Assignment

Mechanism Laboratory (MES 453)

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Prob #1

In a 4R mechanism, the dimensions of the links are given as:
Length of the crank = 2 cm; Length of the coupler = 6.6 cm; Length of the follower = 5.6 cm; Length of the fixed link = 8 cm;
The crank rotates at uniform angular velocity of 5 rad/s in CCW.
Plot angular displacements, angular velocities & angular accelerations of the follower and coupler for a complete revolution of the crank.

Formula used:

t = number of different points for plotting graph for one revolution of crank.
theta2 = w2*t
a = r3^2 - r4^2 - r2^2 + r1^2 - 2*r1*r2*cos(theta2)
b = -2*r3*r1
c = r3^2 - r1^2 - r2^2 - r4^2 + 2*r2*r4*cos(theta2)
Theta3 = 2*atan2(-b-sqrt(b^2-4*a*c), 2*a)
theta4= theta2 + theta3
omega3 = r2/r3*omega2*sin(theta3
omega4 = omega2 + omega3
alpha3 = r2/r3*omega2*cos(theta3)*omega3 - r2/r3^2*omega2^2*sin(theta3)
alpha4 = alpha3

Code :

```
clc;
r2 = 2; %length of crank
r3 = 6.6; %length of coupler
r4 = 5.6; %length of follower
r1 = 8; %length of fixed link

% Define angular velocity of the crank
w2 = 5; % rad/s, CCW

% Define time vector for one revolution of the crank
t = linspace(0, 2*pi/w2, 1000);

% Calculate angular displacements, velocities, and accelerations for follower and coupler
for i = 1:length(t)
% Calculate angular displacement of the crank
theta2 = w2*t(i);
% Calculate angles between links using geometric relations
a = r3^2 - r4^2 - r2^2 + r1^2 - 2*r1*r2*cos(theta2);
b = -2*r3*r1;
c = r3^2 - r1^2 - r2^2 - r4^2 + 2*r2*r4*cos(theta2);
theta3(i) = 2*atan2(-b-sqrt(b^2-4*a*c), 2*a); % angle of coupler
theta4(i) = theta2 + theta3(i); % angle of follower
% Calculate angular velocities using time derivative of angular displacements
omega3(i) = r2/r3*omega2*sin(theta3(i));
omega4(i) = omega2 + omega3(i);
% Calculate angular accelerations using time derivative of angular velocities
alpha3(i) = r2/r3*omega2*cos(theta3(i))*omega3(i) - r2/r3^2*omega2^2*sin(theta3(i));
alpha4(i) = alpha3(i);
end
```

```
figure;
subplot(2,3,1);
plot(t, theta3);
title('Angular Displacement of Coupler');
xlabel('Time (s)');
ylabel('Angle (rad)');

subplot(2,3,2);
plot(t, omega3);
title('Angular Velocity of Coupler');
xlabel('Time (s)');
ylabel('Angular Velocity (rad/s)');

subplot(2,3,3);
plot(t, alpha3);
title('Angular Acceleration of Coupler');
xlabel('Time (s)');
ylabel('Angular Acceleration (rad/s^2)');

subplot(2,3,4);
plot(t, theta4);
title('Angular Displacement of Follower');
xlabel('Time (s)');
ylabel('Angle (rad)');

subplot(2,3,5);
plot(t, omega4);
title('Angular Velocity of Follower');
xlabel('Time (s)');
ylabel('Angular Velocity (rad/s)');

subplot(2,3,6);
plot(t, alpha4);
title('Angular Acceleration of Follower');
xlabel('Time (s)');
ylabel('Angular Acceleration (rad/s^2)');
```

Graph: