Rhoban Football Club – Extended abstract
Humanoid Kid-Size League, Robocup 2022 Thailand

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Abstract. This paper presents some of the experience acquired by Rhoban during RoboCup 2019, some of the modifications made since and our future plans. It focus on three points: project using a localisation ground truth, changes on the robot hardware and an update on the development of our cycloidal reducer.

1 Introduction

Team Rhoban FC has been involved in RoboCup since 2011. It has won the KidSize league for the last four editions.

Some of the key problems met and improvements envisioned for RoboCup 2022 are discussed in this document using a thematic structure. We present the following elements:

- some projects using a localisation ground truth,
- the changes we made on the hardware of the robot
- the current status of a new joint design we would like to use for the knees of our robot.

An extensive review of the improvements we brought is presented in [2].

2 Localisation ground truth

The neural network of our vision system recognises seven different labels. This makes manual labelling of the training data fastidious. We plan on continuing the development of a solution based on the Vive indoor tracking system developed by *HTC*. We already succefully used it during the german open 2019.

In order to assess and improve the precision of the odometry of the robot we are developping a setup using the Flex 3 mocap cameras of Optitrack. In fact, we tried to use the *Vive* system, but when we put the trackers at the feet of the robot, the vibrations seem to mess with the algorithm giving the localisation of the trackers.

3 Changes in the robot hardware

Three main changes were made in the hardware of the robot whose new 3D model can be found here. The motor controlling the pitch of the head used to break quite often. It seems that the inertia of the head when the robot falls generates a torque above the specifications of the MX-64. In order to reduce the produced torque, the first change puts the center of mass of the head on the rotation axis of the motor. The second one aims to protect some motors from external forces by adding some thrust needle roller bearings to the output of the motor. We found out that a similar design is used in the robot of the team CIT Brains.

We change batteries technology: instead of LiPO batteries we use now Lithium-ion drill batteries which are easier to integrate.

Finally, we plan on redesigning the electronic boards off the feet to integrate an analog filter processing the signals of the pressure sensors. This should help us closing the loop in the walk algorithm.

4 Experimental joint design

We are still working on a new joint design using a cycloidal speed reducer based on [1]. The main purpose of that work is to replace the dynamixel motors by a low cost speed reducer having better specifications (torque and velocity).

While we were testing our first prototype in stressfull conditions, a ballbearing broke. This failure might be explained by the use of undersized bearings. Hence, a second version, inspired by the paper [3], was developped using needle roller bearings and changing the cycloidal plates from aluminium to steel. The 3D model of the reducer is available and a small video can be watched here. The use of needle roller bearings makes the reducer very complaint. We would like to use it as a replacement for the dynamixel motors, but some work is still needed since we still did not test it in stressfull conditions.

References

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3. Kang Kyu Lee, Seungwoo Hong, and Jun-Ho Oh. Development of a lightweight and high-efficiency compact cycloidal reducer for legged robots. *International Journal of Precision Engineering and Manufacturing*, 21:415–425, 2019.