ENM221-0040/2020

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The striking mechanism of a weaving machine consists of a four bar linkage. In a particular case, such a linkage is required to coordinate five positions of the rocker follower with five positions of the input crank as shown in the table 1. The length of the fixed link is required to be 180mm.

Table 1:

S/NO.	**Input angle, θ_2**	**Input angle, θ_4**
1.0	40^0	70^0
2.0	45^0	76^0
3.0	50^0	83^0
4.0	55^0	91^0
5.0	60^0	100^0

Write a computer program in any language to,

(a) Evaluate K_1, K_2 and K_3 using the least square method, and hence determine the length of the other links

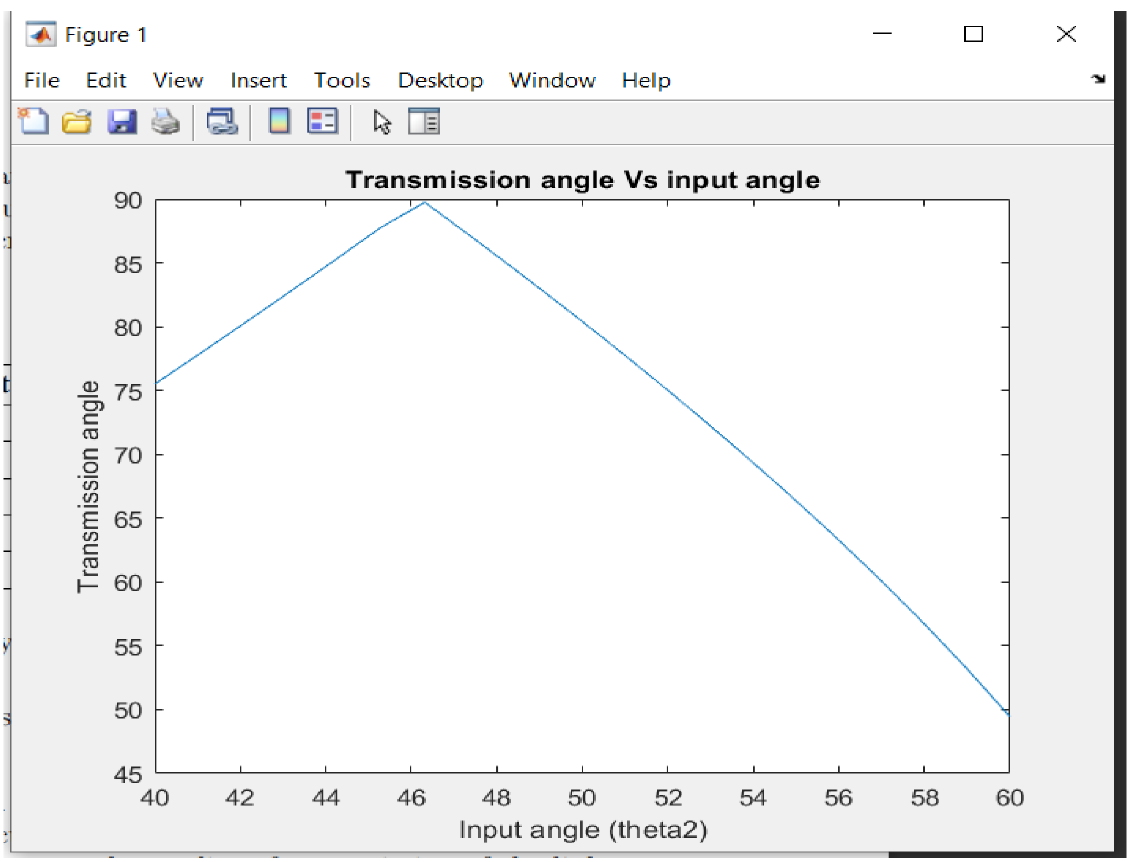
(b) Calculate the transmission angles for the given range of input angles and at an increment of 1^0, and plot a curve of the transmission angles against the input angles for the given range. Comment on the quality of transmission of the linkage.

```
%Using Least Square Method
format long g %to prevent e from forming in the output

theta2=[40,45,50,55,60];
theta4=[70,76,83,91,100];
% Fixed Link
d=180;

%Matrix of the Least Square Method Formula
A = [sum((cosd(theta4)).^2), -sum(cosd(theta2).*cosd(theta4)), sum(cosd(theta4));
    sum(cosd(theta4).*cosd(theta2)), -sum((cosd(theta2)).^2), sum(cosd(theta2));
    sum(cosd(theta4)), -sum(cosd(theta2)),5];

B = [(sum(cosd(theta4).*cosd(theta2-theta4)));
    (sum(cosd(theta2).*cosd(theta2-theta4)));
    (sum(cosd(theta2-theta4)))];

x = A\B;

% Link length ratios
```

```
K1 = x(1)
K2 = x(2)
K3 = x(3)

% Determine the lengths of the other links
a = abs(d/K1)
c = abs(d/K2)
b = sqrt(abs(K3*(2*a*c)-a.^2-c.^2-d.^2))


% Compute the transmission angles for the given range of input angles
theta2_trans=linspace(40,60,20)
transmission_angles = acosd(abs((b.^2 +c.^2 - a.^2-
d.^2+((2.*a.*d).*cosd(theta2_trans)))./(2.*b.*c)));

% Plot the variation of the transmission angles with the input angles
plot(theta2_trans, transmission_angles);
xlabel('Input angle (theta2)');
ylabel('Transmission angle');
title('Transmission angle Vs input angle');
```

K1 =1.02006046122396 **K2 = .60526304463988** **K3 = 1.74637991389733**

a =176.460128435935 **c =112.131155452084** **b = 83.6747188988615**



(c) Calculate the structural errors throughout the given range of input angles and at an increment of 1^0. Plot a curve of the structural error against the input angles for the given range, and hence comment on the resulting error.

```
%Structural Error
format long g %to prevent e from forming in the output

theta2=[40,45,50,55,60];
theta4=[70,76,83,91,100];


%Matrix of the Least Square Method Formula
A = [sum((cosd(theta4)).^2), -sum(cosd(theta2).*cosd(theta4)), sum(cosd(theta4));
    sum(cosd(theta4).*cosd(theta2)), -sum((cosd(theta2)).^2), sum(cosd(theta2));
    sum(cosd(theta4)), -sum(cosd(theta2)),5];

B = [(sum(cosd(theta4).*cosd(theta2-theta4)));
    (sum(cosd(theta2).*cosd(theta2-theta4)));
    (sum(cosd(theta2-theta4)))];

x = A\B;

% Link length ratios
K1 = x(1)
K2 = x(2)
K3 = x(3)


%Structural Error
theta2struc =linspace(40,60,20);
theta4struc=linspace(70,100,20);

A=(1-K2).*cosd(theta2struc)-K1+K3;
B=-2*sind(theta2struc);
C=K1-((1+K2).*cosd(theta2struc))+K3;

theta4generated=2*atand((-B-sqrt((B.^2)-(4.*(A.*C)))))./(2.*A));
theta4required=theta4struc;
error=theta4required-theta4generated
plot(theta2struc,error);

ylabel('error');
xlabel('Input Angle');
title('Structural Error Graphs- Lab2 c');
```

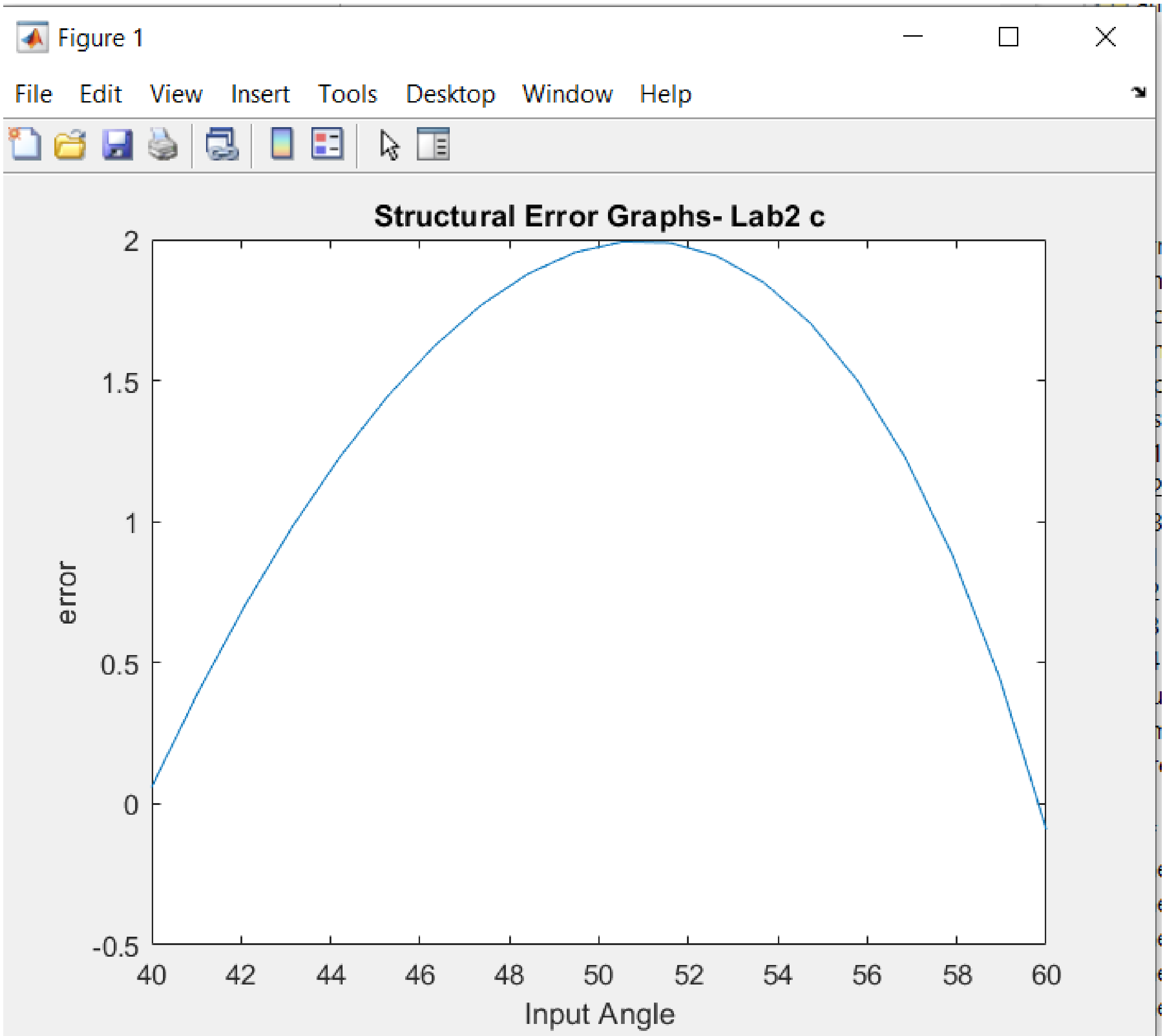


Figure 1
File Edit View Insert Tools Desktop Window Help
Structural Error Graphs- Lab2 c
2
1.5
1
0.5
0
-0.5
error
40 42 44 46 48 50 52 54 56 58 60
Input Angle