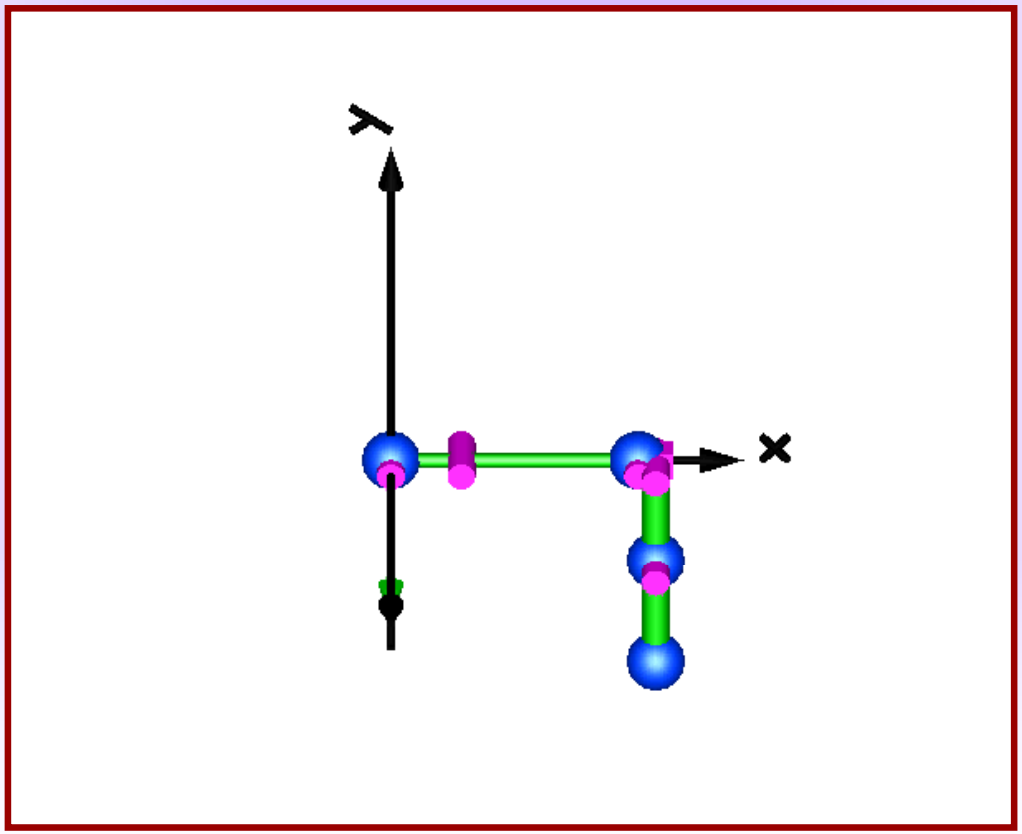
11th Homework

- In this homework, we shall model and simulate a 3D mechanical system with proper animation.

Multi-body System

- We wish to model and simulate the following multi-body system using the 3D mechanics sub-library of the multi-bond graph library:



Multi-body System II

- Although this is actually a 2D mechanical system, we shall use the 3D mechanical library, as this enables us to hang the two rods of the double pendulum a little in front to prevent these bodies from intersecting with each other graphically.
- There is a revolute joint at the origin. Connected with the revolute joint is a mass of ***2 kg*** with an inertial tensor, represented by a diagonal matrix with diagonal elements of ***0.3 kg·m²***.
- The mass is accelerated by an external torque of ***2 N·m***. The torque must be applied in the same direction as the rotational axis of the revolute joint.
- Also connected to the revolute joint is a rod of ***0.1 m*** length that rotates around the origin.

Multi-body System III

- At the other end of the rod, there is a second revolute joint, connected to a second rod of ***0.25 m*** length.
- There follows a third revolute joint that connects to a prismatic joint and back to a wall that is located ***0.4 m*** to the right of the origin.
- Due to the two walls, there exists a planar kinematic loop. As explained in class, one of the three revolute joints will have to be replaced by a cut joint in order to break that loop.
- In parallel with the prismatic joint, there is a damper with a damping coefficient of ***50 N·s/m***.
- Also connected to the moving end of the prismatic joint, there is a second mass of ***1 kg*** with an inertial tensor, represented by a diagonal matrix with diagonal elements of ***0.03 kg·m^2***.

Multi-body System IV

- We have so far built a model of a compressor driven by a mechanical motor.
- Let us simulate this system over a duration of ***10 sec*** and watch the animation.

Multi-body System V

- To make the system a bit more interesting, we shall now hang a double pendulum off the moving part of the prismatic joint.
- The top end of the first pendulum rod is located at the center of the prismatic joint in its initial position, yet ***0.02 m*** in front, so that the pendulum does not bump into the piston.
- The first rod is ***0.15 m*** long.
- At the end of that rod, there is a third mass identical to the second mass.
- A rod of ***0.02 m*** length connects that mass to the top end of the second pendulum rod. The purpose of that short rod is to hang the second pendulum ***0.02 m*** in front of the first pendulum to prevent that they bump into each other.

Multi-body System VI

- The second pendulum is connected to the first pendulum by another revolute joint.
- The second pendulum is equal in size to the first.
- There is a fourth mass of identical size as the third connected to the end of the second pendulum.

Multi-body System VII

- Simulate the enhanced multi-body system over a duration of ***10 sec*** and watch the animation.