RO:BIT Team Extended Abstract for Humanoid Kid Size League of RoboCup 2025

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Abstract. This extended abstract presents RO:BIT's plans to improve gait and motion control primarily for Robocup 2025. It is based on the problems and lessons learned from our participation in previous RoboCup competitions.

Keywords: Walking control, Motion control, Vision, Capture Point Walking

1 Introduction

This paper outlines the RO:BIT team's plans for RoboCup 2025, developed based on experiences from RoboCup 2023 and 2024. In previous competitions, observations of our robots swaying during walking and losing balance while kicking the ball highlighted critical issues. Recognizing the significance of addressing these issues, our primary focus lies in the improvement of walking mechanisms and motion control. Extensive research and development efforts are being dedicated to solving these problems in the control domain.

Another identified challenge from past competitions was the recognition of robot objects. While some robots could be detected in images, the accuracy was not satisfactory. To address this, we have undertaken algorithm enhancements and additional labeling to improve object recognition.

2 Walking Control and Motion Control

In the previous 2024 Robocup Humanoid competition, the bridge was designed with a link structure to stabilize the walking of humanoid robots, but the overall weight of the hardware increased, often resulting in motor overload and gear damage due to the weight increase received by the motor on the leg side. Therefore, we plan to apply real-time control technology using motor feedback to mitigate the impact of feet touching the floor.

Currently, our team's humanoid motion technology is designed to perform the desired motion by manually adjusting the motor value every set time frame. However, since this work is done manually by humans, it takes a lot of time to obtain the desired motion,

and if the motion is unstable because it is not controlled through the sensor or motor even when creating and executing the motion, it takes a lot of time to generate the motion again.

Furthermore, during football matches, the robot performs post-walking movements, but due to the current structural nature, it is necessary to execute code for the actions through the central circuit, resulting in delays.

Therefore, to address these challenges, we plan to completely modify and develop the inverse kinematics part code so that there is no difference between the robot's walking and motion performance tasks, reducing the delay that occurs before the motion is performed, and at the same time allowing the optimal motion to be performed under the control of the sensor when the motion is performed.

The control currently under development is in the stage of adjusting the walking trajectory and number of steps suitable for the desired path when implementing and executing the robot's model on the matlab with MPC control, but it still takes a long time to create the path in real time. Also, we are in the process of providing more stable walking by controlling based on capture point dynamics. [2]

Therefore, we plan to develop it using deep reinforcement learning together to create a walking path in real time.

3 Vision and Localization

Last year, we attempted semantic segmentation, but deemed it impractical for real-time usage due to excessive resource consumption. As an alternative, we labeled the robots and utilized YOLO for robot detection. However, there was a tendency for accuracy to decrease during the process of recognizing and localizing other robots. As a solution to this challenge, given the difficulty in fully estimating the robots, we plan to incorporate MCL-based localization [1], which compares the possibility field with the extracted joints of the line for line correction, into the robot's position correction.

References

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