Theory and Practice of Humanoid Walking Control
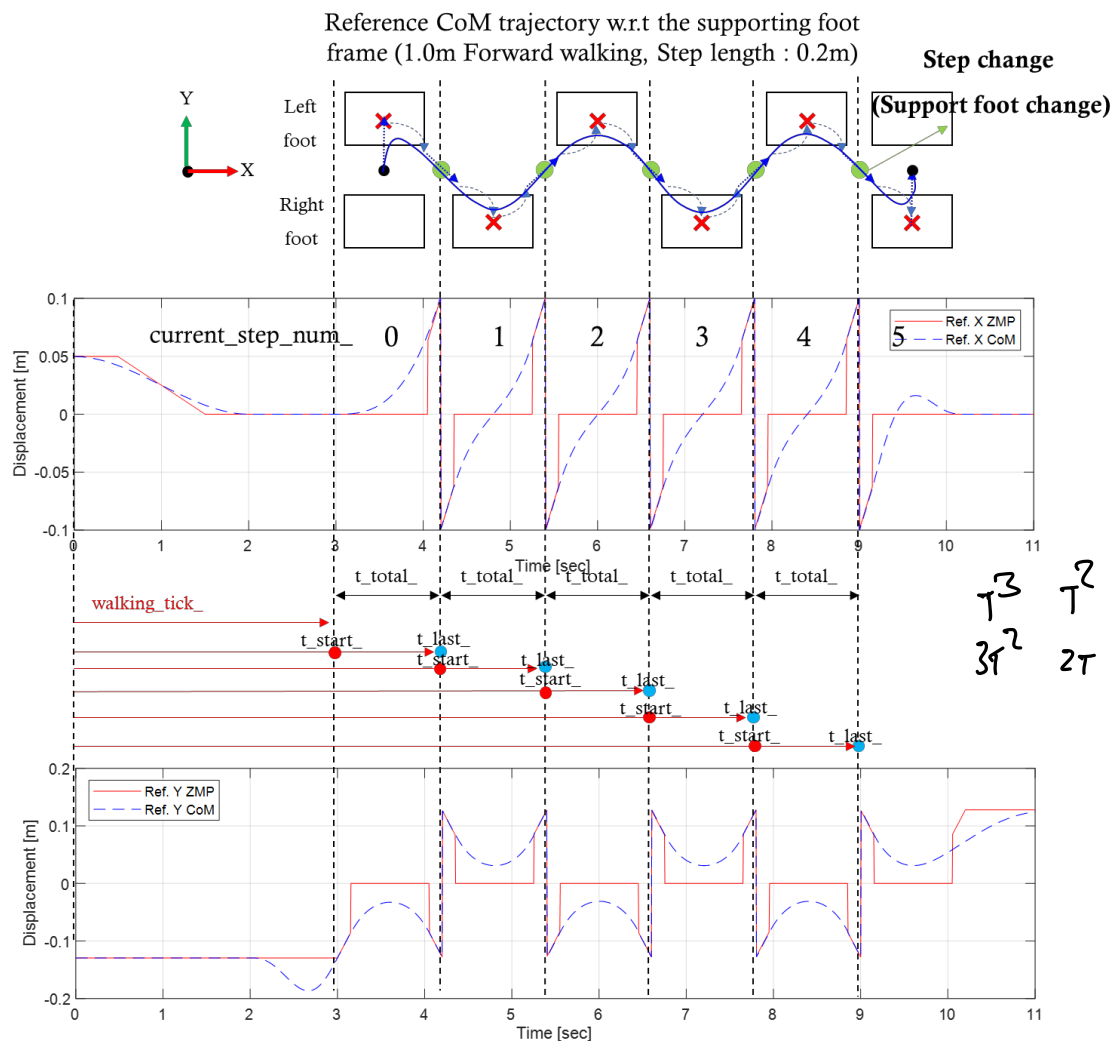
2022 Fall semester

Homework # 3

Problem 3 Offline CoM planning (For forward walking)

※ References : Y. Choi, D. Kim, Y. Oh, and B.-J. You, "Posture/walking control for humanoid robot based on kinematic resolution of CoM jacobian with embedded motion," *IEEE Trans. on Robotics*, vol. 23, no. 6, pp. 1285–1293, 2007.

※ The first step's support foot is the left foot.

Figure. 1

✓ Design the reference CoM trajectory w.r.t the supporting foot frame as shown in the figure. 1 (Note the figure. 1 and reference paper.)

    1) Since the robot's initial X CoM is not zero, design a reference CoM trajectory that makes X CoM zero before the walking. (Note the X CoM in the figure. 1)

2) Design the CoM trajectory for a given ZMP using LIPM's ZMP–CoM dynamics in the single support phase.

3) Design the CoM trajectory to be the same for the given ZMP trajectory in the double support phase.

4) Design the CoM trajectory in the first and last steps to be continuous with the CoM trajectory designed above by using a 3rd or 5th order polynomial.

✓ Run it after programming

1) rosrun dyros_jet_gui dyros_jet_gui → X: 1.0m, Step length : 0.2m → START walking button click!!

2) Plot the Reference X, Y CoM trajectory

※ Hint

Available variables implemented in code framework. (Refer to the figure. 1)

Simulation time → walking_tick_ (1tick : 0.005sec)

1 step time (1.2sec) → t_total_

Start time of each step → t_start_

End time of each step → t_last_

First DSP and last DSP time in one step → t_double1_ (0.1 sec), t_double2_ (0.1 sec)

The total number of steps to reach the target point. (It is automatically calculated when you click the start walking button.) → total_step_num_

Current number of steps → current_step_num_

Initial X, Y, Z CoM position w.r.t the support foot → com_support_init_(0), com_support_init_(1), com_support_init_(2)

Foot step position w.r.t the current support foot frame

→ foot_step_support_frame_(n,0), foot_step_support_frame_(n,1)

→ The first element n of the variable means sequence, and the second elements 0 and 1 mean the positions of X and Y, respectively.