# RoboCup 2015 SPL
# *Z-Knipsers* Team Description Paper

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**Abstract.** This report summarizes the activities of the young RoboCup SPL team *Z-Knipsers*. In 2014, we participated at our first open tournament and our main focus has been perception and behavior programming. At the 2015 RoboCup, we will compete in the drop-in player event as well as the technical challenges.

## 1 The Team

The *Z-Knipsers* started in 2012 at ETH Zurich and are a joint effort of the Computer Vision Lab (CVL) and the Automatic Control Lab (IfA, Institut fr Automatik) at the Department for Information Technology and Electrical Engineering. The letter 'Z' stands for Zurich and 'Knipsers' is a German word meaning something like an efficient goal scorer.
The team consists mainly of bachelor and master students that work on bachelor, semester or master projects to earn credits to their respective degrees. They are supervised by PhD student team leaders, currently Alex Locher and Louis Lettry from the Computer Vision Lab and Khoa Nguyen from the Automatic Control Lab, as well as by Profs. Luc Van Gool and John Lygeros. In the spring term 2015, eleven students are working on bachelor or semester projects with the help of two student assistants. They have been working in the fields of perception, motor control to behavior that we will explain in more detail in this paper. In the 2014/2015 season the following students were part of the team (no particular order): Marc Naumann, Gautham Manoharan, Kelly Steich, Filippo Martinoni, Orhan Sylejmani, Céline Eggenberger, Shiying Li, Dany Manickathu, Fisnik Kura, Cédric Mauquoi, Yinghao (Eric) Xu, Malvin Leuenberger, Lukas Affolter, Philippe Schwendener, Yi Hao Ng, Isaac Deutsch, Basile Verhulst, Sasha Pagani, Huub Heijnen. Figure 1 shows part of the team at the Iran Open 2015.

## 2 Robot Hardware

We have currently four V5, one V4, and three V3.3 NAOs (all H21). All robots are used for developing, testing, competition and exhibition (e. g., public relations events). Most probably we will carry three or four robots to the RoboCup for the drop-in player competition and technical challenges. Currently we still have compatibility issues with the V3.3 robots and the 2015 game controllers and are used in the lab for testing only.


**Fig. 1.** The Z-Knipsers team at the 2015 German Open.

## 3 Robot Software and 2015 SPL contributions

At the very start of our endeavor we tried developing all software parts in-house based solely on Aldebaran's Naoqi. However, due to limited resources and having realized the formidable challenge of builiding one's own code base, we decided to adopt the 2013 code release of B-Human and have been focusing our activities on perception, behavior programming and to a limited extent also motor control.

### 3.1 Perception

We pursued different lines of research. Various student projects investigated the potential of SEEDs, a superpixel extraction via energy driven sampling, for obstacle detection. One related publication is available on arXiv.org [3]. However, the performance was not significantly better than the algorithm included in the B-Human framework.
To improve self-localization, one project evaluated SEEDs applied to the background and surrounding. The idea is to use features from the environment to better distinguish the different courts of the pitch. This project has been recently expanded to implement a framework for simultaneous localization and mapping (SLAM) and is ongoing.
Since the B-Human framework relies on color calibration to detect goals and the ball, we have also worked on adaptive color calibration to improve the detection pipeline. A clustering automatically determines segmentation threshold

[3] Van den Bergh M., Boix X., Roig G. and Van Gool L. (2013). "SEEDS: Superpixels Extracted via Energy-Driven Sampling". In arXiv.org

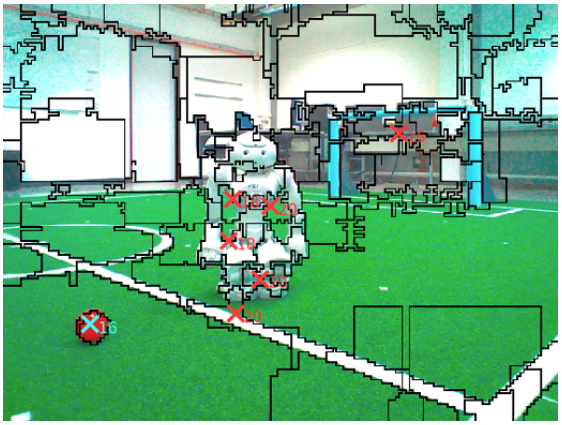

**Fig. 2.** Image segmentation using SEEDS superpixels.

from sample image. An additional project is working on white goal detection, in particular in reducing false positives given by robots, commercial banners and the environment.

### 3.2 Behavior Programming

While our last year's efforts were targeted at the implementation of single roles such as the goal keeper, defender and striker, this year we have implemented a dynamic role assignment (DRA) and passing framework. The DRA provides the roles of defender, supporter and breaking supporter as well as striker to the robots given weighted parameters such as ball and robot position (Fig. 3). Our passing framework is currently still at an infant state and has not been proven sufficiently robust for competition yet (we suspect communication issues). The framework divides the field in different zones to guide the decision to pass or pass (Fig. 4).
Extensions to these two projects are planned. The dynamic role assignment is being expanded with a diamond formation that would lead to a more compact formation close to the ball and would potentially also facilitate passing. A coaching robot is currently not considered in our team strategy.

### 3.3 Motor control

Two student projects have been working on kicking and walking. The former project created a new kicking engine that would allow new team members to use different kicks or adapt kicks more easily (e. g., time length of kick phases). This includes a side kick. The walking project's main task is to create a better understanding of the current walking engine and its parameters. The corresponding student has identified some parameters (such as step height) that he is experimenting with to improve our sluggish walking speed. Although our walking has

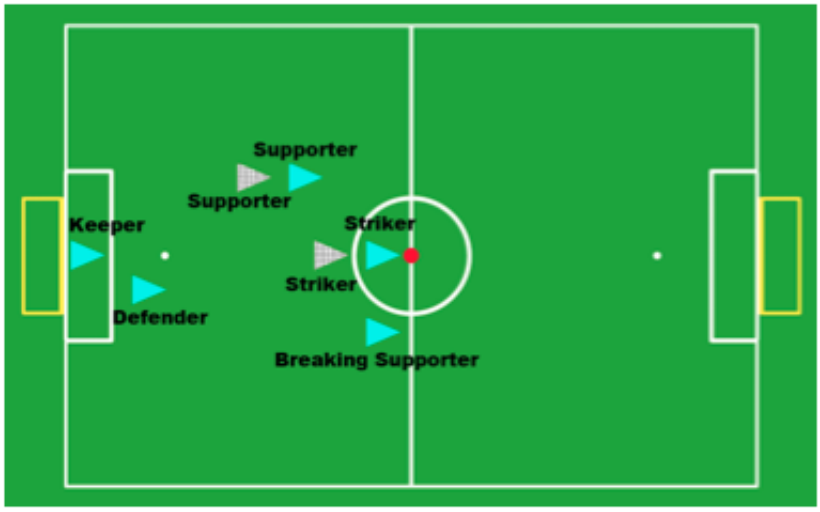


**Fig. 3.** The Z-Knipsers' roles at kickoff.

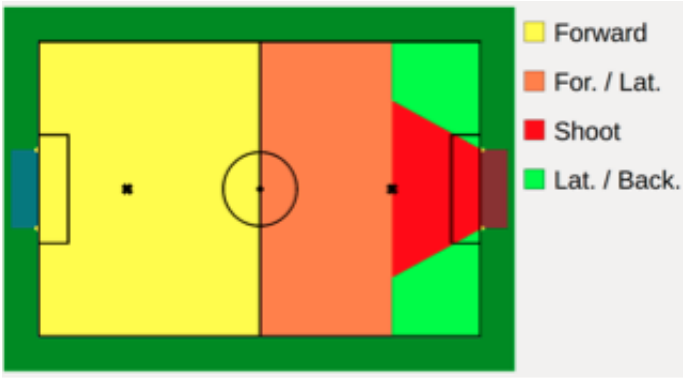


**Fig. 4.** The Z-Knipsers' passing zones and possible actions (shoot at goal, forward, lateral, backward passes).

become more stable than last year when we had the most fallen robots in the German Open, we realized that both our walking and path planning require work.

### 3.4 Drop-in Player

Regarding the drop-in player, we have adapted our code to incorporate the SPL standard message, intentions and suggestions. We categorize our teammates into five reliability states (from unreliable to reliable) based on possibly conflicting information in their sent messages and thus weight their intentions and suggestions accordingly. (We plan to upload the students' reports before the RoboCup.) We are looking forward to this competition, and will use the drop-in games to test and refine our features.

### 3.5 Challenges

Two students are working in our team on the challenges . We especially like the combination of skills needed to tackle them. In the current state, main difficulties are opponent detection for the corner kicks, missing field lines and different shades of green in the carpet challenge and the different sizes and colors of balls in the ball challenge.

## 4 Conclusions

The *Z-Knipsers* are participating for the first time at the RoboCup this year. We are excited to compete in the drop-in player event and technical challenges and would also not mind playing friendly matches against other teams. Our long-term plan is to incorporate our labs' solid background in control for action planning and decision making as well as the computer vision expertise to improve self-localization.

## 5 Acknowledgements

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