

NimbRo AdultSize Extended Abstract 2023

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Abstract. This abstract presents the latest improvements in team NimbRo AdultSize of the Rheinische Friedrich-Wilhelms-Universität Bonn, Germany. This abstract aims to serve as qualification material for the competition held in Bordeaux. 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 2022 competition in Bangkok, 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. We were not able to resolve all of the issues for the previous competition as we had planned. However our improved perception pipeline allowed us to improve our performance. We plan to address the remaining 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.

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 2023 in Bordeaux. We expect to solve all the described problems, to demonstrate technical and behavioral advances, and to show good games to the public.