

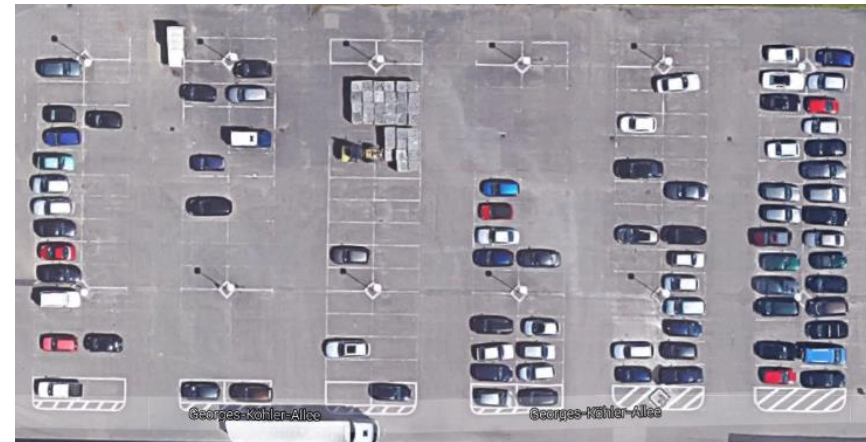
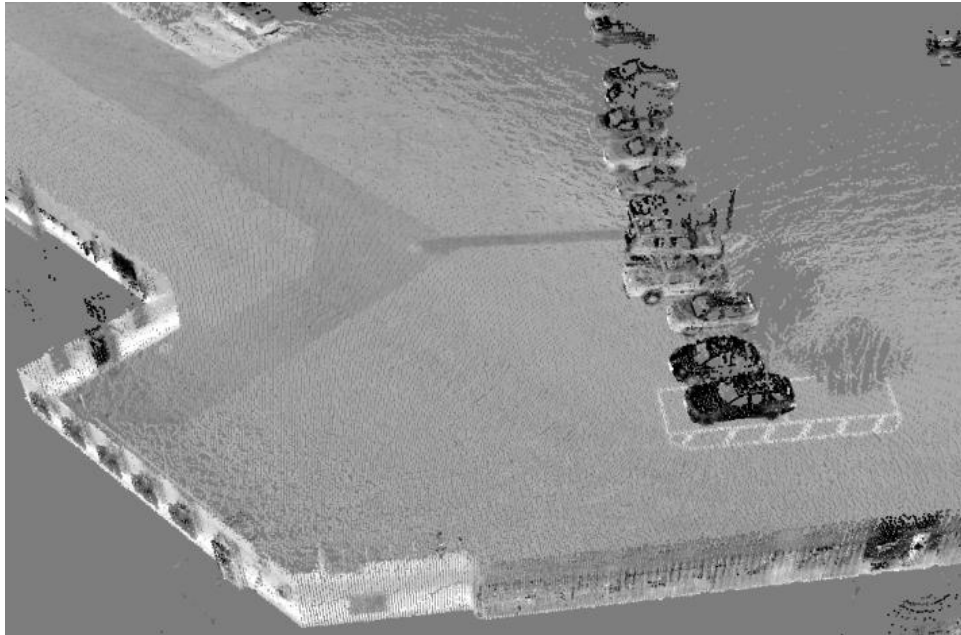
Parking Space Detection

Computer Science Lab Project
SS 2015

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Topic of this Project

How to find a free parking spot?



Topic of this Project

How to find a free parking spot?

- How can we identify parking areas?
- How can we detect parking cars?
- How can we combine information?
- How can we improve our estimate over time?

Goals of this Course

- Hands-on development of a robotic data analysis system
- Deeper understanding of 2D / 3D data analysis and reasoning
- Practical programming experience
- Team work
- Experience in contributing to a software project

Project Structure

- One project, one goal, different tasks building on each other
- Teams of 2/3 people
- Everyone has an own component to develop within the team
- Team members are supposed to help each other
- Workload ~ 2 days / week

Requirements

- Support your team
 - Attend meetings
 - Present results for each milestone
-
- Final evaluation and presentation of the developed system will be graded

Project Idea

- Satellite images (static information)
 - ➔ identify **allowed** parking areas
- 3D point cloud data (current observation)
 - ➔ alignment with satellite image to identify **free** parking lots
- Combine 2D + 3D information
 - ➔ learn to detect cars in point clouds
 - ➔ improve the map estimate

Tasks

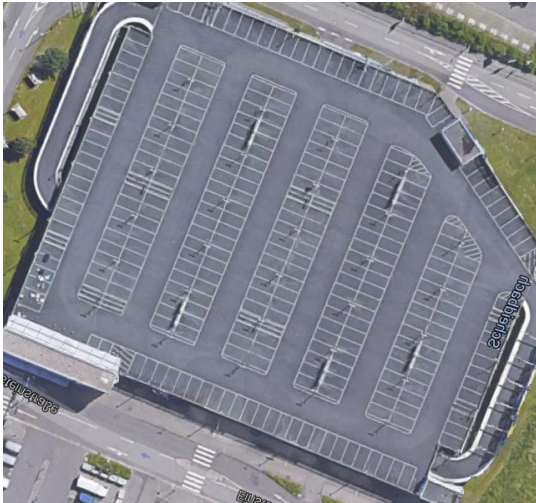
1. Parking area detection
 2. Registration of point cloud and image
 3. Car detection in point cloud
 4. Map improvement
- Data collection with robot Obelix?

Task 1: Parking Area Detection

- Detect parking area features in images (e.g., lines, corners, patterns...)
- Generate a map of parking spaces
- Evaluate your results

- Topics: image processing, filtering, segmentation, OpenCV

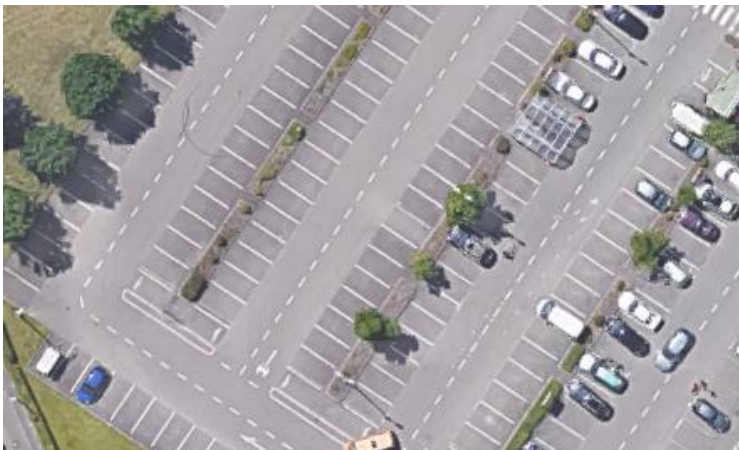
Example Data



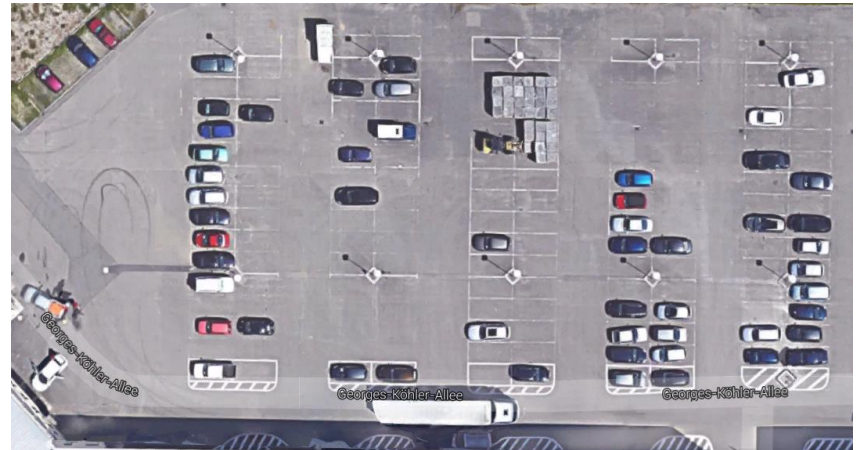
Ikea



Real



Toom



Faculty

Task 2: 2D - 3D Registration

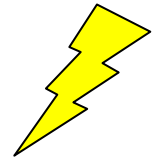
- Compute a transformation of the 2D image and the 3D point cloud
 - Given a set of correspondences
- Detect and visualize all free parking spaces
- Label points in occupied parking spaces as cars
- Topics: visualization, registration

Task 3: Car Detection

- Registration from previous task provides a segmentation of cars
- Use these point clouds as training examples to compute car features
- Implement a car detector
- Topics: 3D features (e.g., NARF, spin images, 3D shape context), PCL, supervised learning techniques

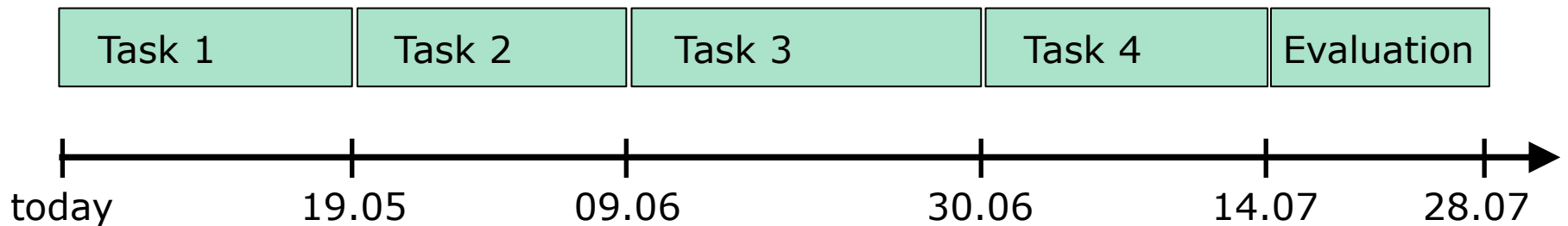
Task 4: Map Improvement

- Identify inconsistencies between 2D image and 3D observation: observed cars but no allowed parking area
- Improve the 2D map
- Consider uncertainties in both classifications



Timeline: Milestones/Meetings

- 19.05: **M1** 2D image segmentation
- 09.06: **M2** map overlay+free parking lots
PCL tutorial
- 30.06: **M3** car classification
- 14.07: **M4** improved maps
- 28.07: final presentations



Summer Semester 2015

Software Development

- Libraries
 - OpenCV (Open computer vision library)
 - PCL (Point Cloud Library)
- Programming language
 - C++ (supported)
 - Matlab, Java, Python (also possible)
- Operating system
 - Linux (Ubuntu 14.04)
 - Windows / Mac ?

Versioning Tool: Subversion

- Useful for cooperative development and version tracking
- Stores every change made to the code
- Allows to go back to any intermediate revision
- Supports to merge different versions
- Inherently multi-user
- See course website for tutorials

Team Setup

- Find your team mates
- Get familiar with your tasks
- Create a work plan
 - Split it up into subtasks
 - Decide on task assignments
 - Define your deadlines within teams
- ...

Framework Setup

- Website:

`ais.informatik.uni-freiburg.de/teaching/ss15/practical`

- SVN repository:

`https://aissvn.informatik.uni-freiburg.de/svn/studentprojects-parking-space-detection/`

- Try out examples from OpenCV tutorial

- Create your own svn repository

Contact

- Contact us whenever you have problems, questions, and ideas
- Best via E-Mail:
 - bfrank@informatik.uni-freiburg.de
 - tatarchm@informatik.uni-freiburg.de
- Office: Building 079, ground floor
- If you have serious problems, contact us as soon as possible (the other team members depend on you).