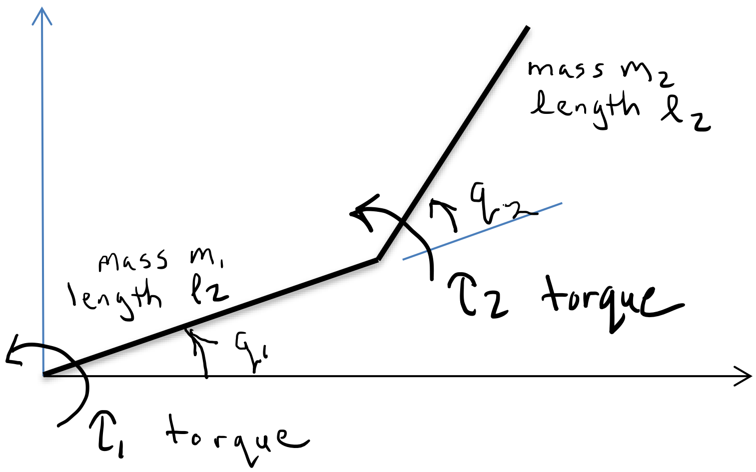
PROJECT Modelling

For the dynamic equations of the horizontal planar Elbow Robot Manipulator, pictured below, write the system is state space form. You can then use any integration routine (eg Runge-Kutta) to do the simulations. Demonstrate that the simulations behave as expected.



$$\tau_1 = [\frac{m_1 l_1^2}{3} + \frac{m_2 l_2^2}{12} + m_2(l_1^2 + \frac{l_2^2}{4} + l_1 l_2 \cos(q_2)]\ddot{q}_1 + [\frac{m_2 l_2^2}{3} + \frac{m_2 l_1 l_2}{2}\cos(q_2)]\ddot{q}_2$$
$$- m_2 l_1 l_2 \sin(q_2)\dot{q}_1\dot{q}_2 - \frac{m_2 l_1 l_2 \sin(q_2)}{2}\dot{q}_2{}^2 + (\frac{m_1 l_1}{2} + m_2 l_1) g \cos(q_1) + \frac{m_2 l_2}{2} g \cos(q_1 + q_2) + c_1 \dot{q}_1$$
$$\tau_2 = [\frac{m_2 l_2^2}{3} + \frac{m_2 l_1 l_2}{2}\cos(q_2)]\ddot{q}_1 + \frac{m_2 l_2^2}{3}\ddot{q}_2 + \frac{m_2 l_1 l_2 \sin(q_2)}{2}\dot{q}_1{}^2 + \frac{m_2 l_2}{2} g \cos(q_1 + q_2) + c_2 \dot{q}_2$$

where g is the gravitation constant.