Lewis O. Harvey, Jr.–Instructor
Clare Sims–Assistant
MUEN D156, 09:30–10:45 TR

Homework 5: Color Vision
10 Points: Due at beginning of class, Thursday, 26 June 2009

There are two parts to this homework assignment. Each part counts 5 points. Late homework will receive a grade of zero.

Part 1: Three colors are each matched by the following three color-equations using the C.I.E. Tristimulus primaries:

$$C_1 \equiv 0.45X + 1.05Y + 0.50Z$$
$$C_2 \equiv 1.35X + 3.15Y + 1.50Z$$
$$C_3 \equiv 3.20X + 1.85Y + 0.95Z$$

The C.I.E. chromaticity coordinates *x, y, z,* are computed from the Tristimulus values:

$$x = \frac{X}{X+Y+Z}, \quad y = \frac{Y}{X+Y+Z}, \quad z = \frac{Z}{X+Y+Z}$$

Compute the chromaticity coordinates of each color (small x, y, and z). Construct a chromaticity graph by plotting x-chromaticity against y-chromaticity (make the axis scales go from 0.0 to 1.0). Compare the chromaticity of the three colors: are they the same or different? Will these colors exactly match each other in appearance? If not, how do they differ? Finally, what C.I.E. primaries X, Y, and Z, will match the color C_4 produced when C_2 is added to C_3? Plot C_4 on your chromaticity graph.

Part 2: There are three processes in color vision: two chromatic channels and one achromatic channel. These three processes receive input from the three types of cones according to these three equations:

$$(+r-g) = 1.89L - 2.79M + 0.45S \qquad \text{Red - Green}$$
$$(+y-b) = 0.85L + 0.22M - 1.72S \qquad \text{Yellow - Blue}$$
$$Lum = 0.85L + 0.15M + 0.015S \qquad \text{Luminance}$$

where S, M, and L are the short, medium, and long wavelength cone types. Assume that two colors activate the cones by the following amounts:

	L	M	S
C_5	22.0	8.8	2.2
C_6	5.0	20.0	5.0

Make a graph of the opponent process color space with the x-axis representing (+r–g) and the y-axis representing (+y–b). Both axis scales should run from -50 to +50. Compute the activation of the two chromatic channels (ignore luminance) to C_5, to C_6, and to a mixture of C_5 and C_6 ($C_5 + C_6$). Plot each of the three colors as points on the graph (C_5, C_6, and C_5+C_6). What are the color **appearances** of C_5 and of C_6? What is the color **appearance** of the mixture of C_5 and of C_6?