$$D^{(q)} = \begin{bmatrix} I_{zz,1} & 0 & 0 \\ 0 & (I_{xx,2}s^2q_1c^2q_2 + I_{yy,2}c^2q_1 + I_{zz,2}s^2q_1s^2q_2) & 0 \\ 0 & 0 & [I_{xx,3}s^2q_1(c^2(q_2+q_3) - 2c(q_2+q_3)s(q_2+q_3) + s^2(q_2+q_3)) + I_{yy,3}c^2q_1 + I_{zz,3}s^2q_1(c^2q_2s^2q_3 + 2cq_2cq_3sq_2sq_3 + s^2q_2c^2q_3)] \end{bmatrix} \begin{bmatrix} \ddot{q}_1 \\ \ddot{q}_2 \\ \ddot{q}_3 \end{bmatrix}$$

G is 3×1

$$G^{(q)} = \begin{bmatrix} 0 \\ mg\frac{L_2}{2}sq_2 \\ mg\frac{L_3}{2}(sq_2cq_3 + cq_2sq_3) \\ mg\frac{L_3}{2}(-sq_2sq_3 + sq_2cq_3) \end{bmatrix}$$

$$G(q) = \begin{bmatrix} 0 \\ mg\frac{L_2}{2}sq_2 + mg\frac{L_3}{2}(sq_2cq_3 + cq_2sq_3) \\ mg\frac{L_3}{2}(-sq_2sq_3 + sq_2cq_3) \end{bmatrix}$$

$$C = (q, \dot{q})$$

$$\begin{bmatrix} \dot{q}_1 \\ \dot{q}_2 \\ \dot{q}_3 \end{bmatrix}$$

$$\begin{bmatrix} \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \end{bmatrix}$$

$$\frac{1}{2}\dot{q}_2\left(I_{xx,2}s^2q_1c^2q_2 - I_{yy,2}s^2q_1 + I_{zz,2}s^2q_1s^2q_2\right)$$

$$\frac{1}{2}\dot{q}_3\Big[I_{xx,3}s^2q_1\big(c^2(q_2+q_3) - 2c(q_2+q_3)s(q_2+q_3) + s^2(q_2+q_3)\big) - I_{yy,3}s^2q_1 + I_{zz,3}s^2q_1\big(c^2q_2s^2q_3 + 2cq_2cq_3sq_2sq_3 + s^2q_2 + c^2q_3\big)\Big]$$

$$\frac{1}{2}\dot{q}_2\left(-I_{xx,2}s^2q_1s^2q_2 + I_{zz,2}s^2q_1s^2q_2\right)$$

$$\frac{1}{2}\dot{q}_3\Big[I_{xx,3}s^2q_1\big(-s^2q_2 + 2sq_2cq_2 + s^2q_2\big) + I_{zz,3}s^2q_1\big(-s^2q_2s^2q_3 - 2s^2q_3c^2q_3 + s^2q_2c^2q_3\big)\Big]$$

$$\frac{1}{2}\dot{q}_3\Big[I_{xx,3}s^2q_1\big(-s^2q_3 + 2sq_3cq_3 + s^2q_3\big) + I_{zz,3}s^2q_1\big(c^2q_2c^2q_3 - 2cq_2cq_3sq_2sq_3 - s^2q_2c^2q_3\big)\Big]$$