$$\begin{cases} x_1^C = l_1 \cos q_1 + l_2 \cos q_2 + l_3 \cos(q_1 + q_2 + q_3), \\ x_2^C = l_1 \sin q_1 + l_2 \sin q_2 + l_3 \sin(q_1 + q_2 + q_3); \end{cases} \tag{1}$$

$$q_3 = -\frac{q_2}{2}, \tag{2}$$

$$\begin{cases} x_1^C = l_1 \cos q_1 + l_2 \cos q_2 + l_3 \cos\left(q_1 + \frac{q_2}{2}\right), \\ x_2^C = l_1 \sin q_1 + l_2 \sin q_2 + l_3 \sin\left(q_1 + \frac{q_2}{2}\right); \end{cases} \tag{3}$$

$$\begin{cases} r = 2l_1 \cos\left(\frac{q_2}{2}\right) + l_3, \\ \phi = q_1 - \frac{q_2}{2}; \end{cases} \tag{4}$$

$$\begin{cases} q_1 = \phi + \arccos\left(\frac{r - l_3}{2l_1}\right), \\ q_2 = 2\arccos\left(\frac{r - l_3}{2l_1}\right); \end{cases} \tag{5}$$

$$\mathbf{M}(\mathbf{q})\ddot{\mathbf{q}} + \mathbf{C}(\mathbf{q}, \dot{\mathbf{q}})\dot{\mathbf{q}} + \mathbf{K}(\mathbf{q}) = \mathbf{Q}(t), \tag{6}$$

$$\sum_i (\mathbf{Q}_i - m_i \ddot{\mathbf{r}}_i) \cdot \delta \mathbf{r}_i = 0, \tag{7}$$

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_i}\right) - \frac{\partial L}{\partial q_i} = Q_i, \quad L = T - \Pi \tag{8}$$