TH-MOS Extended Abstract for Humanoid Kid-size League of RoboCup 2020

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Abstract. This paper describes the robot system designed by team THU-MOS. It includes the lessons we have learned from previous RoboCup competitions and what we try to improve and apply to RoboCup 2020 competition. Our major changes and status of implementation are also presented. To prepare for RoboCup 2020, our work is focused on mechanics, deep learning and walking.

Keywords: RoboCup 2020, Humanoid Kid-size League, robot

1 Lessons and Problems

A lesson we learned from previous competition experience is to prepare adequately before our journey. We should preview every steps, including contacting the referee box, debugging mechanical zero and so on. We also find some problems with our robots. Our localization algorithm is simple and robots can only find the ball and the goal without knowing their accurate position in the field. Besides, a lack of robustness also results in instability when walking on the softer grass. The lessons provide directions of improvement for us.

These are major problems we try to solve this year:

- Low robustness on different fields.
- Inability to locate accurately.
- No feedback to referee box.

2 Plans and Results

2.1 Mechanics

To improve grass holding, we are trying to replace their soles with new 3D printing structure designed by us. Longer sticks and more suitable distribution of sticks decrease robots shaking amplitude, making walking gait more stable.

We lengthened legs of robots legally allowed in the competition to make it walk faster. We are searching for other ways to increase its gait stability.

2.2 Vision

We are trying to apply deep learning in ball searching. The task of this part is to quickly recognize the low-resolution image and return a vector representing the position and distance of the ball. The motion mechanism looks for the ball in the direction indicated by the vector.

Our artificial neural network system adopts nonlinear decision making, which is constructed by two layers of sigmoid elements, that is, one layer of hidden layer and one layer of output layer. The size of the hidden layer is determined according to the actual calculation ability and the technical details of the processor. The size of the output layer is no less than 3, and the relative position of the ball is determined according to the output vector.

2.3 Walk

As a main difference from last version of robot, the new version integrates NVIDIA Jetson TX2 into the robot. Thus, the computation of generating gaits such as omnidirectional walking, getting up after falling down, kicking the ball and so on, is transferred from motion controller (LPC1768) to decision controller (Jetson TX2). The prime advance is that the robot can produce gaits exploiting the abundant computing power of Jetson TX2.

We stored the parameters of basic gaits that have been adjusted by our team into the motion controller. To correspond with longer legs, we are testing for better parameters and seeking for more complicated motion model, instead of inverted pendulum model.