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NimbRo AdultSize Extended Abstract 2022

Dmytro Pavlichenko, Hafez Farazi, Grzegorz Ficht, Marcell Missura,
Mojtaba Hosseini, Angel Villar-Corrales and Sven Behnke

Rheinische Friedrich-Wilhelms-Universität Bonn
Computer Science Institute VI, Autonomous Intelligent Systems
Endenicher Alle 19A, 53115 Bonn, Germany

{ pavlichenko | farazi | ficht | behnke } @ ais.uni-bonn.de
http://www.nimbro.net

Abstract. This abstract presents the latest improvements in team NimbRo AdultSize of the Rheinische Friedrich-Wilhelms-Universitat Bonn, Germany. This abstract aims to serve as qualification material for the competition held in Bangkok from July 11–17. The design and construction of our robots were made entirely by our team members. This abstract presents the lessons learned from the participation in the RoboCup 2019 competition in Sydney, major problems that should be solved for the next RoboCup and their anticipated solutions.

1 Lessons learned

The major lesson from our previous RoboCup experience is that our combination of modular hardware and software is quite effective and robust for competing in a tournament, where little time is given for configuration and preparation between games. Thanks to this, our robots were able to display impressive performance in ball, obstacle and goal detection, localization, ball-handling, and teamplay. This, in turn, allowed respective team members to focus on fixing identified issues at hand during the competition, rather than performing repetitive and situation-specific tuning. In the light of the annual rule improvements and increasing competition, we want to further push the boundaries of our robots capabilities to bring the game closer to human-level. The previous tournament also exposed some hidden, situation-specific behavior which was not observable in a lab setting. To improve our performance, we plan to address all of these issues with suggestions made in the next section.

2 Problems

Several aspects of our software can be improved, where the biggest contribution can be made to team play and soccer behaviors. These can be enhanced with better team communication and path planning. Currently, the communications are mainly used for exchanging the robots' roles on the field based on ball possession. It is based on an asynchronous request-and-response system, which may

lead to some extensive latencies in role changing. Such latencies in role changing add up to precious time lost, which could be spent on keeping the ball in play or scoring a goal.

Another difficulty with our teamplay is imperfect path planning. At the moment, with 2 vs. 2 games in the AdultSize League, only one obstacle is considered to be in the field, which gives the possibility of kicking the ball directly into the second opponent robot. To avoid this possibility, we plan to incorporate support for handling multiple obstacles positions (if detected) into robots' decision making.

Our perception is based on a conjunction of a deep neural network and some post-processing, and even though it works very good, there still is room to grow. For example, the detection of a ball and opponents is very reliable for distances of up to 7 meters, but as the RoboCup rules are getting closer to human soccer rules, the field size grows. With the 2019 field size being 14x9m, it is quite hard for the robots to see the ball from one corner of the field to the other. This can be remedied with a search for the ball behavior, which results in a slower-paced game. We plan to increase the detection range to accommodate for the increased field size.

The NimbRo-OP2(X) robots are able to move around quite fast, with velocities up to 0.5 m/s. This is relatively fast in terms of the league, but really slow when compared to humans. Not only that, but we also need to make them more maneuverable on the field, adding dynamics to the gait. As a next step in this direction, we are trying to improve robots' gait so they could reach the speed of up to 0.7 m/s, to satisfy the road-map requirement for introducing 3 vs. 3 games.

We are also attempting to push the limits of robots' autonomous operating. Eventually, robot handlers will be removed from the game. Two main reasons for robot handlers are positioning robots on the field and taking care of falling robots. As our robots already do not have any problems with repositioning on the field, we plan to improve the latter part. We have previously experimented with safe landing and get-up motions with the igus Humanoid Open Platform, which we hope to transfer to the OP2(X) robots to allow for a more human-like game to be played.

3 Conclusions

We are looking forward to participating in RoboCup 2022 in Bangkok. We expect to solve all the described problems, to demonstrate technical and behavioral advances, and to show good games to the public.