Linköping Humanoids – Application RoboCup 2017 Standard Platform League

Fredrik Heintz and Fredrik Löfgren
The Department of Computer and Information Science
Linköping University, 581 83 Linköping, Sweden

***Abstract*—This is the application for the RoboCup 2017 Standard Platform League from the Linköping Humanoids team.**

I. Introduction

Linköping Humanoids participated in both RoboCup 2015 and 2016 with the intention of incrementally developing a good team by learning as much as possible. We significantly improved from 2015 to 2016, even though we still didn't perform very well. Our main challenge is that we are building our software from the ground up using the Robot Operating System (ROS) as the integration and development infrastructure. When the system became overloaded, the ROS infrastructure became very unpredictable. This made it very hard to debug during the contest, so we basically had to remove things until the load was constantly low. Our top priority has since been to make the system stable and more resource efficient. This will take us to the next level.

From the start we have been clear that our goal is to have a competitive team by 2017 since we are developing our own software from scratch we are very well aware that we needed time to build up the competence and the software infrastructure. We believe we are making good progress towards this goal. The team of about 10 students has been very actively working during the fall with weekly workshops and bi-weekly one day hackathons.

II. Team Information

Our team ("Linköping Humanoids") represents the student association FIA Robotics from Linköping University (LiU) and the Division for Artificial Intelligence and Integrated Computer Systems (AIICS) at the Department of Computer and Information Science (IDA) at LiU. The team consists of:

- Fredrik Heintz – Team Leader, Associate Professor of Computer Science
- Fredrik Löfgren – Team Leader, Student 5th year Applied Physics and Electrical Engineering
- Jon Dybeck – Engineer, Department of Computer Science
- Mattias Tiger – PhD Student at AIICS
- David Bergström – Student 4th year Computer Science and Software Engineering
- Josef Fagerström – Student 4th year Computer Science and Software Engineering
- Carl Dehlin – Student 5th year Applied Physics and Electrical Engineering
- Magnus Selin – Student 5th year Applied Physics and Electrical Engineering
- Erik Öjehag – Student 2nd year Computer Science and Computer Engineering
- Gustaf Söderholm – Student 2nd year Computer Science and Computer Engineering
- more students are expected to join the team in the spring.

Most of the team participated in both RoboCup SPL 2015 and 2016. Some team members also have experience from previous RoboCup competitions such as Fredrik Heintz which participated in the simulation league years 1999 and 2001 and Fredrik Löfgren which is a member of the technical and organizing committee of the RoboCup Junior Rescue league since 2012. Several of our team members has also been participating in Robocup Junior earlier. The new students have taken one of our project courses related to our humanoid robot activities.

At the university we have a student association called FIA (Swedish abbreviation for the association for intelligent and autonomous systems). The association was founded 2012 to organize RoboCup Junior in Sweden and other activities in the new humanoid laboratory at Linköping University. Since then we also run student projects for our members. The association has over 100 members.

III. Robot Information

At Linköping University we have full access to the AIICS humanoid laboratory, where we have 6 H25 NAO v5 and 2 H25 NAO v4. Since we already have integrated the NAO with ROS we also have access to all the tools and algorithms available through ROS. The laboratory also has six powerful computers with Webots installed. In the lab we have a four by eight meter soccer field which allows us to practice full games even though the field is slightly smaller than the real field. Since we are aiming to develop a scalable and adaptive overall approach, absolute size does not matter in our case.

IV. Mixed Teams

We are not interested in participating in a mixed team this year. The focus is on our own team.

V. Code Usage

We have ben developing our own code base basically from scratch. The very first version several years ago used code from UPenalizers and we have also used some parts of the

ROS drivers developed for the Nao by Freiburg's Humanoid Robots Lab. Today very little, if any, of this is still in our code base.

VI. Past History

RoboCup 2016 was our second SPL competition. Even though our team didn't work as planned, we only lost one game against UT Austin Villa (0:8) who later won the second place. We drew against SPQR (0:0) and the Dutch Nao Team (0:0). We had made significant improvements compared to the year before and could succefully compete in all the games and were also active as referees.

RoboCup 2015 was our first SPL competition. We lost against Nao Team HTWK 0:10, MRL 0:8, and UT Austin Villa 0:3 and drew against Austrian Kangaroos 0:0. When we arrived nothing worked as expected, but at the end of the competition we had a working team. This was both frustrating and rewarding.

In 2014 we won the Humabot Challenge at 2014 IEEE-RAS International Conference on Humanoid Robots. *"In the HUMABOT Challenge, the robot is an integral part of the house and helps its occupants to live there better. In this edition, the tests will be held in the kitchen of the house."* http://www.irs.uji.es/humabot/humabot-challenge

We learned a lot from these competitions and look forward to new challenges!

VII. Impact

The main short term potential impact of our team on RoboCup SPL is to show that ROS can be used to make a competitive team (or by failing indicate that it is not a great choice). We are also building a completely separate code base, which is available as open source, which could potentially influence other teams.

In Sweden our participation has had great impact with the national Swedish Television sending a crew to RoboCup 2016 to follow us. Reports from RoboCup were shown at the national news. The interest in RoboCup in Sweden is large, even though the focus has mainly been on RoboCup Jr. With our team particpating in the Major league has increased the interest for the competition in Sweden.

In Linköping we are very active in promoting science, technology and programming to kids through the use of our Nao robots. We regularly organize workshops for both pupils and teachers, with great interest. Hopefully these activities will make more kids go into science and technology in the future.

VIII. Other

We aim to participate in the RoboCup SPL, because we are convinced that the therein required competences are of high relevance for collaborative autonomous systems. Besides being challenging, interesting, and highly motivating, working with problems relevant for the competition is also of highest relevance to society and more serious application areas such as autonomous transportation and rescue robotics.

The lessons learned during the preparation for the competition will impact future research projects of the involved research labs as will as on future industrial initiatives triggered by the involved students.

IX. Conclusion

The Linköping Humanoids team is committed to work with RoboCup SPL and to build up a competitive team. We have been working with the NAO for more than 3 years and have built up a laboratory facility with 8 NAOs, 6 workstations, a soccer field and an overhead camera system to speed up the development. Besides RoboCup the lab is also used for teaching, which makes more students aware of RoboCup.

We have significant research experience in AI, autonomous systems and computer vision that we really want to apply in the RoboCup domain. The team consists of both students, PhD students and researchers covering all the important skills from computer science, computer vision, artificial intelligence, control theory and robotics.

We really looking forward to participate in the competition and the Standard Platform League!

References

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