

Bold Hearts Team Description

RoboCup 2013 Kid Size

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Abstract. In this paper we describe the RoboCup Humanoid Kid Size section of team Bold Hearts, the RoboCup team of the University of Hertfordshire, in Hatfield UK. As a team that is well experienced in the 3D Soccer Simulation, we focus on combining our efforts in both teams, by sharing frameworks and experience between both.

1 Introduction

Team Bold Hearts, representing the University of Hertfordshire in Hatfield, UK, is committed to participate in the 2013 RoboCup Humanoid League, Kid Size championship in Eindhoven, The Netherlands. The team was founded in 2002, competing in both the 2D and 3D RoboCup Simulation Leagues. After a short hiatus, a full restart of the team was initiated. As listed below, this resulted in several successful years with a number of rewards.

The team consists of members with a wide range of experience, from first year undergraduate students to master students, PhD students, professional developers from industry and university staff.

Team Bold Hearts has a long history within the 3D simulation league, competing in thirteen events since 2009, placing in the top four in all but one. Two of our team members have served on the technical committee, and one as the organising chair in both a regional and world cup competition. All team members participate voluntarily on an extra-curricular basis.

The University of Hatfield procured seven DARwIn-OP robots at the end of 2012. Our intention is to compete at a high level in both the 2013 German Open in Magdeburg, and the 2013 World Cup in Eindhoven ¹.

The main goals of our team are twofold: firstly, to provide a valuable source of experience, contacts, and enjoyment. Secondly, to use the robotic football scenario as an important test bed for several of our ongoing research projects.

In the rest of this paper we go into these aspects more deeply. Finally, team Bold Hearts commits to supplying at least one team member with enough knowledge of the Humanoid Kid Size rules to perform as referee during the competitions.

¹ We are aware that the DARwIn-OP's stock feet are too large according to the 2013 rules; we are working on replacing these with regulation feet

2 Simulation & Hardware, Joint Opportunities

To the best of our knowledge team Bold Hearts is currently the only team working on both Soccer Simulation and Kid Size challenges.

In previous years, SimSpark, the 3D simulator, has been used to model a replica of the Nao robot from the Standard Platform League. 2013 promises to be the first year in which heterogeneous robot models will be used during competitions.

As we work to bring the capabilities of our 3D team to physical robots, we are undertaking the expansion of our codebase to cover multiple diverse platforms. We have found the rapid prototyping of ideas and automation of learning algorithms and optimisation that the simulator afford very valuable and are working to utilise such techniques within the Kid Size league.

We also have considerable experience of developing the 3D simulator itself, including RoboCup Federation-funded project work. We are learning more about the challenges physical robots pose, and will strive to use this knowledge to improve the capability and fidelity of the simulation where it makes sense to do so.

Each league has much to offer, and we are pleased to have taken a position that spans such challenges and disciplines.

3 Research & Development

In this section we will go into more detail on the research and development that our team is interested in and actively working on. In the first part we will describe the framework we have built for the simulation league and are currently porting to the physical robots, and discuss the benefits and challenges in doing so. Secondly, we review our work on bipedal locomotion, an important topic for both leagues.

3.1 Shared Framework

As a base for our team we use the `libbats` framework ². This library was originally developed by 3D simulation team Little Green BATS, from the University of Groningen, The Netherlands, in 2006. It has been released as open-source, and currently team Bold Hearts are the maintainers. Several other teams have used it to base their work on.

Besides a low level interface to the simulation environment, the library provides a range of modules, including localisation through Kalman or particle filters, forward and inverse kinematics, graphical monitoring and debugging tools, a generic skill-set interface, formation and coordination frameworks, and an extensive XML configuration module. We are currently in the process of porting this over to the DARwIn-OP platform.

² <http://launchpad.net/libbats>

In doing so, we encounter several challenges that arise from connecting the different leagues. For instance, the vision model in the simulated environment is more abstract. As this is such an important source of information, our first work consists implementing image processing methods needed to feed the framework with similar data. This involves dealing with higher levels of noise, more ambiguity, and false positives and negatives. This makes the Kalman localization method used in simulation unfeasible, but luckily `libbats` natively supports using different localization implementations.

Another major difference are the different physical aspects of the simulated Nao and physical DARwIn-OP robots. Again, `libbats` is set up to easily configure different body models. Also, the shared framework, and the open architecture of the RoboCup SSL 3D simulation server, will allow us to quickly set up a simulated test-bed for the Kid Size league to prototype, test, and optimize in.

3.2 Bipedal Locomotion

Much of the success of team Bold Hearts in the RoboCup SLL 3D competitions was due to high speed of locomotion. This was achieved by developing gait modules that can generate a wide range of motions, with a small set of parameters. These were then optimized by applying different methods, e.g. GA, PSO, CMA-ES, etc. As part of a RoboCup Federation funded project, one of our members has developed and released an open source framework to facilitate such optimizations on a large scale ³.

The RoboCup 3D SSL currently has no concept of the energy expended by agents. However, to test our methods, we have implemented this in the simulator in order to study both the trade-off between speed and efficiency, and the ability of our methods to find such a trade-off. As a result, we managed to successfully find energy efficient gaits that are both stable and fast [1].

We look forward to apply this range of experience to the hardware platform.

³ <http://launchpad.net/rcsimcontrol>

4 Achievements

The following are the achievements of team Bold Hearts in the RoboCup 3D SSL of the last four years.

2012

- 3rd RoboCup World Championship 2012, Mexico City, Mexico
- 2nd Dutch Open 2012, Eindhoven, The Netherlands
- 4th Iran Open 2012, Qazvin, Iran

2011

- Top 8 RoboCup World Championship 2011, Istanbul, Turkey
- 1st Iran Open 2011, Tehran, Iran
- 3rd German Open 2011, Magdeburg, Germany

2010

- 2nd AUTCUP 2010, Tehran, Iran
- 2nd RC4EW, Eisteddfod of Wales 2010, Ebbw Vale, UK
- 4th RoboCup World Championship 2010, Singapore
- 1st German Open 2010, Magdeburg, Germany
- 3rd Iran Open 2010, Tehran, Iran

2009

- 2nd RoboCup World Championship 2009, Graz, Austria
- 1st German Open 2009, Hannover, Germany

References

1. Valerio Lattarulo and Sander G. van Dijk. Application of the “Alliance Algorithm” to Energy Constrained Gait Optimization. In *The 15th Annual RoboCup International Symposium*, pages 393–404, Istanbul, Turkey, 2011.