SQUIRREL Summer School 2014
Freiburg, 21. – 25. July

1 Overview

Welcome to the 2014 SQUIRREL Summer School in Freiburg! The following pages will provide you with the basic information about the school, the schedule, local arrangements and invited lectures.

The school consists of three invited lectures, a tutorial on integration, and hands-on work. The latter focuses around the topic of the project: cleaning up clutter. We will use the Robotino (in its current form without arm) to solve a simplified cleaning task. This task is meant to close the loop of perception, planning, and action, and serves to familiarise everyone with within the SQUIRREL software framework. We will form teams to solve this task, and the school will end with a competition between teams.

We hope you will all have an interesting learning experience and a good time!

2 Schedule

Monday, 21.5., Building 051, Room 034 (ground floor)

- 13:30 - 14:00 Welcome and opening
- 14:00 - 15:30 Invited Lecture: Tamim Asfour
- 15:30 - 16:00 *Coffee break*
- 16:00 - 17:30 Invited Lecture Tamim Asfour
- 18:30 *Organised dinner (Weinkost)*

Tuesday, 22.5., Building 102, Room 012 (first floor)

- 9:00 - 10:30 Invited Lecture: Cyrill Stachniss
- 10:30 - 11:00 *Coffee break*
- 11:00 - 12:30 Tutorial Integration: Ulrich Reiser
- 12:30 - 14:00 *Lunch*
- 14:00 - 15:30 Tutorial Integration: Ulrich Reiser
- 15:30 - 16:00 *Coffee break*
- 16:00 - 17:30 Hands on coding
- 19:00 *Dinner (individual)*

Wednesday, 23.5., Building 102, Room 012 (first floor)

- 9:00 - 10:30 Invited Lecture: Tom Duckett
- 10:30 - 11:00 *Coffee break*
- 11:00 - 12:30 Hands on coding
- 12:30 - 14:00 *Lunch*
- 16:00 - 20:00 Social event

Thursday, 24.5., Building 102, Room 012 (first floor)

- 11:00 - 12:30 Invited Lecture: Paul Furgale
- 12:30 - 14:00 *Lunch*
- 14:00 - 15:30 Hands on coding
- 15:30 - 16:00 *Coffee break*
- 16:00 - 17:30 Hands on coding
- 19:00 *Dinner (individual)*

Friday, 25.5., Building 051, Room 031 (ground floor)

- 10:00 - 12:30 Hands on coding / demo
- 12:30 - 13:00 Closing
- 13:00 End and safe trips home

3 Local Arrangements

3.1 Hotel

- Hotel Central (4 *), Wasserstrasse 6
  `www.central-freiburg.de`
- price: single 87 EUR (breakfast incl.), double 123 EUR [61,50 EUR per person, breakfast incl.)

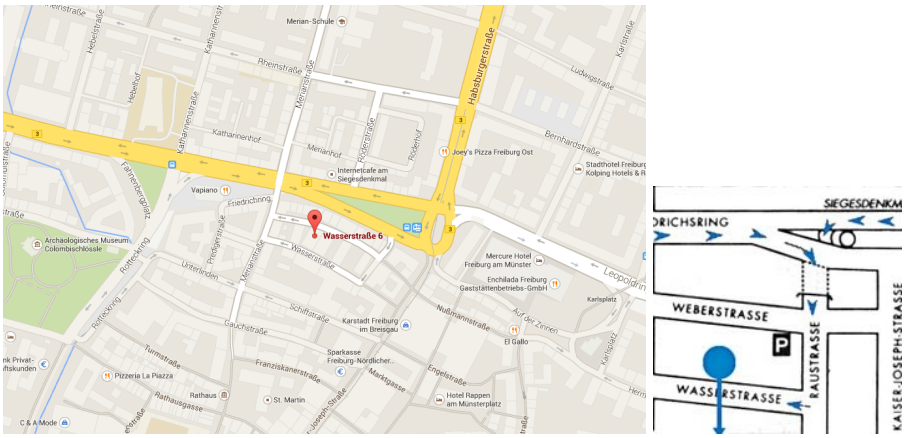

Abbildung 1: Hotel Central

3.2 Dinner Monday evening, 21.5.

- 18:30 Starts with a 1 hour city tour (`http://www.historix-tours.de/Touren/Ghost-Walks/English_Tours/english_tours.html`)
- Starting point: “Am Prediger Tor” (corner Unterlinden/Rotteckring)
- End of the tour: Alte Wache (Münsterplatz)
- 19:30 Alte Wache: Wine tasting and tapas (approx 2 hours)
  `www.alte-wache.com`

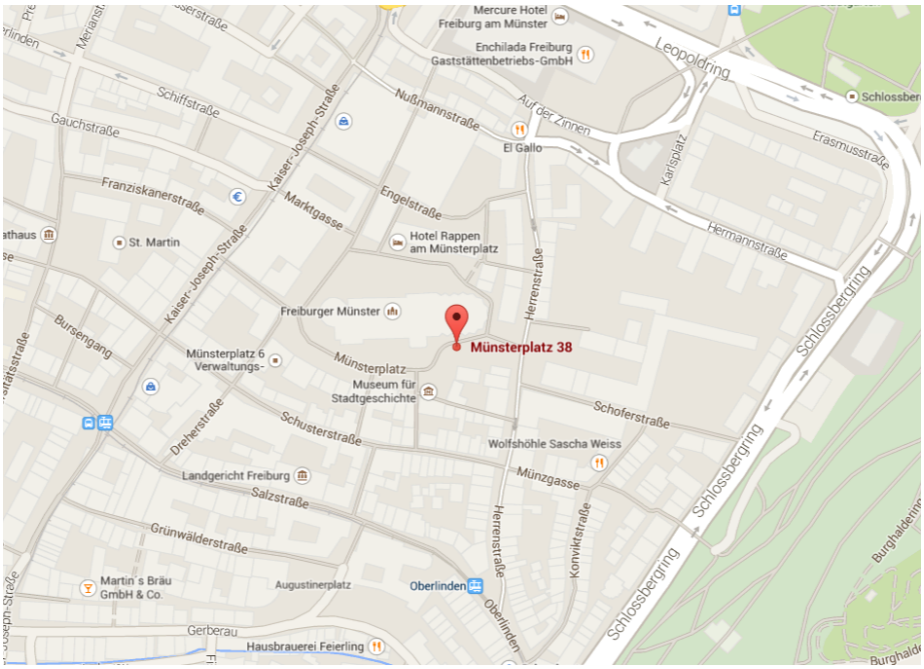

Abbildung 2: Alte Wache

3.3 Social event Wednesday afternoon, 23.5.

- 16:00 Carting (Kartbahnfahren), racing in teams of 8
  `www.impulsiv-umkirch.de/de/kart_einzelfahrt_trainingsfahrt.html`
- Please bring casual clothing and "robust" shoes, such as sports shoes or sneakers (no flip-flops).

Abbildung 3: Carting

3.4 Dinner Thursday evening, 24.5.

- 19:00 Dinner at "Der Kaiser" (in the Beer Garden), Günterstalstrae 38
  `www.freiburgerkaiser.de/restaurant.html`

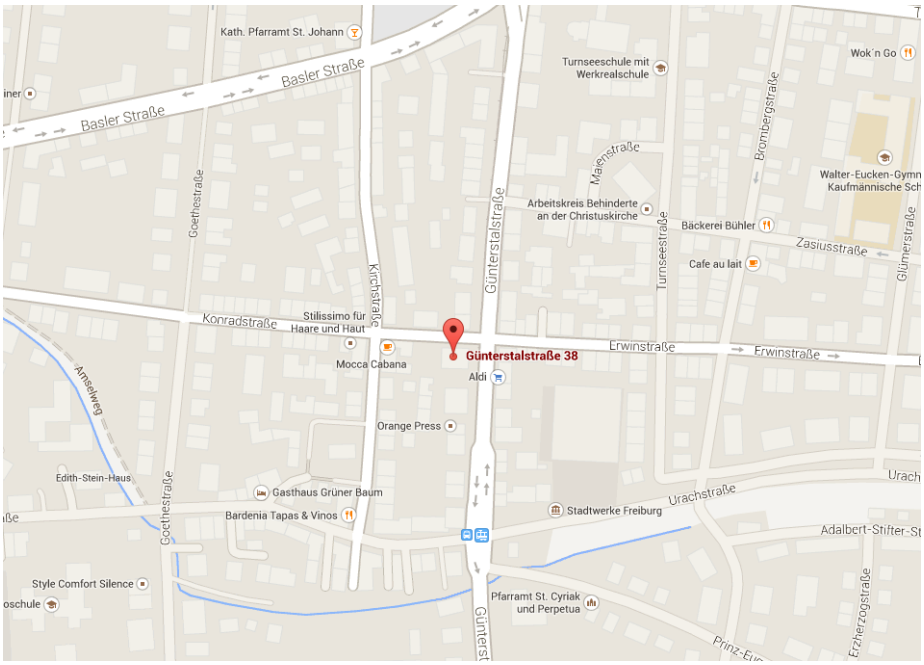

Abbildung 4: Der Kaiser

4 Invited Lectures

4.1 Active Perception for Scene Exploration, Grasping and Walking

Tamim Asfour: Institute for Anthropomatics and Robotics, Karlsruhe Institute of Technology, Germany

Abstract: Grasping objects is indispensable capability of robots which has to act and interact in the real world. Such robots should be able robots able to predict and act in the real world, to autonomously acquire knowledge about the world and to interact and collaborate with humans in open-ended environments. In this talk, we present our ongoing research towards the implementation of integrated 24/7 humanoid robots able to 1) perform complex grasping and manipulation tasks in a kitchen environment 2) autonomously acquire object knowledge through active visual and haptic exploration and 3) learn actions from human observation and imitate them in goal-directed manner. I will present results on combining visual and haptic information for discovering, segmenting and grasping unknown objects on a humanoid robot as well as on memory-based visual search. The developed capabilities will be demonstrated on the ARMAR humanoid robots. The second part of the talk will address the concept of Object-Action Complexes (OAC, pronounced oak) which has been introduced by the PACO-PLUS project to emphasize the notion that objects and actions are inseparably intertwined and to provide a formal, computational framework for object-action-effect and affordances. I will provide examples on show how such representations can be learned from both exploration and human observation and how they can be applied to grasping tasks and balancing of a humanoid robot.

4.2 Getting Things Done

Cyrill Stachniss: University of Freiburg / University of Bonn, Germany

Abstract: This lecture will present techniques and best practices for efficient work and project management.

4.3 Robotic Mapping into the Fourth Dimension

Tom Duckett: Lincoln Centre for Autonomous Systems, University of Lincoln, UK

Abstract: Future service robots will be required to run autonomously in dynamic human environments for really long periods of time. These robots will be required to live together with people and adapt to the changes that people make to the world. This includes the problems of learning and adapting a robots spatial knowledge in the form of a **map** throughout the lifetime of the robot. However, most of the past research on robotic mapping addresses only the initial learning of an environment, a phase which will only be a short moment in the lifetime of a service robot that may be expected to operate for many weeks, months and years. This session will explain the research challenges and the state-of-the-art methods for long-term mapping by mobile robots in dynamic human environments which are subject to both temporary and structural changes in time. First I will outline the major sub-problems and the corresponding solutions developed so far by the robotics research community for mapping static environments. Then I will explain the special challenges for robotic mapping in changing environments, and present some of the state-of-the-art approaches developed for long-term mapping, with a particular focus on mobile service robots which must perform in cluttered, indoor environments shared with humans.

4.4 Representing Robot Pose: The First-Order View

Paul Furgale: Autonomous Systems Lab, ETH Zürich, Switzerland

Abstract: There is a lot of confusion around the representation and estimation of poses in robotics. Although all of this information is known, it is presented in disparate sources without common notation or an overview. This talk will try to clear away some of confusion and present a gentle introduction to some of the key methods that we use to represent and manipulate expressions containing robot poses. This will include the following topics:

1. The very basics of understanding the connection between robot poses and the associated Lie Group structure of rotations (SO(3)) and transformations (SE(3))

2. How to estimate robot poses within an unconstrained optimization framework. This will cover the topic of how to linearize expressions that include rotations or transformations and provide identities to manipulate these expressions that work regardless of what underlying representation you use. This will also include extremely practical information about how to unit test these linearizations using Matlab to test for correctness.

3. One method of associating uncertainty with rotations and transformations, how this relates back to the Lie Group structure, how to recover the uncertainty from the estimator, and how to transform uncertainty between different representations (to first order).