Color Image Processing

Image Processing
CSE 166
Lecture 9
Announcements

• Assignment 3 is due today, 11:59 PM
• Midterm exam is on May 6
• Reading
  – Sections 7.1-7.6: Color Image Processing
Electromagnetic spectrum
Separating visible light
Human eye cones

![Graph showing absorption peaks for human eye cones at different wavelengths (445 nm, 535 nm, and 575 nm) and corresponding colors (Blue, Green, Red).]
Primary and secondary colors are swapped

Note that green, cyan, and blue are not accurate colors in the book. More accurate colors below.

- Red
- Yellow
- Green
- Cyan
- Blue
- Magenta
RGB color model

RGB color cube

RGB coordinates
XYZ color model and chromaticity coordinates

Not actual colors locations; just gives an idea
Color gamuts

Average person

Computer monitor

Printer
HSI color model: Relationship to RGB color model

RGB color cube rotated such that line joining black and white (intensity axis) is vertical

All colors with cyan hue
HSI color model

RGB color cube rotated such that observer is on intensity axis, beyond white looking towards black

HSI intensity axis

Shape does not matter, only angle from red
HSI color model

HS-plane is orthogonal to intensity axis
Color models

CMYK

CMY

RGB

HSI
Intensity slicing

Grayscale to 2 colors
Intensity slicing

Grayscale to 2 colors
Intensity slicing

Grayscale to 8 colors
Intensity slicing

Colorbar

Grayscale to 256 colors
Intensity to color transformations

Grayscale input image

RGB output image
Intensity to color transformations

X-ray grayscale input image

Without explosive

With explosive

RGB output images

Misses explosive
Intensity to color transformations

Multiple grayscale input images

Single RGB output image
Intensity to color transformations

Red (R)  Green (G)  Blue (B)

Multiple satellite grayscale input images

Near infrared (NIR)  NIR,G,B as RGB  R,NIR,B as RGB

Output RGB images
Intensity to color transformations

Multiple grayscale input images, some outside of visible spectrum

Physical and chemical processes likely to affect sensor response

Single RGB output image

Close up
Full-color image processing

Spatial filtering: process each channel independently

Gray-scale image

RGB color image
Full-color image processing

Spatial filtering: image smoothing

All RGB channels

HSI intensity channel only

Difference
Full-color image processing

Spatial filtering: image sharpening

All RGB channels

HSI intensity channel only

Difference
Full-color image processing

Histogram equalization: **do not** process each channel independently

1. RGB to HSI
2. Histogram equalize HSI intensity
3. HSI to RGB
4. HSI saturation adjustment
Next Lecture

• Midterm exam review