UChile Robotics Team

Standard Platform League Qualification Document - RoboCup 2017

1 Statement of Commitment to Participate in the RoboCup 2016 SPL

UChile Robotics Team has been participating continuously in the RoboCup soccer competitions since 2003. With this document we state our intention to participate in the Standard Platform League 2017, assuming the compromise and responsibilities implied.

2 Team Constitution and affiliation

Team Leader:	Prof. Dr. Javier Ruíz-del-Solar
Team Captain:	Pablo Cano
Doctorate Students:	José Miguel Yáñez, Leonardo Leottau, Carlos Celemin
Master Students:	Pablo Cano, Matías Mattamala
Undergraduate Students:	Constanza Villegas, Kenzo Lobos, Gabriel Azócar, Nicolás Cruz, Rodrigo Pérez, Francisca Herrera, Luis Cossio, Camila Verdugo, Marco Oporto, Nicolás Pacheco, Fabiola Rivera, Ignacio Bugueño, Pablo Cabargas, Francisco Leiva
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Presentation Video:	`https://youtu.be/8qxBkIgyt2k`

3 Mixed Team

Due to the difficulties regarding the location of our team and the number of current members, we will not participate in the mixed teams competition this year. So, we commit to compete in the main competition for this RoboCup 2017.

4 Acknowledge for using other teams code

Since 2013 we have been using the BHuman[1] Code Release as core library for our developments as a replacement of our old self-developed library used for aibos. In the last Robocup we used the BHuman 2014 Code Release[13], and we ported all our work from previous Robocups into this release. This year we continue using these release and we do not plan to use any other team's code. Upon Bhuman framework, we have made several developments, some of them has been published, and we are persuing new advances for this year.

4.1 Past Developments

Here we present the principal works we have done since we adopt the BHuman's framework. A complete history of our works can be find in Section 7.

4.1.1 Active Vision

We propose an efficient approach to the active vision problem by creating and using a look-up table with the most relevant heading angles for localization. We after propose to include dynamic information obtained during the game such as the ball and other robots [12].

4.1.2 White Goals Detector

To overcome the new rules of year 2015, we developed a new goal perceptor, to detect goals in realistics scenarios, i.e. white backgrounds. This work was presented in [3].

4.1.3 Realistic Ball Perceptor

A new ball was used in the RoboCup 2016, which is realistic soccer ball. We developed a new ball perceptor which mainly use the color texture of the ball to identify it. This work was succefully used in the competition these year and allow us to reach the semifinals again. We share this work with the comunnity by a well documented code realease of this perceptor (for more information see Section 7.1)

4.1.4 Robots Tracking with RFS

In order to improve the oponent and teammates tracking, we implemented a new filter using the Random Finite Sets framework. This framework overcomes most of the problems of a multi-hypothesis Kalman filter (mainly data association) while having fewer parameters to tune and allowing the use of negative information. This work was presented in [2].

4.1.5 Reinforcement Learning

We generate a methodology for implementing a decision making system, defining a state space according to specific game configurations, taking into account positions and probable team actions, and training recurrent and relevant game situations. This work has been presented in differents pulbications over the years, in [10],[9] and [7].

4.1.6 Interactive Machine Learning

We proposed an strategy of Interactive Machine Learning that allows human teachers to provide feedback signals for correcting decision making systems during the execution of the task. Part of this work was presented in [4], and won the Best Science Paper Award 2015.

4.2 Current Developments

For this competition, we will continue creating new developments. Some of them are mentioned next.

4.2.1 New Ball Model

The new ball featured for the RoboCup 2016 posseses a non uniform mass distribution. This makes the prediction of the ball position and velocity much more difficult since the ball doesn't follow a straigh line path. Considering this challenge a new ball model was developed to correctly predict the ball state. The new ball model is a diffuse multiple model Kalman filter (IMM), where each model represents a different deacceleration along the x axis (parallel to ball velocity) and an acceleration along the y axis (perpendicular to the ball velocity). Each model is weighted acording to the kalman filter innovation and finaly the states are combined in a single prediction acording to their weight. This allows us to predict curved ball trayectories.

4.2.2 Adaptive Color Segmentation

We are currently developing an adaptive color segmentation based vision system. Color segmentation is used since the computational sources available are scarce, and this approach has been widely used in the RoboCup SPL with great results. Since the SPL is moving towards a non-controlled environment and this approach fails against changing illuminations conditions due to the segmentation parameters being fixed, classic color segmentation alone is not enough. To address this issue several approaches have been reported, but our work is similar to the one published by HTWK[6], in which an YCbCr color cube is estimated using stadistical information of the image. We propose a HSV color cube estimation with a field detection step and a filtering step, to adress the issues presented in the approach followed by HTWK, which are cube estimation on ill conditioned images, highly image-specific cubes, and sub-optimal segmentation due to the use of the YCbCr color space.

4.2.3 Automatic Camera Settings

To achieve a robust vision systems in terms of changing and extreme lightning conditions, software alone is unable to perform the tasks at hand. The cameras provided in the NAO allow the setting of different hardware related parameters such as gain, exposure, saturation and white balance. Similar to other implementations in the SPL League, we propose a controller over these parameters to achieve illumination invariance, with focus real time excecution.

4.2.4 Robot Detection with LATCH descriptors

In order to improve the robot detection performance concerning the variant lighting conditions, and since the fixed color table proposals are not reliable anymore, a LATCH descriptors approach is been developed. Regarding the descriptors matching stage, we propose to take advantage of the geometry of the robot in the image.

4.2.5 Machine Learning Based Vision System

Pure machine learning based vision systems are usually complex and due to the hardware capabilities of the NAO, their use have been limited since real time image processing is difficult to achieve. We propose an hybrid vision system, which uses color segmentation for most perceptors, and only use complex yet efficient methods like X-NOR nets or SqueezeNets to perform the final classification over object proposals found with color segmentation.

5 Team participation and results

Due to funding difficulties we are not planning to attend to any Robocup Open competition before the next Robocup in Japan. In Table 1 the last 4 years' results are shown.

RoboCup 2013	
First Round Robin	
Nao Team HTWK - UChile	8:0
RoboCanes - UChile	1:3
Intermediate Round	
Kouretes - UChile	0:2
Second Round Robin	
BHuman - UChile	8:0
DAInamite - UChile	3:0
Cerberus - UChile	1:2
Tournament position	13/22

RoboCup 2014	
First Round Robin	
BHuman - UChile	7:0
Berlin United - UChile	2:1
RoboCanes - UChile	2:2
Philosopher - UChile	0:2
PlayIn Round	
UPennalizers - UChile	0:4
Quarter Finals	
NaoDevils - UChile	1[1]:1[4]
Semi Finals	
Nao Team HTWK - UChile	5:4
3rd Place	
BHuman - UChile	7:0
Tournament position	4/20

RoboCup 2015	
First Round Robin	
Northern Bites - UChile	0:4
Cerberus - UChile	0:3
SPQR - UChile	1:4
Nao Devils - UChile	1:3
Quarter Finals	
UT Austin Villa - UChile	0:2
Semi Finals	
UNSW Australia - UChile	6:1
3rd Place	
Nao-Team HTWK - UChile	3:1
Tournament position	4/20

RoboCup 2016	
First Round Robin	
UChile - HULKs - Hamburg Ultr	1:2
UChile - UPennalizers	2:0
UChile - Bembelbots	5:0
Second Round Robin	
UChile - SPQR Team	4:1
UChile - MRL-SPL	5:0
UChile - Berlin United - Nao	3:0
Quarter Finals	
UChile - Nao Devils Dortmund	1[3]:1[2]
Semifinals	
UChile - B-Human	1:6
Third Place	
UChile - Nao-Team HTWK	1:4
Tournament position	4/24

Table 1: RoboCup results since 2013. Penalty results are shown inside brackets.

6 Impact of team's participation

At present, we are the only South American team who have participated every year in the SPL in both main and challenge competitions since 2003. Despite having a regrettable result in 2012 (Table 1), we have worked hard to position ourselves within the four best teams of the league.

Our participation in the RoboCup is an acclaimed activity by our University and the Chilean media. Last participations has been widely covered by press and television, giving us a chance to present our work along the country in several science fairs.

7 Past Relevant Work and Scientific Publications

UChileRT has been involved in RoboCup competitions since 2003 in different leagues: Four-legged 2003-2007, @Home in 2007-2015, Humanoid in 2007-2009, and Standard Platform League (SPL) in 2008-2015. UChile's team members have served RoboCup organization in many ways: Javier Ruiz-del-Solar was the organizing chair of the Four-Legged competition in 2007, TC member of the Four-Legged league in 2007, TC member of the @Home league in 2009, Executive Member of the @Home league since 2009, and co-chair for the RoboCup 2010 Symposium. Among the main scientific achievements of the group are the obtaining of four important RoboCup awards: RoboCup 2004 Engineering Challenge Award, RoboCup 2007 and 2008 @Home Innovation Award and the Best Science Paper Award in RoboCup 2015 [4]. UChile's team members have published a total of 37 papers in RoboCup Symposium (see Table 2), 27 of them directly related with robotic soccer, in addition to many papers in international journals and conferences. A brief summary of our publications and past relevant work is listed below.

Table 2: Presented papers in the Robocup Symposia by year

Articles	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Oral	1	2	1	1	2	3	2	2	-	-	1	1	1	-
Poster	1	1	1	-	3	2	-	-	2	1	2	1	4	2

7.1 Open Source Contribution

Tutorial - ROS Cross-Compiling and Installation for the NAO V4: UChileRT has uploaded to the ROS community, a detailed tutorial to build, install and run ROS natively onto the NAO V4 [11]. To the best on our knowledge, this was the first tutorial that provides a step-by-step guide to build, install and run ROS embedded onto the Atom CPU of the latest NAO V4 robot.

ROS Node - Motion Module: Currently, UChile Robotics Team is using the B-Human walking and motion engine [5]. That motion module has been isolated, integrated as a ROS node, and shared as open source code. It is described in [8].

New Ball Perceptor: The ball was updated for the the RoboCup 2016, as such, the team had to update the ball perceptor to comply with the needs. UChileRT has uploaded a repository with the used code[14], along a wiki document that contains useful information about the algorithmn and usage.

References

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