Introduction to Color Science and Engineering

MUSIHOVEN, 12\textsuperscript{th} March 2011
Stupid color questions

• Why the sky often looks blue?
• Why the leaves are green?
• How to say if there is a difference in color of those red roses?
• How to make a certain color?
• ...
• ...
• What is color anyway?
What colors are these?
What colors are these?
Then, what colors are these?
Once upon a time, ...
Once upon a time, ...
Once upon a time, ...
Color wheels

Traditional colors for painting
Additive and Subtractive Colors
Subtractive colors

Color attributes

Color attributes

So, what is color?

3 necessary components for the existence of colors

Electromagnetic waves
Light sources

... etc
Their spectrums
3 necessary components

With no viewer, the rose is actually colorless. It reflects the wavelength composition necessary for us to see red...

...but the color we sense and remember as "red" only happens in our minds.

Object

Objects’ response to light

Opaque Non-Metal

Metal

Transparent Material

Translucent Material

(source: http://www.hunterlab.com/appnotes/an05_00.pdf)
Spectral data curves of samples

Fingerprint of Cyan
Magenta’s fingerprint

Spectral Data for samples with D65 10°
Yellow’s fingerprint

![Spectral Data for samples with D65 10°](image)
3 necessary components

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Photoreceptor cells

(source: www.wikipedia.com)
Eye

(source: http://www.hunterlab.com/appnotes/an10_07.pdf)
Standard Human Observer

3 necessary components

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Colors in numbers
Example

Example

So…

Colors in practices

Flower A: $L^* = 52.99$  $a^* = 8.82$  $b^* = 54.53$

Flower C: $L^* = 64.09$  $a^* = 2.72$  $b^* = 49.28$

dE

Standard Color

ΔE*

L*

b*

a*

ΔE* tolerance sphere

Samples within sphere are acceptable.

Samples outside sphere are rejected.

Quiz

Spectral Data for samples with D65 10°
Quiz

Spectral Data for samples with D65 10°

%Reflectance vs. Wavelength (nm)
Quiz

Spectral Data for samples with D65 10°
Quiz

Spectral Data for samples with D65 10°
Real quiz

Spectral Data for samples with D65 10°

%Reflectance

Wavelength (nm)
The End