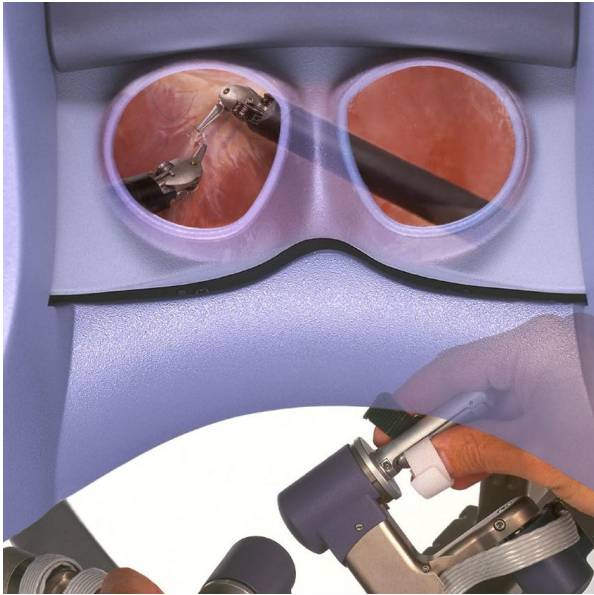
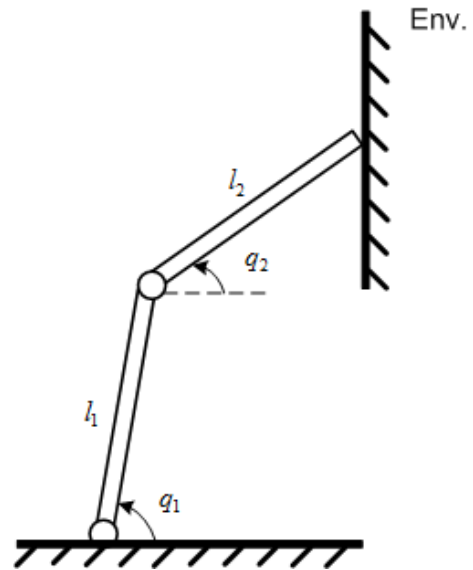


Question:

Contact stability is important for surgical robotic system to achieve safe interaction with tissue (Figure (a)). Design a Hybrid position/force control system for the robotic system below (Figure (b)):



(a) Interaction between a surgical robot and tissue



(b) A robotic arm in contact with an environment

Figure. Contact stability has to be achieved for surgical robotic systems.

The robotic systems have the following parameters: $l_1 = l_2 = 0.5$ m, $m_1 = m_2 = 10$ kg, $I_1 = I_2 = 2$ kg.m² . For the 2 DOF robotic system, $q_1 = 80^\circ$ and $q_2 = 30^\circ$.

Derive the control laws for each system that achieved stable contact with the environment.

You have also to do stability analysis based on the Routh-Hirwitz Criteria.