Project: 3D Hopper Controller

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In this project, you will use reinforcement learning to improve the control algorithm for a 3D hopping robot. You will implement your control algorithms in Matlab using the provided Open Dynamics simulation, which will enable you to get precise sensory feedback about the robot state from the simulator. For this project, your final work should be performed alone, but you are welcome to discuss your approach to this problem with others and me when you are developing your ideas.

1. A directory containing the Open Dyanmics Mex simulation software (for Mac OS X and Linux—Windows users will need to investigate how to compile the provided source code) as well as the Matlab M-files to setup a 3D hopping robot simulation are available. You are free to modify the control and plotting routines for this project.

2. You should first implement a simple Raibert-style control algorithm to get the robot to hop in place. Note that you'll have to use the position, rotation, and velocities from hopperState to determine your control variables. You should also look at hopperControl to see how the simple velocity controls are set.

3. Now use reinforcement learning to see if you can improve the stability of the controller. For this step, you should just try to improve its ability to hop in place from various initial conditions.

4. Finally, see how well you can get the hopper to follow a given trajectory on the floor of the simulation. You can define a reward function that computes how well the robot performs, and use learning optimization to improve this over time.

5. You should write a short description of your processing and learning algorithms, along with any code. Also, be prepared to present a brief presentation in class about your approach, along with a short demonstration of your final system.