Lab 6 Report

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2 Plotting Color Matching Functions and Illuminants

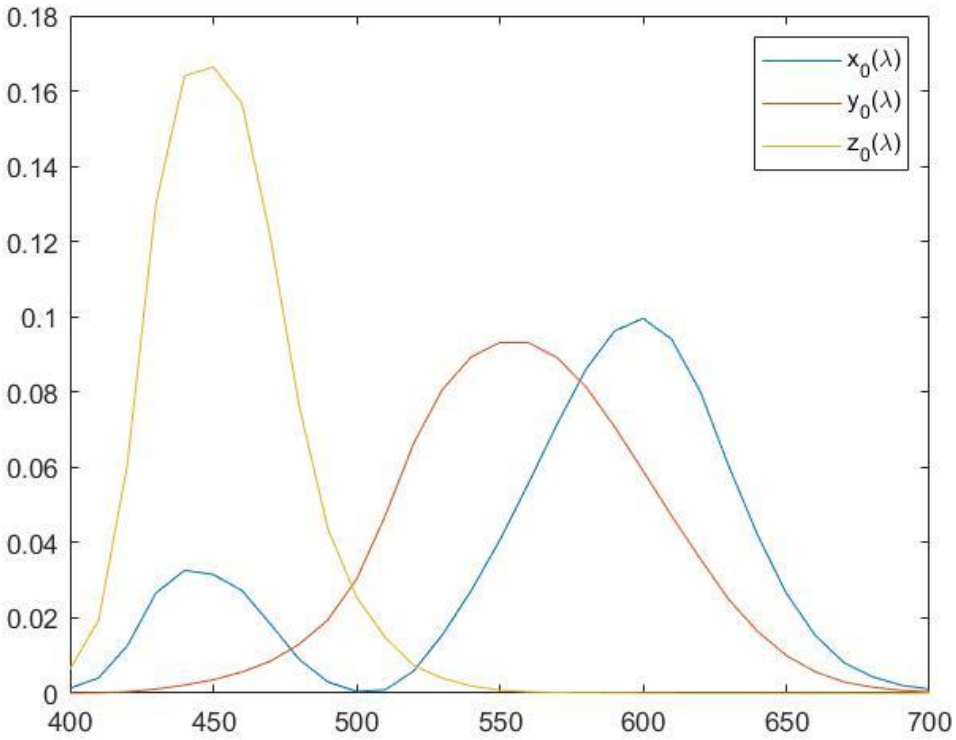


Figure 1. The plot of the x0, y0, and z0 color matching functions.

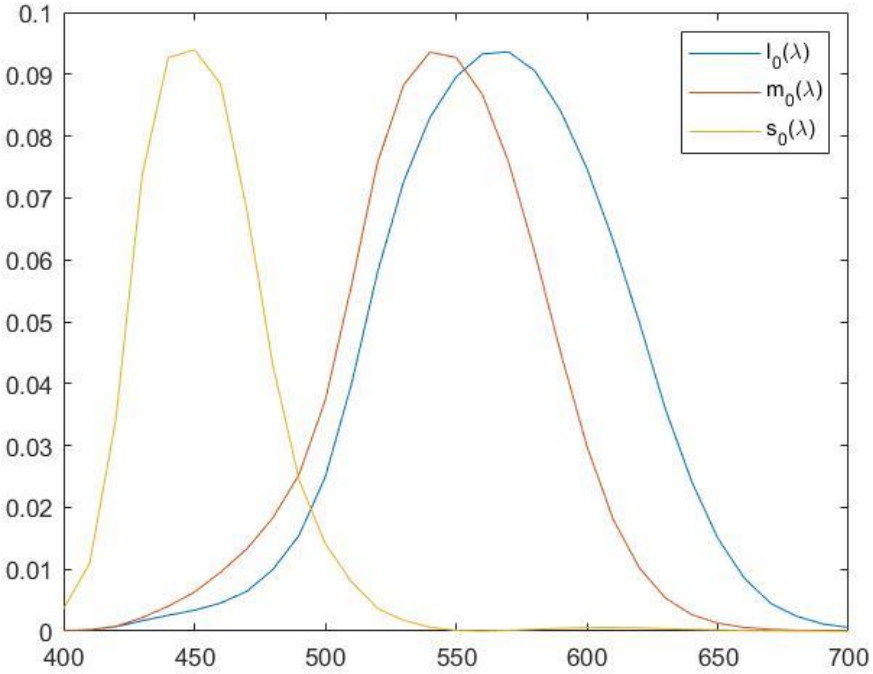


Figure 2. The plot of the l0, m0, and s0 color matching functions.

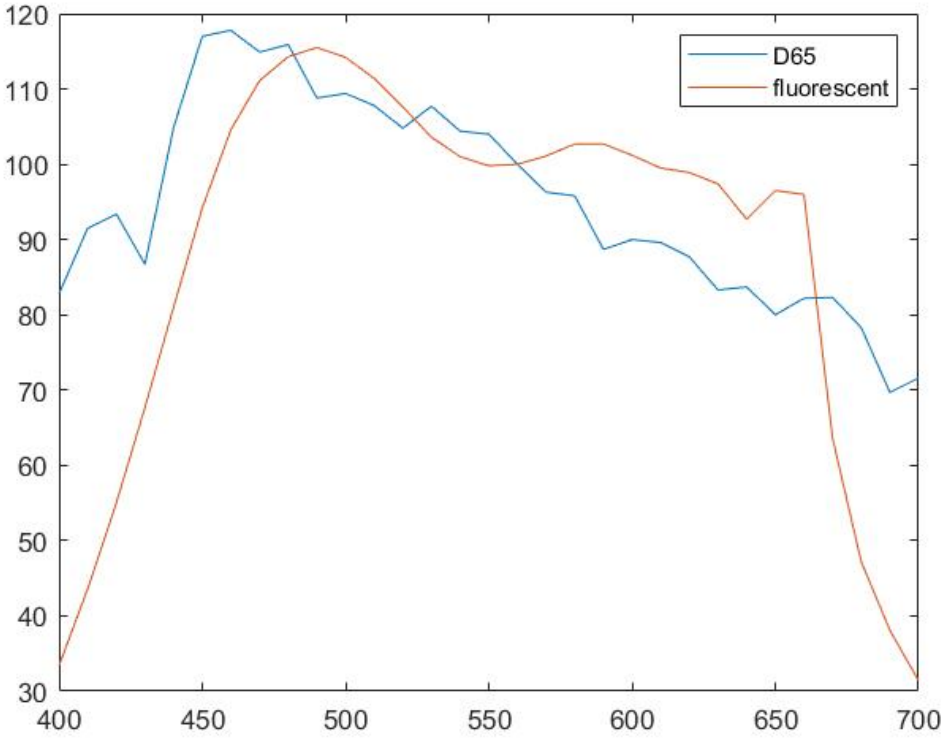
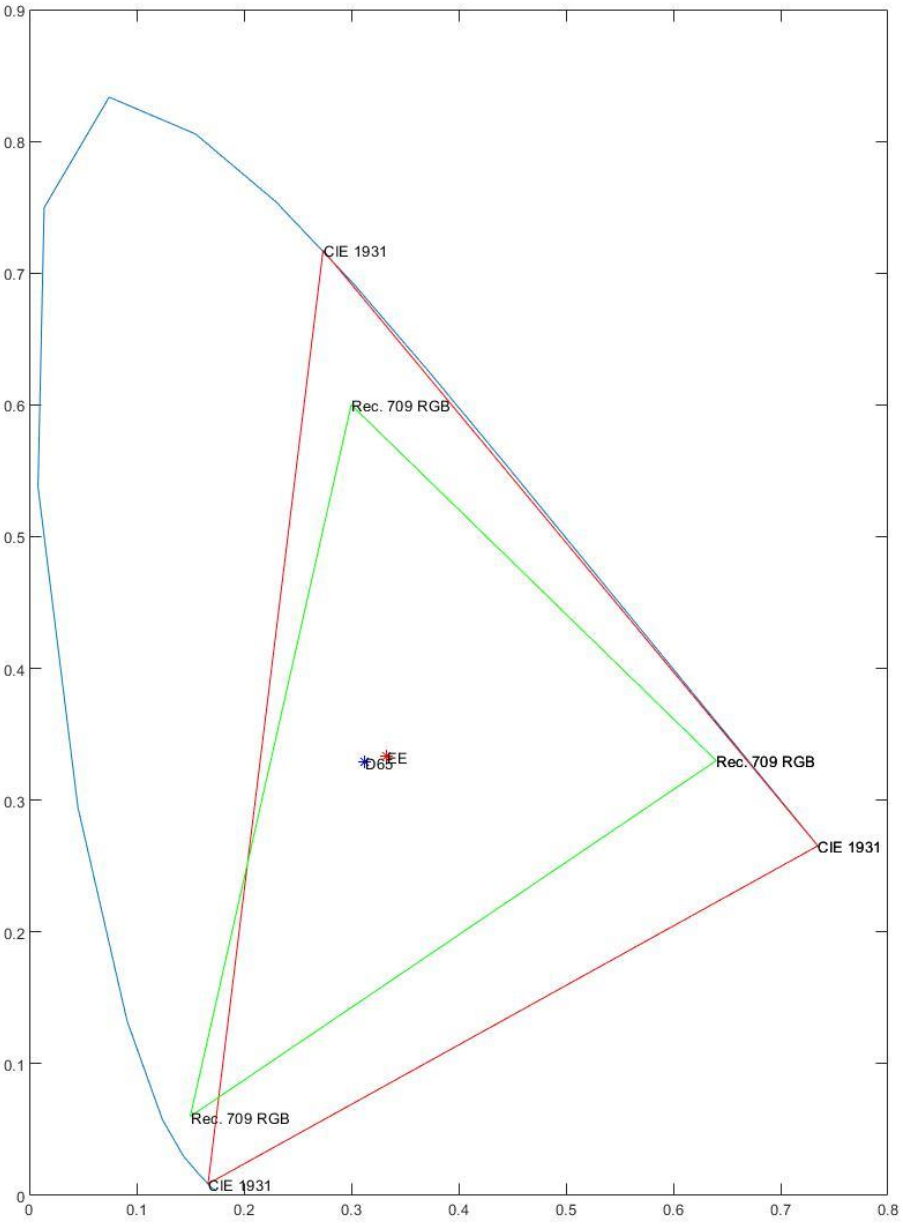


Figure 3. The plot of the D65 and fluorescent illuminants.

3 Chromaticity Diagrams



4 Rendering an Image from Illuminant, Reflectance, and Color Matching Functions

1.

0.412390799265959	0.357584339383878	0.180480788401834
0.212639005871510	0.715168678767756	0.0721923153607337
0.0193308187155918	0.119194779794626	0.950532152249661

2.

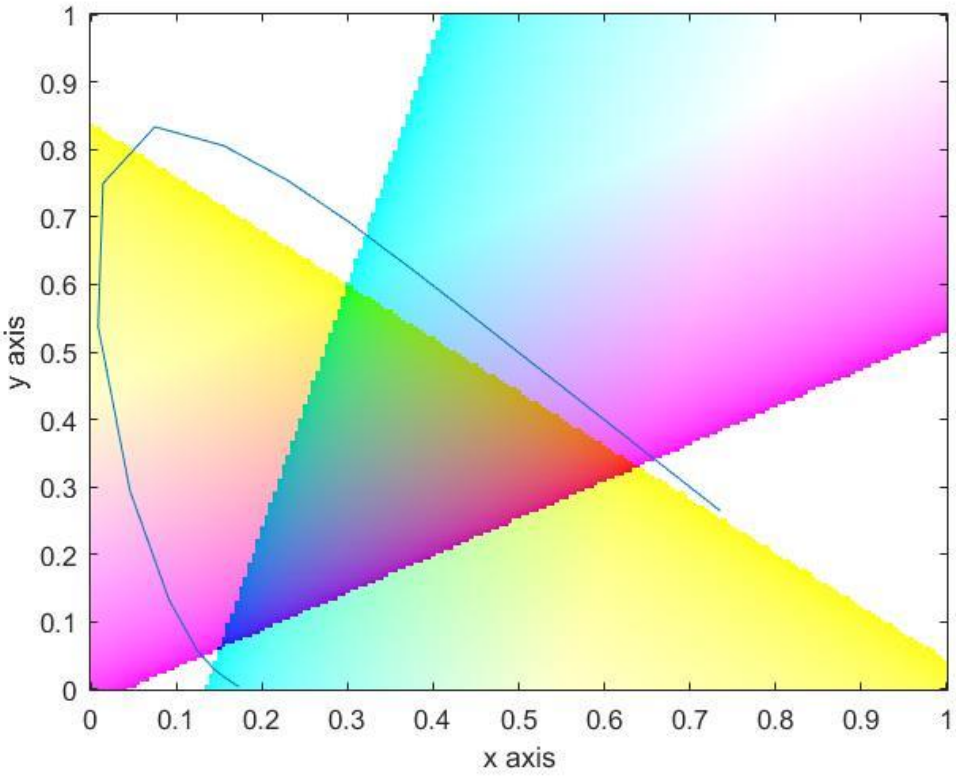
Figure 4. Image from D65

Figure 5. Image from fluorescent

3.

The image from D65 has more blue components, and the image from fluorescent has more green components.

5 Color Chromaticity Diagram



```
clear all
%{
%% 2 Plotting Color Matching Functions and Illuminants

load('data.mat')
%{
figure()
lambda = 400:10:700;
plot(lambda,[x;y;z])
legend('x_0(\lambda)','y_0(\lambda)','z_0(\lambda)')
%}
A_inv = [0.2430,0.8560,-0.0440;-0.3910,1.1650,0.0870;0.0100,-0.0080,0.5630];
% figure()
lambda = 400:10:700;
% plot(lambda,A_inv * [x;y;z])
% legend('l_0(\lambda)','m_0(\lambda)','s_0(\lambda)')

figure()
plot(lambda,[illum1;illum2])
legend('D65','fluorescent')
%}
%{
%% 3 Chromaticity Diagrams

load('data.mat')

figure()
plot(x./(x+y+z),y./(x+y+z))
hold on

CIE1931 = [0.73467, 0.26533, 0.0; 0.27376, 0.71741, 0.00883; 0.16658, 0.00886, 0.82456; 0.73467,
0.26533, 0.0];
plot(CIE1931(:,1),CIE1931(:,2),'r-')
text(CIE1931(:,1),CIE1931(:,2),'CIE 1931')
hold on

Rec709RGB = [0.640, 0.330, 0.030; 0.300, 0.600, 0.100; 0.150, 0.060, 0.790; 0.640, 0.330, 0.030];
plot(Rec709RGB(:,1),Rec709RGB(:,2),'g-')
text(Rec709RGB(:,1),Rec709RGB(:,2),'Rec. 709 RGB')
hold on

plot(0.3127,0.3290,'b*')
text(0.3127,0.3290, 'D65')
hold on

plot(0.3333,0.3333,'r*')
text(0.3333,0.3333, 'EE')
orient tall
```

```
hold off
%}
%{
%% 4 Rendering an Image from Illuminant, Reflectance, and Color Matching Functions

load('data.mat')
load('reflect.mat')
% calculating I
[rowR, colR, wl] = size(R);
I = zeros(rowR, colR, 31);
for i = 1:rowR
    for j = 1:colR
        for k = 1:wl
            I(i,j,k) = R(i,j,k) * illum1(k);
            % I(i,j,k) = R(i,j,k) * illum2(k);
        end
    end
end
% calculating XYZ
XYZ = zeros(rowR,colR,3);
for i = 1:rowR
    for j = 1:colR
        XYZ(i,j,:) = reshape(I(i,j,:),[1,wl]) * [x;y;z]';
    end
end
% compute M709_D65
Rec709RGB = [0.640, 0.330, 0.030; 0.300, 0.600, 0.100; 0.150, 0.060, 0.790]';
D65 = [0.3127;0.3290;0.3583];
wp = D65 / D65(2);
M709_D65 = Rec709RGB * diag(inv(Rec709RGB) * wp);
% XYZ to RGB
RGB = zeros(rowR,colR,3);
for i = 1:rowR
    for j = 1:colR
        RGB(i,j,:) = inv(M709_D65) * reshape(XYZ(i,j,:),[3,1]);
    end
end
% clip
RGB(RGB < 0) = 0;
RGB(RGB > 1) = 1;
% Gamma correction
RGB_gamma = (RGB.^(1/2.2));
% Display
RGB_gamma = uint8(255*RGB_gamma);
figure()
image((RGB_gamma))
imwrite(RGB_gamma,"4.tif")
%}
```

```
%% 5 Color Chromaticity Diagram

[X Y] = meshgrid(0:0.005:1);
Z = 1 - X - Y; % x+y+z = 1

Rec709RGB = [0.640, 0.330, 0.030; 0.300, 0.600, 0.100; 0.150, 0.060, 0.790]';
M = Rec709RGB; % since K = 1
XYZ(:,:,1) = X;
XYZ(:,:,2) = Y;
XYZ(:,:,3) = Z;
% transfer XYZ to RGB
[rowRGB,colRGB] = size(X);
RGB = zeros(rowRGB,colRGB,3);
for i = 1:rowRGB
    for j = 1:colRGB
        RGB(i,j,:) = inv(M) * reshape(XYZ(i,j,:),[3,1]);
    end
end
% clip
RGB(RGB < 0) = 1;
% gamma correction
RGB = uint8(255 * RGB.^(1/2.2));
% display color diagram
figure()
image([0:0.005:1],[0:0.005:1],RGB)
axis('xy')
xlabel('x axis')
ylabel('y axis')
hold on

load('data.mat')
plot(x./(x+y+z),y./(x+y+z))
```