DOUBLE 3D PENDULUM

Model Features

An inverted Double 3D Pendulum is represented in an inertial frame (x, y, z) as a two-body system :

- The lower body is an axially symmetric rigid link whose end-points are referred to as the "foot" and the "hip", respectively. There is an additional lumped mass placed at the "hip" and the "foot" is rigidly fixed to the ground understood to be the (x, y) plane.
- The upper body is also an axially symmetric rigid link with an additional lumped mass placed at its tip that represents the "head". The upper and lower bodies are attached to one another at the "hip".
- The joint at the "foot" is assumed to be spherical, but is realized here as three consecutive revolute joints permitting three rotations about the x, y, z axes. The revolute joints at the "foot" are NOT actuated.
- The joint at the "hip" is assumed to be universal and is realized as two consecutive revolute joints permitting rotations about the x and y axes. Both revolute

joints at the "hip" are actuated freely (there is no constraint on the actuation power).

- All joints are frictionless and the pendulum is placed in a gravity potential field.

In this simulation, but without the loss of generality, the geometry and inertia matrices for the upper and lower bodies are assumed the same. The spatial double pendulum system is modeled as a five link kinematic chain in the framework of the Spatial Operator Algebra (SOA),

http://dshell.jpl.nasa.gov/SOA/index.php

The SOA framework permits to calculate the forward and backward dynamics of the system, all reaction forces at the joints, the kinetic and potential energies of the system and its parts, and the work performed on the body by the reaction forces at the ground.