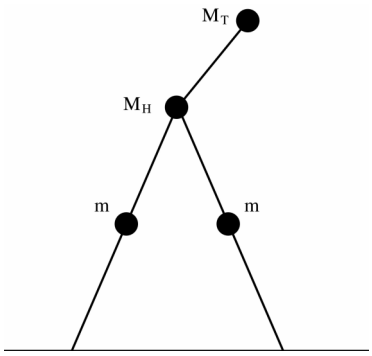
User Documentation for Underactuated Three-link Biped

This is the only documentation you have other than the comments in the files. The authors do NOT support the software in any way. The software is offered for your free noncommercial use. The code has been run successfully on MATLAB 6.5 on a PC. Use of the software in a unix environment may require minor changes where directories and paths are involved.



The following directories should be present:

1) symbolic
2) functions_auto_gen
3) functions_manual
4) simulation

symbolic: this directory contains files that use the symbolic toolbox in MATLAB to generate the dynamic model of the robot using the method of Lagrange. The main file is **symb_model_biped_3dof.m** which computes the 3-DOF swing phase dynamics and the 5-DOF dynamics required for the impact model. In addition, it symbolically computes functions required for the feedback controller based on hybrid zero dynamics. Finally, this file calls other files that then write out the symbolic data as m-files that can be called in ODE45. These

files are placed in the directory functions_auto_gen. The coordinate system used in the model is documented in the file **fig_biped_newer_coordinates.jpg**

functions_auto_gen: this directory contains the m-files that are produced by **symb_model_biped_3dof.m** When the symbolic file is run, the files in this directory are automatically updated. You may wish to make a backup copy of this directory before executing the symbolic code.

functions_manual: this directory contains miscellaneous m-files that have been hand coded. The files in this directory are permanent in the sense that executing the symbolic code does not change them.

simulation: this directory contains files that are specific to executing a complete simulation of the biped in closed loop with a controller based on the hybrid zero dynamics. The main file is **test_full_simu.m** It first sets the parameters in the controller, the initial conditions of the robot, and a few gait parameters. It then calls the function

[x,t]=full_simul(x0,a,theta_minus,steps,do_animation,draw_graphs)

which simulates the closed-loop system, produces relevant plots, and performs and animation of the gait.

Quick start: start MATLAB, “cd” to the directory “simulation” and execute the m-file “test_full_simul”. The default is to take 10 steps, perform an animation of the motion, and plot the trajectories of the joint angles and the torques.