

R\_TRR

Input data

{AC → 0.1, BC → 0.3, xC → 0.1, yC → 0., phi[t] → 0.785398, phi'[t] → 10.472, phi''[t] → 0}

Joint B

Position of joint B

Equations for B (xB[t], yB[t])

$$-\text{Tan}[\text{phi}[t]] + \frac{yB[t]}{xB[t]} == 0$$

$$-BC^2 + (xC - xB[t])^2 + yB[t]^2 == 0$$

$$xB = 0.256155 \text{ m}$$

$$yB = 0.256155 \text{ m}$$

Linear velocity of joint B

Equations for vB (xB'[t], yB'[t])

$$\frac{-yB[t] xB'[t] + xB[t] yB'[t]}{xB[t]^2} == \text{Sec}[\text{phi}[t]]^2 \text{phi}'[t]$$

$$2 yB[t] yB'[t] == 2 (xC - xB[t]) xB'[t]$$

$$-3.90388 xB'[t] + 3.90388 yB'[t] == 20.944$$

$$0.512311 yB'[t] == -0.312311 xB'[t]$$

$$xB' = -3.33304 \text{ m/s}$$

$$yB' = 2.03186 \text{ m/s}$$

$$vB=vB2=vB3= \{-3.33304, 2.03186, 0\} \text{ m/s}$$

Linear acceleration of joint B

Equations for aB (xB''[t], yB''[t])

$$\frac{2 yB[t] xB'[t]^2 - 2 xB[t] xB'[t] yB'[t] - xB[t] yB[t] xB''[t] + xB[t]^2 yB''[t]}{xB[t]^3} ==$$

$$\text{Sec}[\text{phi}[t]]^2 (2 \text{Tan}[\text{phi}[t]] \text{phi}'[t]^2 + \text{phi}''[t])$$

$$2 (xB'[t]^2 + yB'[t]^2 - xC xB''[t] + xB[t] xB''[t] + yB[t] yB''[t]) == 0$$

$$545.037 - 3.90388 xB''[t] + 3.90388 yB''[t] == 438.649$$

$$30.4753 + 0.312311 xB''[t] + 0.512311 yB''[t] == 0$$

$$xB'' = -20.026 \text{ m/s}^2$$

$$yB'' = -47.2778 \text{ m/s}^2$$

$$aB=aB2=aB3= \{-20.026, -47.2778, 0\} \text{ m/s}^2$$

Link BC

$$\tan[\phi_3[t]] = \frac{y_B[t]}{-x_C + x_B[t]} \text{ or}$$

$$\sin[\phi_3[t]] (-x_C + x_B[t]) - \cos[\phi_3[t]] y_B[t] == 0$$

$$\phi_3 = 1.02334 \text{ rad} = 58.633 \text{ deg}$$

Equation for  $\phi_2'[t]$

$$\cos[\phi_3[t]] (-x_C + x_B[t]) \phi_3'[t] + \sin[\phi_3[t]] y_B[t] \phi_3'[t] + \sin[\phi_3[t]] x_B'[t] - \cos[\phi_3[t]] y_B'[t] == 0$$

$$-3.90354 + 0.3 \phi_3'[t] == 0$$

$$\phi_3' = 13.0118 \text{ rad/s}$$

$$\Omega_3 = \{0, 0, 13.0118\} \text{ rad/s}$$

Equation for  $\phi_3''[t]$

$$-\sin[\phi_3[t]] (-x_C + x_B[t]) \phi_3'[t]^2 + \cos[\phi_3[t]] y_B[t] \phi_3'[t]^2 + 2 \cos[\phi_3[t]] \phi_3'[t] x_B'[t] + 2 \sin[\phi_3[t]] \phi_3'[t] y_B'[t] + \cos[\phi_3[t]] (-x_C + x_B[t]) \phi_3''[t] + \sin[\phi_3[t]] y_B[t] \phi_3''[t] + \sin[\phi_3[t]] x_B''[t] - \cos[\phi_3[t]] y_B''[t] == 0$$

$$7.50974 + 0.3 \phi_3''[t] == 0$$

$$\phi_3'' = -25.0325 \text{ rad/s}^2$$

$$\alpha_3 = \{0, 0, -25.0325\} \text{ rad/s}$$

Another way of calculating  $\omega_3$

$$\omega_{3v} = \{0, 0, \omega_3\}$$

$$r_{CB} = \{x_B - x_C, y_B - y_C, 0\} = \{0.156155, 0.256155, 0\}$$

$$v_{B2} = v_{B3} = \omega_{3v} \times r_{CB} \Rightarrow \omega_3$$

$$\omega_3 = 13.0118 \text{ rad/s}$$

Another way of calculating  $\alpha_3$

$$\alpha_{3v} = \{0, 0, \alpha_3\}$$

$$a_{B2} = a_{B3} = \alpha_{3v} \times r_{CB} - \omega_{3v}^2 r_{CB} \Rightarrow \alpha_3$$

$$\alpha_3 = 0.820194 - 11.2947 i \text{ rad/s}^2$$

$$v_{B1} = \omega_{1v} \times r_{AB} = \{-2.68245, 2.68245, 0\} \text{ m/s}$$

$$a_{B1} = -(\omega_1^2) r_{AB} = \{-28.0906, -28.0906, 0\} \text{ m/s}^2$$

$$v_{B2B1} = v_{B2} - v_{B1} = \{-0.65059, -0.65059, 0\} \text{ m/s}$$

$$|v_{B2B1}| = 0.920073 \text{ m/s}$$

$$a_{B2B1} = a_{B2} - a_{B1} - 2 \omega_1 \times v_{B2B1} = \{-5.56134, -5.56134, 0\} \text{ m/s}^2$$

$$|a_{B2B1}| = 7.86492 \text{ m/s}^2$$