ZJUDancer Team Extended Abstract

Yu Ruiqi, Yu wei, Wang Xiyun, Bi Yancheng, Cheng Zhifan, Zhang Shuaichen, Wang Yiran, Zhou Yiyao, Shen Yike, Wu Xinning, Su Hao, Wang Shuai, Fang Renda, Huang Xianmin, Ding Yuhan, Dai Chengjiang, Sun Yifang, Zhou Zhongxiang, and Xiong Rong

College of Control Science and Engineering, Zhejiang University, Hangzhou, China

1 Lessons Learned and Major Problems to Be Done

1.1 Hardware Part

In recent RoboCup competitions, our robot has often experienced circuit crashes during confrontations. This seriously affected the performance of our robot, compared to other teams who hardly experienced circuit crashes throughout the competition phase.
We believe this is due to the higher integration of the boards in their circuit section, making it more stable. Whereas our circuits have more boards, resulting in a higher replacement rate and aging. Improving the integration of the circuit is an important point of improvement for us in the coming period.
Also, in order to take on the software changes, we decided to add force feedback sensors to the soles of the feet, which is another key improvement in the circuitry
Also, mechanically, we have found that many teams have two degrees of freedom in the shoulder joint, while we only have one. More degrees of freedom in the shoulder joint allows for more hand movements, which in turn allows for more strategies when balancing the body and climbing up. Therefore increasing the degrees of freedom in the shoulder joint is another focus for us to improve in the future.

1.2 Software Part

In the past competitions, we found that other teams had rich visualization interfaces for servo state detection and motion debugging, which greatly improved the debugging efficiency and overhauling efficiency.
In addition, the kicking motion of our robot is completely done by manually adjusting the end position sequence, which makes it inefficient to spend a lot of time to adjust when encountering a new field, etc., and cannot guarantee to get a good motion effect. Therefore, we intend to access the foot force sensor to obtain the feedback data, and use ZMP to automatically adjust the kicking motion to maintain the kicking balance.
In terms of localization, we feel that there is still room for improvement in the current particle filter-based localization system, and try to include some visual odometers to make visual localization more accurate.

We currently intend to use the VINS-fusion algorithm as an update strategy for the motion modeling portion of ACML, instead of the original motion odometry calculated based on servo angle values.
Moreover, for the motion module, we also intend to introduce reinforcement learning to completely avoid tedious debugging of the kicking motion before each preparation. The specific plan is to input the image recognition results of the kicking phase into the reinforcement learning network, output the six-dimensional keyframe sequences of the center of gravity and the ankle, and then process the keyframes by interpolation to obtain a sequence of kicking movements.For the localization module, we also want to use the neural network to output localization information directly. A more feasible solution would be to input the corner points and ball information obtained from each frame of image recognition into the neural network and output a localization information directly. Such a scheme has a strong dependence on sequence information and also has some difficulty in data acquisition, and we are currently working on solving these two problems.

2 Plans to Be Implemented and Current Status

As previously described, on the hardware side we have identified a number of current issues and set out to address them. These are issues that we intend to address before the 2024 competition and make them effective for the competition.
Currently, for the circuitry section, due to the replacement of the host computer, we have reconfigured our circuitry section to reduce the number of boards to improve integration. For the force sensor on the bottom of the foot, the design has also been completed and is currently waiting for testing. For the mechanical part, the shoulder modification has been completed, but the role of the shoulder joint has not been tested yet.
For the software part, the preliminary code for ZMP feedback to adjust body balance is now completed and ready for testing. There are preliminary ideas for improvements in positioning, and materials are being procured. Visualization of the servo debugging interface has not yet begun.We currently intend to use the VINS-fusion algorithm as an update strategy for the motion modeling portion of ACML, instead of the original motion odometry calculated based on servo angle values. In terms of hardware, we intend to use the ZED-X series, which comes with a high-precision IMU and binocular camera.
We only have some preliminary ideas for the application of deep and reinforcement learning at this point. More feasibility and possibilities need to be verified subsequently.