

4 Homework:

Velocity and Acceleration Analysis

Part II

Problem 4.3: R-RRR-RRT mechanism

A planar mechanism is shown in Fig. P4.3. The following data are given: $AB=0.150$ m, $BC=0.400$ m, $CD=0.370$ m, $CE=0.230$ m, $EF=CE$, $L_a=0.300$ m, $L_b=0.450$ m, and $L_c=CD$. The constant angular speed of the driver link 1 is 60 rpm. Find the velocities and the accelerations of the mechanism for $\phi=\phi_1=30^\circ$. For $\phi=30^\circ$ the position of the mechanism is given by: $x_B=0.129904$ m, $y_B=0.075$ m, $x_C=-0.0689445$ m, $y_C=0.422073$ m, $x_E=-0.298288$ m, $y_E=0.404712$ m, $x_F=-0.37$ m, $y_F=0.186177$ m, $\phi_2=-1.05052$ rad, $\phi_3=0.0755515$ rad, $\phi_4=1.25372$ rad.

Results

$$\begin{aligned} \dot{x}_B &= -0.471239 \text{ m/s}, & \dot{y}_B &= 0.81621 \text{ m/s}, & \ddot{x}_B &= -5.1284 \text{ m/s}^2, & \ddot{y}_B &= -2.96088 \text{ m/s}^2, \\ \dot{x}_C &= -0.0788027 \text{ m/s}, & \dot{y}_C &= 1.04105 \text{ m/s}, & \ddot{x}_C &= 2.87595 \text{ m/s}^2, & \ddot{y}_C &= 1.03567 \text{ m/s}^2, \\ \dot{x}_E &= -0.127788 \text{ m/s}, & \dot{y}_E &= 1.68819 \text{ m/s}, & \ddot{x}_E &= 4.66371 \text{ m/s}^2, & \ddot{y}_E &= 1.67947 \text{ m/s}^2, \\ \dot{x}_F &= 0 \text{ m/s}, & \dot{y}_F &= 1.64625 \text{ m/s}, & \ddot{x}_F &= 0 \text{ m/s}^2, & \ddot{y}_F &= 3.29262 \text{ m/s}^2, \\ \omega_2 &= \dot{\phi}_2 = -1.1307 \text{ rad/s}, & \alpha_2 &= \ddot{\phi}_2 = -22.33 \text{ rad/s}^2, \\ \omega_3 &= \dot{\phi}_3 = -2.82169 \text{ rad/s}, & \alpha_3 &= \ddot{\phi}_3 = -2.20443 \text{ rad/s}^2, \\ \omega_4 &= \dot{\phi}_4 = 0.58475 \text{ rad/s}, & \alpha_4 &= \ddot{\phi}_4 = -21.453 \text{ rad/s}^2. \end{aligned}$$

Problem 4.4: R-RRR-RTT mechanism

The R-RRR-RTT mechanism is shown in Fig. P4.4. The following data are given: $AB=0.080$ m, $BC=0.350$ m, $CE=0.200$ m, $CD=0.150$ m, $L_a=0.200$ m, $L_b=0.350$ m, and $L_c=0.040$ m. The driver link 1 rotates with a constant angular speed of $n = 300$ rpm. Find the velocities and the accelerations of the mechanism when the angle of the driver link with the horizontal axis is $\phi=155^\circ$. For $\phi=155^\circ$ the position of the mechanism is given by: $x_B=-0.0725046$ m, $y_B=0.0338095$ m, $x_C=0.254847$ m, $y_C=0.157668$ m, $x_D=0.295983$ m, $y_D=0.0134181$ m, $\phi_2=0.361716$ rad, $\phi_3=-1.293$ rad.

Results

$$\begin{aligned} \dot{x}_B &= -1.06216 \text{ m/s}, & \dot{y}_B &= -2.2778 \text{ m/s}, & \ddot{x}_B &= 71.5592 \text{ m/s}^2, & \ddot{y}_B &= -33.3686 \text{ m/s}^2, \\ \dot{x}_C &= -1.73662 \text{ m/s}, & \dot{y}_C &= -0.495228 \text{ m/s}, & \ddot{x}_C &= 37.3878 \text{ m/s}^2, & \ddot{y}_C &= 27.6173 \text{ m/s}^2, \\ \dot{x}_D &= -3.03908 \text{ m/s}, & \dot{y}_D &= -0.866649 \text{ m/s}, & \ddot{x}_D &= 65.4287 \text{ m/s}^2, & \ddot{y}_D &= 48.3303 \text{ m/s}^2, \\ \omega_2 &= \dot{\phi}_2 = 5.44543 \text{ rad/s}, & \alpha_2 &= \ddot{\phi}_2 = 197.52 \text{ rad/s}^2, \\ \omega_3 &= \dot{\phi}_3 = -9.0292 \text{ rad/s}, & \alpha_3 &= \ddot{\phi}_3 = 217.641 \text{ rad/s}^2. \end{aligned}$$

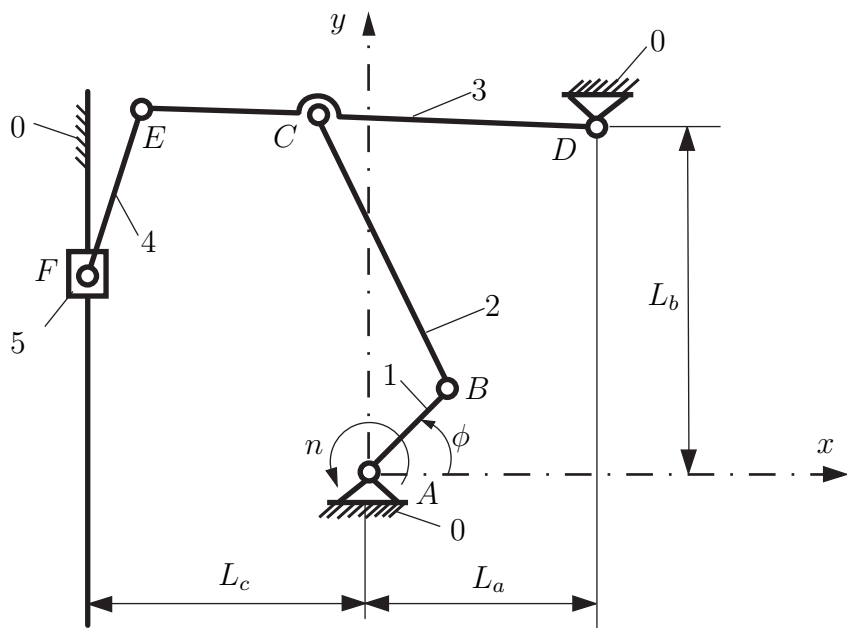


Figure P4.3

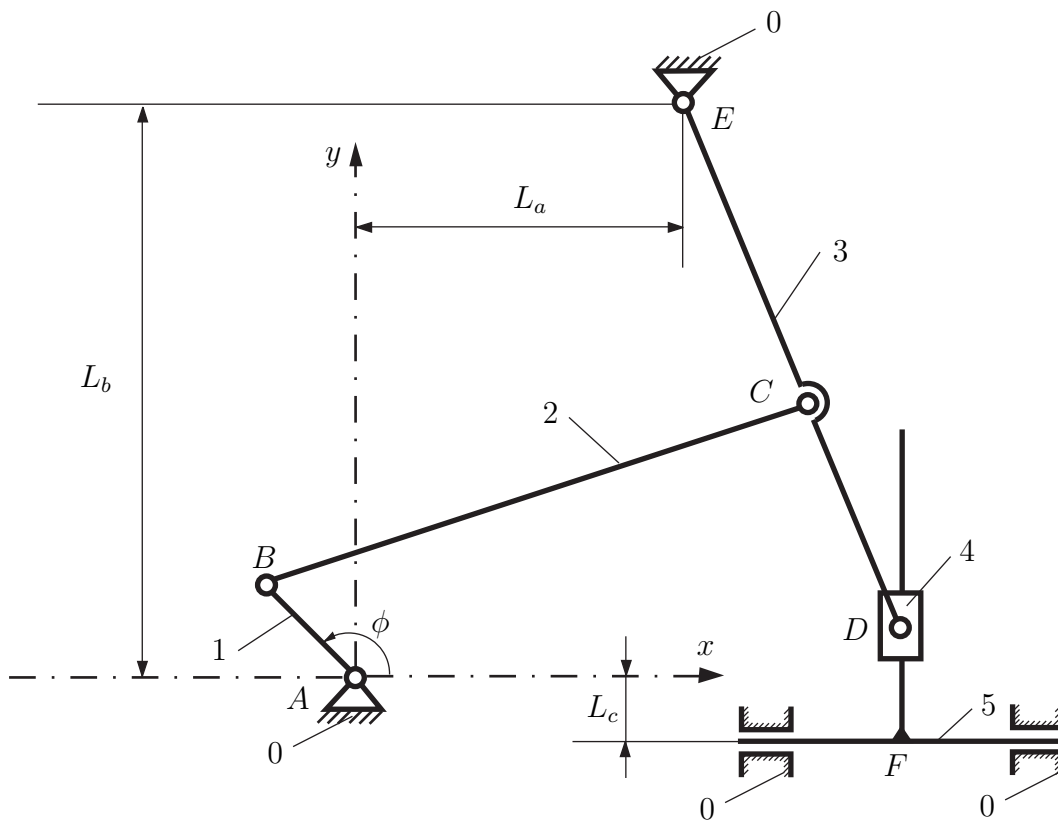


Figure P4.4