Position Analysis

For Compound Mechanism 1:

$$\vec{r_1} = \vec{r_2} + \vec{r_3} + \vec{r_4}$$

$$r_1 e^{j\theta_1} = r_2 e^{j\theta_2} + r_3 e^{j\theta_3} + r_4 e^{j\theta_4}$$

$$r_1 cos(\theta_1) = r_2 cos(\theta_2) + r_3 cos(\theta_3) + r_4 cos(\theta_4)$$

$$r_1 sin(\theta_1) = r_2 sin(\theta_2) + r_3 sin(\theta_3) + r_4 sin(\theta_4)$$

$$0 = 30 cos(\theta_2) + 50 cos(\theta_3) + 55 cos(\theta_4)$$

$$-70 = 30 sin(\theta_2) + 50 sin(\theta_3) + 55 sin(\theta_4)$$

For input θ_2.

For Compound Mechanism 2:

$$\vec{r_5} = \vec{r_4} + \vec{r_6}$$

$$r_5 e^{j\theta_5} = r_4 e^{j\theta_4} + r_6 e^{j\theta_6}$$

$$r_5 \cos\theta_5 = r_4 \cos\theta_4 + r_6 \cos\theta_6$$

$$r_5 \sin\theta_5 = r_4 \sin\theta_4 + r_6 \sin\theta_6$$

$$125 \cos\theta_5 = 55 \cos\theta_4 + r_6 \cos\theta_6$$

$$125 \sin\theta_5 = 55 \sin\theta_4 + r_6 \sin\theta_6$$

where θ_4 is an input,

θ_5 and r_6 as outputs.

Velocity analysis

For Compound Mechanism 1:

$$0 = \omega_2 r_2 cos\theta_2 + \omega_3 r_3 cos\theta_3 + \omega_4 r_4 cos\theta_4$$

$$0 = \omega_2 r_2 sin\theta_2 + \omega_3 r_3 sin\theta_3 + \omega_4 r_4 sin\theta_4$$

for omega 2 as an input and omega 3 and 4 as unknowns

For Compound Mechanism 2:

$$-\omega_5 r_5 sin\theta_5 = -\omega_4 r_4 sin\theta_4 + \dot{r_6} cos\theta_6$$

$$\omega_5 r_5 \cos\theta_5 = \omega_4 r_4 \cos\theta_4 + \dot{r}_6 \sin\theta_6$$

For omega 4 as input,

omega 5 and r6 dot as unknowns

Acceleration analysis

For Compound Mechanism 1:

$$0 = -\omega^2{}_2 r_2 \cos\theta_2 - \alpha_2 r_2 \sin\theta_2 + -\omega^2{}_3 r_3 \cos\theta_3 - \alpha_3 r_3 \sin\theta_3 + -\omega^2{}_4 r_4 \cos\theta_4 - \alpha_4 r_4 \sin\theta_4$$

$$0 = -\omega^2{}_2 r_2 \sin\theta_2 + \alpha_2 r_2 \cos\theta_2 + -\omega^2{}_3 r_3 \sin\theta_3 + \alpha_3 r_3 \cos\theta_3 + -\omega^2{}_4 r_4 \sin\theta_4 + \alpha_4 r_4 \cos\theta_4$$

for $\alpha_2 = 0$ as an input and α_3 and α_4 as unknowns

For Compound Mechanism 2:

$$-\omega^2{}_5 r_5 \cos\theta_5 - \alpha_5 r_5 \sin\theta_5 = -\omega^2{}_4 r_4 \cos\theta_4 - \alpha_4 r_4 \sin\theta_4 + \ddot{r}_6 \cos\theta_6$$

$$-\omega^2{}_5 r_5 \sin\theta_5 + \alpha_5 r_5 \cos\theta_5 = -\omega^2{}_4 r_4 \sin\theta_4 + \alpha_4 r_4 \cos\theta_4 + \ddot{r}_6 \sin\theta_6$$

For α_4 as input,

α_5 and $\ddot{r}_6$ as unknowns.