Tsinghua Hephaestus 2020 AdultSize Extended Abstract*

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Abstract. Lessons Tsinghua Hephaestus learned from the RoboCup2019 and major changes prepared for the RoboCup 2020 competition.

1 Lessons

Dataset is important for object detection method, which means only tiny data to be captured when robot moves into a new field. we collected more than 40,000 images with cloud data in different fileds, including our own ground and the official venues from RoboCup 2017 to 2019. And a SOTA model[1] is trained to realize a real-time(20FPS) detection in competition.
Cloud msg can be rebuild by depth matrix. We firstly used cloud msg from the sdk of ZED to get the 3D position to robot, but we soon found the update process of the cloud data take too much computation resources, then we calculate the 3D information using depth matrix related to the image rgb matrix with all our estimated robot and camera coordinate.
Dribbling Kick is better than Long Kick. Dribbling the ball is easy for light-weight robots such as NimbRo-OP2[2], these robots can switch from dribbling to kicking in short time. Our robot realized a kick motion during walking gait this year, instead of kicking the ball out of vision range. Using this strategy in our own half can greatly reduce the risk of losing possession of the ball.

2 Major Problems

Walking on uneven and soft terrain The major problem is to realize a dynamic walking on soft grass field, our team has theoretical methods on Passive Dynamic Walking[3, 4] and ZMP based gait[5]. But due to the error of state estimation, we cannot fully control the WALKER when stepping on soft ground.
Vision, Localization and Obstacle Detection The vision module peformed well in Sydney, but can lose the markers and ball which are out of range(7m). For the lack of field-line markers, the localization cannot get accurate position

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and relied heavily on odometry, thus it introduced a serious direction drift in the game. We cannot detect opponent's position very well, which is a great danger for all robots on the field, and this is also a challenge for our decision module to pick a proper way to attack or defence without seeing the opponent.
Cooperation and Monitoring Interface It reduce the quality of the competition a lot without cooperation. For the 2 vs. 2 game was firstly added into AdultSize in 2019, we experimented rarely with the communication protocol between our two robots and made one robot a striker and another one a goal-keeper without a choice. The Monitoring Interface was not fully used, and the status of game and robot cannot been visualized real-time in 2019.

3 Plans for RoboCup 2020

There will be tiny change on mechanical and electrical system. Changes will occur in
Gait: we will introduce a event-based gait generator compared to[5] and utilize a momentum-based controller using QP to minimize the Ground Reaction Force.
Vision and Localization: More markers has been added into dataset such as field lines to lift up the ability of localization. The range to detect the ball will be longer than 15m.
Behavior and Communications: Two robots will share the info about the environment and make synchronous actions, the status can be monitored and visualized in UI.

4 Current Status

The range to detect the ball is 10m now and localization can work excellently without odometry. New gait controller has been verified in the simulation. Cooperation algorithm is continously being tested on two Walkers to build a synchronized behavior, and we currently have a new UI to monitor the robots bahavior.

References

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