Assignment 7, EECS 397/600: DARPA Robotics Challenge
Rosbag Data Analysis and Center of Mass
due by 5pm, Tuesday, 21 October

Refer to the document: "Analyzing Bagged Data in Octave/Matlab." See the Octave code example "example_octave.m" in …/catkin/src/examples/example_rosbag_analysis. Also, see the playfile script "ankles_lean_fwd.traj" in the repository subdirectory "traj_files."

Start up drcsim, as well as the joint-trajectory server (and set it to USER mode). Run the example playfile trajectory (rosrun play_file play_file ankles_lean_fwd.traj). Open a terminal and navigate to a directory where you will store your logged data. Log data while running this above trajectory:

```
rosbag record -O my_log  atlas/atlas_state
```

Convert this data to Matlab format. Copy the example Octave code to your bagfile directory and run it. Look at the sum of the ankle torques about the y-axis (already performed in the example code).

Your objective is to derive a linear model for center-of-mass perturbations as a function of joint angles. Alter the trajectory file to send the robot to different poses, moving coordinated joints. Specifically, bend just the ankles, dq8 and dq14, relative to the starting pose (while keeping all other joints frozen at the initial pose). These two angles should be perturbed equally, to keep Atlas's feet flat while leaning forward/back from the ankles. Subsequently, restore these angles to the nominal (starting) pose, and bend the knees together (dq7 and dq13), again bending them in unison to keep Atlas symmetric. Repeat for the hips (dq6 and dq12), and finally the waist (dq1). Note that the angle indices here refer to the ROS/Atlas numbering (starting index from 0), not Matlab numbering (starting indexing from 1).

Find factors K_ankles, K_knees, K_hips and K_back to fit the equation:

r_com = K_ankles*dq_ankles + K_knees*dq_knees + K_hips*dq_hips + K_back*dq_back.

Where r_com is the location of the center of mass forward/backward (i.e., in the x-direction) relative to the ankles, and the dq values are perturbations of joint angles relative to the start-up pose.

Prove that your model works by trying in with example poses that perturb all 4 joint combinations simultaneously. Your model should predict a center of mass, and your bagfile/Matlab analysis should validate your model.