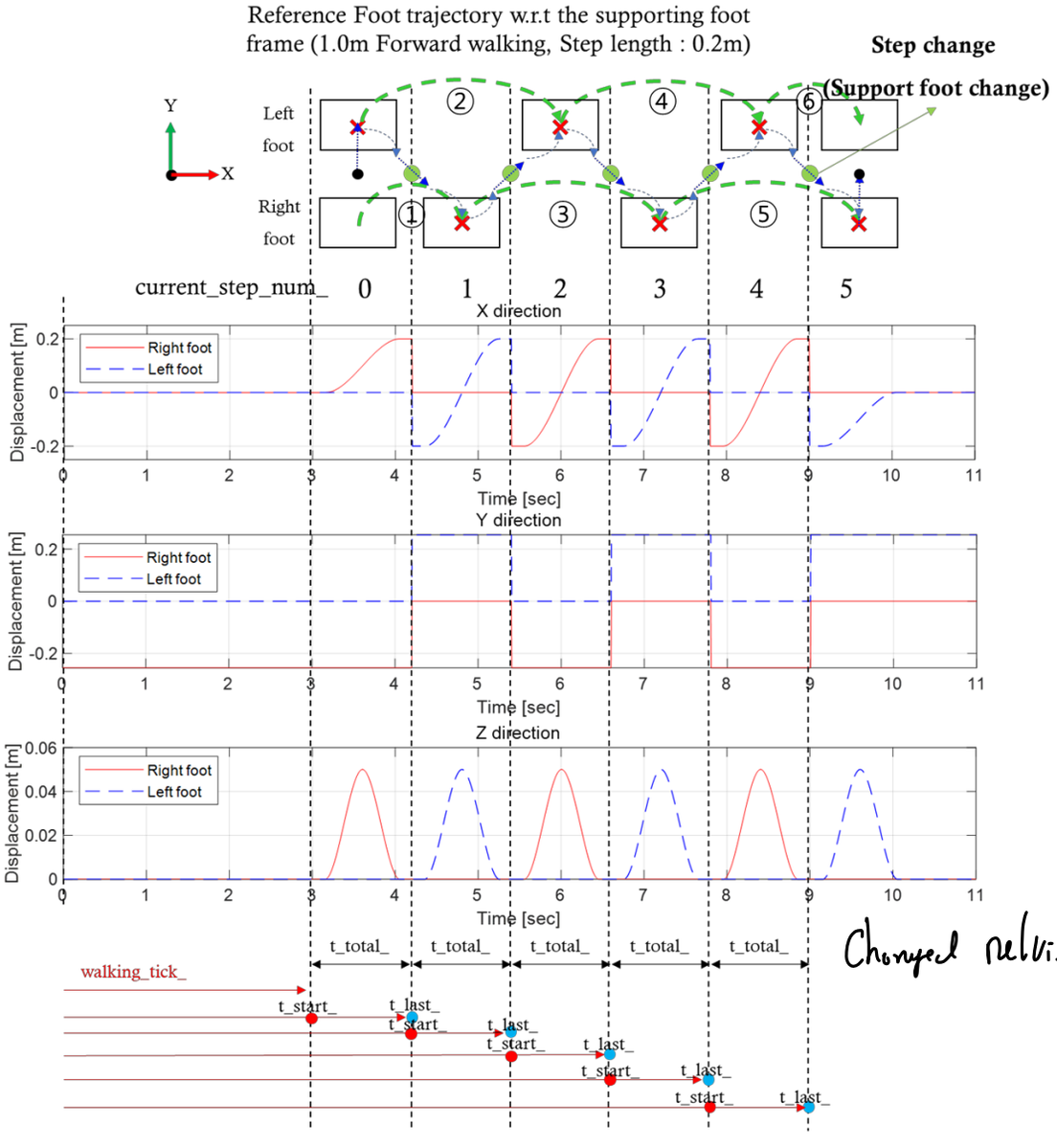
Theory and Practice of Humanoid Walking Control

2022 Fall semester

Homework # 4

Problem 4 Foot trajectory, CoM closed loop control (For forward walking)

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



Changed pelvis Pov.

✓ Generate a reference foot trajectory w.r.t the supporting foot frame.

1) In the double support phase, keep both feet in place.

2) In the Single Support Phase, keep the support foot in place w.r.t the supporting foot frame, and swing the swing foot from the previous foot step to the next foot step. (Use the planned

footstep variables)

3) Set the orientation of the support foot and swing foot to be the same as that of Pelvis.

- ✓ Generate the reference pelvis trajectory using the CoM trajectory implemented in HW#3 and the CoM closed loop control.
  1) Reference pelvis position (X, Y) = Actual pelvis position + K·(Reference CoM position – Actual CoM position)
  2) Reference pelvis position (Z) → Initial position of the pelvis (Constant)
  3) Reference pelvis orientation → Set identity

- ✓ Compute inverse kinematics using the generated pelvis and foot trajectories.
- ✓ 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 pelvis, foot trajectory w.r.t the supporting foot frame, and record the walking simulation video.

* Hint

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)

Real pelvis position w.r.t the supporting foot frame → pelv_support_current_.translation()(n), n = 0, 1, 2 (X, Y, Z respectively.)

Initial pelvis height w.r.t the supporting foot frame → pelv_support_start_.translation()(2)

Real CoM position w.r.t the supporting foot frame → com_support_current_(n), n = 0, 1, 2 (X, Y, Z respectively.)

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.