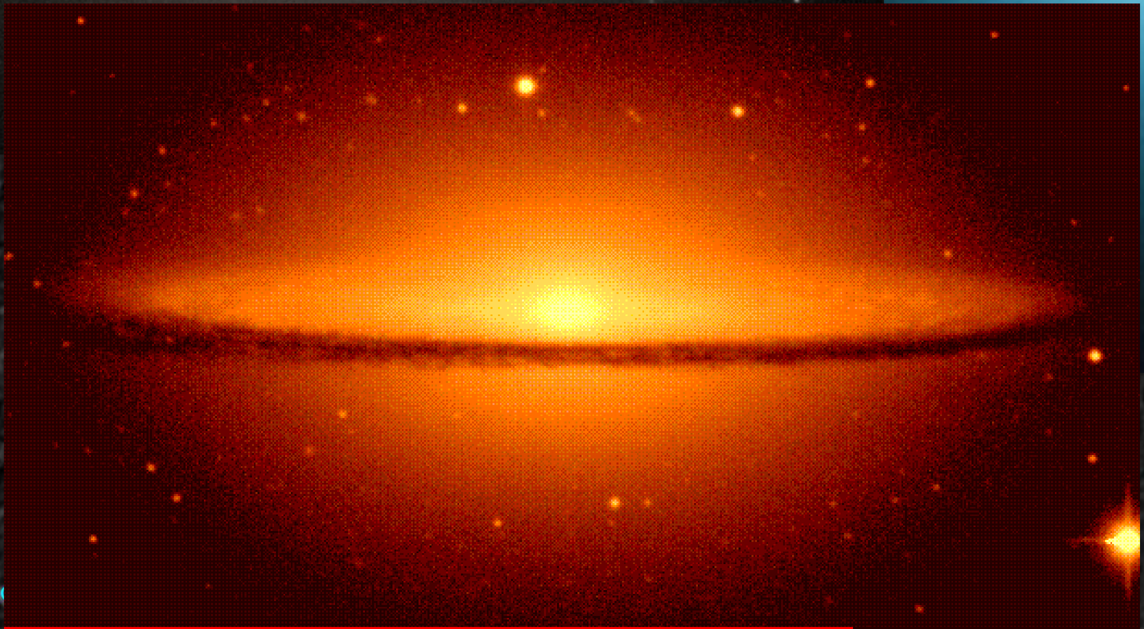
Pseudo-color



False vs Pseudo

False-color

Pseudo color



end

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