



Bembelbots Frankfurt

ROBOCUP SPL TEAM AT GOETHE UNIVERSITY FRANKFURT

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1 Team Information

The Bembelbots team was founded in 2009 at the Goethe University Frankfurt(Main), Germany. Its current Team Leader is Andreas Fürtig, a PhD student from the Electronic Design Methodology (EM) group at the Institute of Computer Science at Goethe University. Additionally we are 7 undergraduate students as well as 4 former university members, who are continuing participation in their free time.



Figure 1: Team Bembelbots at the RoboCup German Open 2015

Because of the recent loss of many of the founding members due to graduation, we're dealing with a completely new team structure. This is partially compensated by several undergraduates that joined in the last two years. Out of this new groups dealing with walk optimization, debugging, and a new simulator backend emerged.

We currently own six Nao H21 v4 robots. We'd like to upgrade to Nao H25 v5 prior to the competition and are currently applying to university funding. Additionally there are some ideas for private spon-

soring to help sustaining our team.

2 Preference

Team Bembelbots Frankfurt preferences are as follows: (1) indoor team competition, (2) outdoor team competition and (3) drop-in player competition.

3 Code Usage

As part of an institute with a focus on theoretical computer science we're trying to give students the opportunity to work on a software project providing not only interesting problems but also the chance to train practical skills on a big project. For this reason, we decided to build our framework completely from scratch although we exchanged code and techniques with other teams over the course of our participation in the SPL.

As there is no dedicated robotic group at the university we designed our framework without previous expertise. As our framework increased in complexity, we recognized several shortcomings of our initial approach, namely complicated maintenance and difficulties for new team members to integrate new modules. So we redesigned our framework in 2014 and it was split up in two parts: a backend interfacing with the robot, cameras and network, a frontend that handles cognition and acting on the provided data—in distinction to many other implementations our approach realizes both, the cognition and the motion inside the frontend.

During this process, we created a NaoQi independent camera grabber, which was based on the *Video4Linux* standard. This grabber is used by several other teams.

Further a distinctive feature of the current Bembelbots framework is a unique method for localization using a Monte Carlo-driven particle filter, which scales itself based on the current game situation. In particular, if the current position and game situation is well defined and known the statistical variety is massively reduced. In contrast, if the robot gets lost or a kidnapped robot scenario is determined—the localization spreads, to again converge in a well defined position.

After using a self implemented state machine based behavioral description language, we switched to XABSL, which is well known in the RoboCup community. To reduce the software overhead and improve the debug functionality, we decided to use the C implementation of XABSL from B-Human and included it into our framework.

Our walk was originally derived from an early version of the HTWK Leipzig walk engine, and was since then extended and modified. The current development focusses on integrating inverse kinematics into the existing approach to merge the simplicity of the existing realization with well established walk engines like the one developed by B-Human.



Figure 2: Teams and Visitors at the FIAS Bembelcup in Frankfurt.

Finally, we decided to partially replace our statistics and color based vision [3] by the colorless vision module from HTWK Leipzig and created a patch to compile it with the standard Aldebaran Robotics crosscompile toolchain. As the module detects objects in the image plane, we made it compatible

with our localization algorithms that were already in place.

4 Past History

The team attended the RoboCup Main Competition in 2013 in Eindhoven / Netherlands, as well as every RoboCup German Open event since 2010 in Magdeburg / Germany. The Results of every game are shown in Table 1. In addition, the team is proud to organize the FIAS¹ Bembelcup in Frankfurt / Main, which started in 2013 with two teams, and four teams in 2014 / 2015. We are considering participation on the European Open 2016 in Eindhoven as an opportunity to test our new features in an environment similar to the RoboCup Main Competition and to give our new team members the chance to experience a RoboCup event before Leipzig.

Table 1: Game results of the Team Bembelbots since 2013

RoboCup German Open 2013 (Magdeburg)		
Bembelbots	RoboEireann	0:1
Bembelbots	Nao-Team HTWK	0:7
Bembelbots	DAInamite	1:1

RoboCup 2013 (Eindhoven / Netherlands)		
Bembelbots	Nao Devils	0:4
Bembelbots	Northern Bites	0:4
Bembelbots	Austrian Kangaroos	0:1
Bembelbots	Cerberus	0:0 [0:2]

RoboCup German Open 2014 (Magdeburg)		
Bembelbots	Nao-Team HTWK	1:4
Bembelbots	RoboEireann	0:3
Bembelbots	HULKs	0:0

RoboCup German Open 2015 (Magdeburg)		
Bembelbots	B-Human	1:6
Bembelbots	Nao-Devils	0:1
Bembelbots	DAInamite	1:1
Bembelbots	SPURT	0:0

5 Impact

Since 2013, the team Bembelbots is organizing the FIAS Bembelcup, a small tournament filling the gap between national RoboCup German Open and international Robocup competitions. A full size playing field is provided to help the participating teams

¹Frankfurt Institute of Advanced Studies, <https://fias.uni-frankfurt.de/de/>



Figure 3: Every team wants it: The FIAS Bembelcup!

to test their current working progress. After the tournament itself, a whole weekend is used to discuss algorithms and problems. The Tournament is planned for 2016 as well.

Additionally, the team presents the institute for computer science of the Goethe University on nearly all public events like *Tage der Informatik*, *Girl's Night* and the *Night of Science*. The team tries to improve visibility of natural sciences and computer science in particular to the general public by showing interesting and tangible applications at various events. The goal is to awake interest in natural sciences especially for young people. Thus, we also participate in local events like *Innovative* and *Aldebaran Robotics Workshops*.

6 Other

The RoboCup Team Bembelbots is located inside the Joint Robotics Lab (JRL) at the Computer Sci-

ence Institute of the Goethe University Frankfurt. It offers much more than the soccer playing robots. The JRL tries to help the students to realize their own projects and supports them with hardware, knowledge and access to our laboratory. Initiated by four professors, the JRL combines different fields of interest, giving the students a deeper view into applied state of the art work.

Team publications

It's possible to write your thesis in the topic of RoboCup at the Goethe University. Several works are published in the last years. Together with the new bachelor arrangements in 2014, it's possible to earn credit points for the work at the Bembelbots project, which hopefully will increase the number of active team members in the future.

Here is a list of already finished bachelor and diploma theses:

1. Rohnfeld, Erik (2010): Reinforcement Learning zum Lernen eines Schusses auf dem Nao-Roboter, Bachelor thesis at Goethe-University, Frankfurt
2. Jäger, Moritz (2010): Entwicklung eines automatisierten Verfahrens zur Optimierung der Laufbewegung des Nao Roboters, Bachelor thesis at Goethe-University, Frankfurt
3. Fürtig, Andreas (2011): Farbklassifizierung für humanoide Roboter im RoboCup Umfeld, Diploma thesis at Goethe-University, Frankfurt
4. Weis, Tobias (2011): Selbstlokalisierung für humanoide Roboter im RoboCup Umfeld, Diploma thesis at Goethe-University, Frankfurt
5. Becker, Christian (2013): Linienbasierte Featuredetektion und Positionstracking durch Voronoi-Diagramme in einer symmetrischen Umgebung, Diploma thesis at Goethe-University, Frankfurt
6. Ruscher, Gerhard (2013): Entwurf und Realisierung eines Frameworkes zur Bewegungsplanung eines Humanoiden Roboters, Diploma thesis at Goethe-University, Frankfurt