

MATLAB Simulation of Thick Lens Equation in Matrix Form

Intro to Geometrical Optics/Photonics

Assignment due: 2/21/2020

Name: Michael Benker

University of Massachusetts Dartmouth

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Professor: Dr. Manzur

In Class Problem Results using MATLAB

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%Michael Benker
%ECE591 Intro to Geometrical Optics/Photonics, Dr. Manzur
%Using Thick Lens Equation for Optical Design
clc;
clf;
clear all;

%In-Class Problem
Ang_inc = 0.175*180/pi; %Angle of incidence (10 degrees)
R1 = 10; %First Radius of curvature
R2 = -10; %Second Radius of curvature
n1 = 1; %Refractive index (before lens)
n2 = 1.5; %Refractive Index (after lens)
d = 1; %Distance or thickness between curvatures
Y1 = 0.2; %Height of incident ray
%Ang_exit = 0; %Exiting angle of incidence
%Yt2 = 0; %Height of exiting ray
D1 = (n2 - n1)/R1;
n2 = n1;
n1 = n2;
D2 = (n2 - n1)/R2;

Incident = [n1*Ang_inc; Y1]
Surfacel = [1, -D1; 0, 1]
Middle = [1, 0; (d/n2), 1]
Surface2 = [1, -D2; 0, 1]
ExitRay = Surface2*Middle*Surfacel*Incident

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Incident =
    10.0268
     0.2000

Surfacel =
    1.0000   -0.0500
           0    1.0000

Middle =
    1.0000    0
    0.6667    1.0000

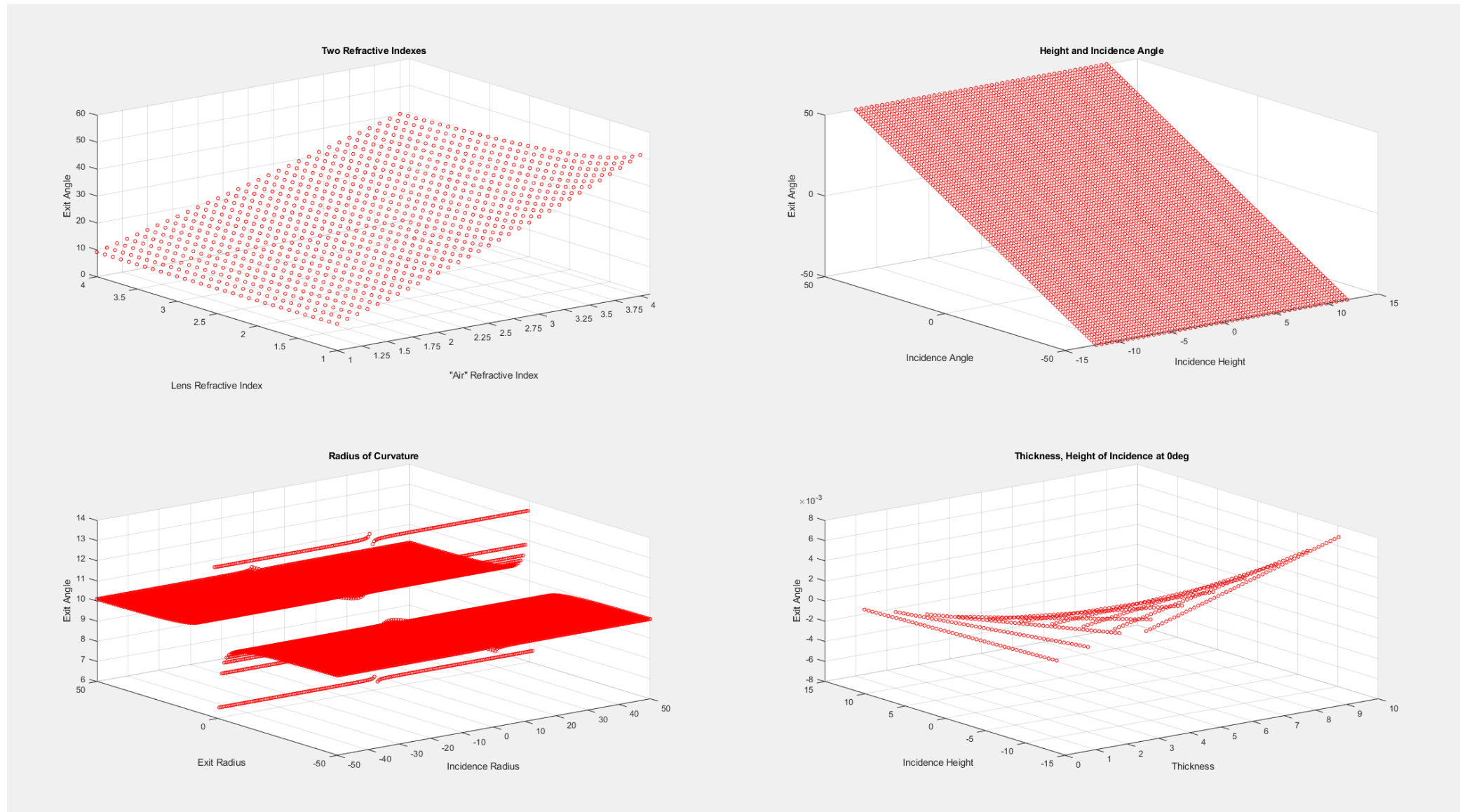
Surface2 =
    1.0000   -0.0500
           0    1.0000

ExitRay =
    9.6729
    6.8778

```

Note:
Converted to degrees

Parameter Sweep Results in MATLAB



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#####
%Parameter Sweep: Radius of Curvature
subplot(2,2,3)
for i = -50:1:50
    for j = -50:0.5:50
        R1 = j;
        R2 = i;
        %Calculations
        D1 = (nt1 - nil)/R1;
        nt2 = nil;
        ni2 = nt1;
        D2 = (nt2 - ni2)/R2;
        Incident = [nil*Ang_inc; Yil];
        Surfacer1 = [1, -D1; 0, 1];
        Middle = [1,0; (d/nt1),1];
        Surface2 = [1, -D2; 0, 1];
        ExitRay = Surface2*Middle*Surfacer1*Incident;

        scatter3(R1,R2, ExitRay(1),15,'red')
    hold on
    end
end
title('Radius of Curvature')
xlabel('Incidence Radius')
ylabel('Exit Radius')
zlabel('Exit Angle')
hold off
R1 = 10; %First Radius of curvature
R2 = -10; %Second Radius of curvature

```

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#####
%Parameter Sweep: Height and Angle
subplot(2,2,2)
for i = -50:1:50
    for j = -12:0.5:12
        Yil = j;
        Ang_inc = i;
        %Calculations
        Incident = [nil*Ang_inc; Yil];
        Surfacer1 = [1, -D1; 0, 1];
        Middle = [1,0; (d/nt1),1];
        Surface2 = [1, -D2; 0, 1];
        ExitRay = Surface2*Middle*Surfacer1*Incident;

        scatter3(Yil,Ang_inc, ExitRay(1),15,'red')
    hold on
    end
end
title('Height and Incidence Angle')
xlabel('Incidence Height')
ylabel('Incidence Angle')
zlabel('Exit Angle')
hold off
Yil = 0.2;
Ang_inc = 0.175*180/pi;

```

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#####
%Parameter Sweep: Refractive Index
subplot(2,2,1)
for i = 1:0.1:4
    for j = 1:0.1:4
        nil = i;
        nt1 = j;
        %Calculations
        D1 = (nt1 - nil)/R1;
        nt2 = nil;
        ni2 = nt1;
        D2 = (nt2 - ni2)/R2;
        Incident = [nil*Ang_inc; Yil];
        Surfacer1 = [1, -D1; 0, 1];
        Surface2 = [1, -D2; 0, 1];
        ExitRay = Surface2*Middle*Surfacer1*Incident;

        scatter3(nil,nt1, ExitRay(1),15,'red')
    hold on
    end
end
title('Two Refractive Indexes')
xlabel('Air Refractive Index')
xticks(1:0.25:4.05)
xlim([1 4.1])
ylabel('Lens Refractive Index')
zlabel('Exit Angle')
hold off
nt1 = 1.5; %Refractive Index (after lens)
nil = 1;

```

```

#####
%Parameter Sweep: Thickness, Height of Incidence at 0deg
Ang_inc = 0;
subplot(2,2,4)
for i = 0.5:10
    for j = -12:0.5:12
        Yil = j;
        d = i;
        %Calculations
        Incident = [nil*Ang_inc; Yil];
        Surfacer1 = [1, -D1; 0, 1];
        Middle = [1,0; (d/nt1),1];
        Surface2 = [1, -D2; 0, 1];
        ExitRay = Surface2*Middle*Surfacer1*Incident;

        scatter3(d,Yil, ExitRay(1),15,'red')
    hold on
    end
end
title('Thickness, Height of Incidence at 0deg')
xlabel('Thickness')
ylabel('Incidence Height')
zlabel('Exit Angle')
hold off
R1 = 10; %First Radius of curvature
R2 = -10; %Second Radius of curvature

```

Parameter Sweep Code

Homework Questions