Linköping Humanoids – Application RoboCup 2016 Standard Platform League

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***Abstract*—This is the application for the RoboCup 2016 Standard Platform League from the Linköping Humanoids team.**

I. Introduction

Linköping Humanoids participated in RoboCup 2015. We didn't do very well, but we learned a lot. When we arrived nothing worked. However, we fixed more and more of the open issues and managed to play a draw in our final game. We also participated in some of the technical challenges and scored some points. At the end of the competition we had a working team. This was both frustrating and rewarding. Analyzing the competition we have identified both what we did well and the main issues that we need to fix. One important lesson is that it takes time to develop a competitive RoboCup SPL team. We are dedicated to improving our performance over time in order to be competitive in 2017.

II. Team Information

Our team ("Linköping Humanoids") represents the student association FIA Robotics from Linköping University (LiU), the Division for Artificial Intelligence and Integrated Computer Systems (AIICS) at the Department of Computer and Information Science (IDA) at LiU and the Computer Vision Laboratory (CVL) department at the Department of Electrical Engineering (ISY) 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
- Martin Danelljan – PhD student at CVL
- Jon Dybeck – Department of Computer Science
- Michael Felsberg – Professor at CVL
- Gustav Häger – PhD student at CVL
- Fahad Khan – Assistant professor at CVL
- Mattias Tiger – PhD Student at AIICS
- and at least 5 undergraduate/masters students.

Most of the team participated in RoboCup SPL 2015. 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 4 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. Preference

We are willing to participate in all 4 competitions. The preferences are: (1) outdoor, (2) indoor, (3) technical challenges, (4) drop-in competition. We are interested in participating in the outdoor competition since we already have significant experience with computer vision solutions for both indoor and outdoor settings. We therefore believe that we have a good chance of developing competitive solutions to the outdoor computer vision challenges.

We learned during RoboCup 2015 that it takes time to become competitive and that there are fundamental problems like computer vision and localization with the extremely limited Nao hardward that must be solved to perform well. Since we realize that we might not be able to solve these by RoboCup 2016 we are aiming for being competitive in 2017. We are more than willing to participate in RoboCup 2016, even though our aim is to do well in 2017.

V. Code Usage

We have ben developing our own code base basically from scratch. The very first version many 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.

VI. Past History

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

Since we are a new team we haven't really had a chance to make an impact on the SPL league. However we are developing a new line of software using the Robot Operating System (ROS). This could potentially have a big impact as most of the robotics community are using ROS. In Linköping we have had a big impact both on the education and on recruiting students to the university as the Nao robots are very popular to show at fairs and other events. We have also used them extensively in teaching younger kids to program and to get excited about robotics.

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 embodied and 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 well 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 10 NAOs, 6 workstations and a soccer field that have mainly been used for teaching so far, but always with RoboCup in mind.

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!

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