

Robotics and
Embedded Systems

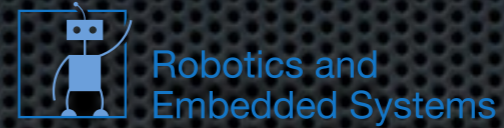


Final Projects

Applied Computer Vision for Robotics

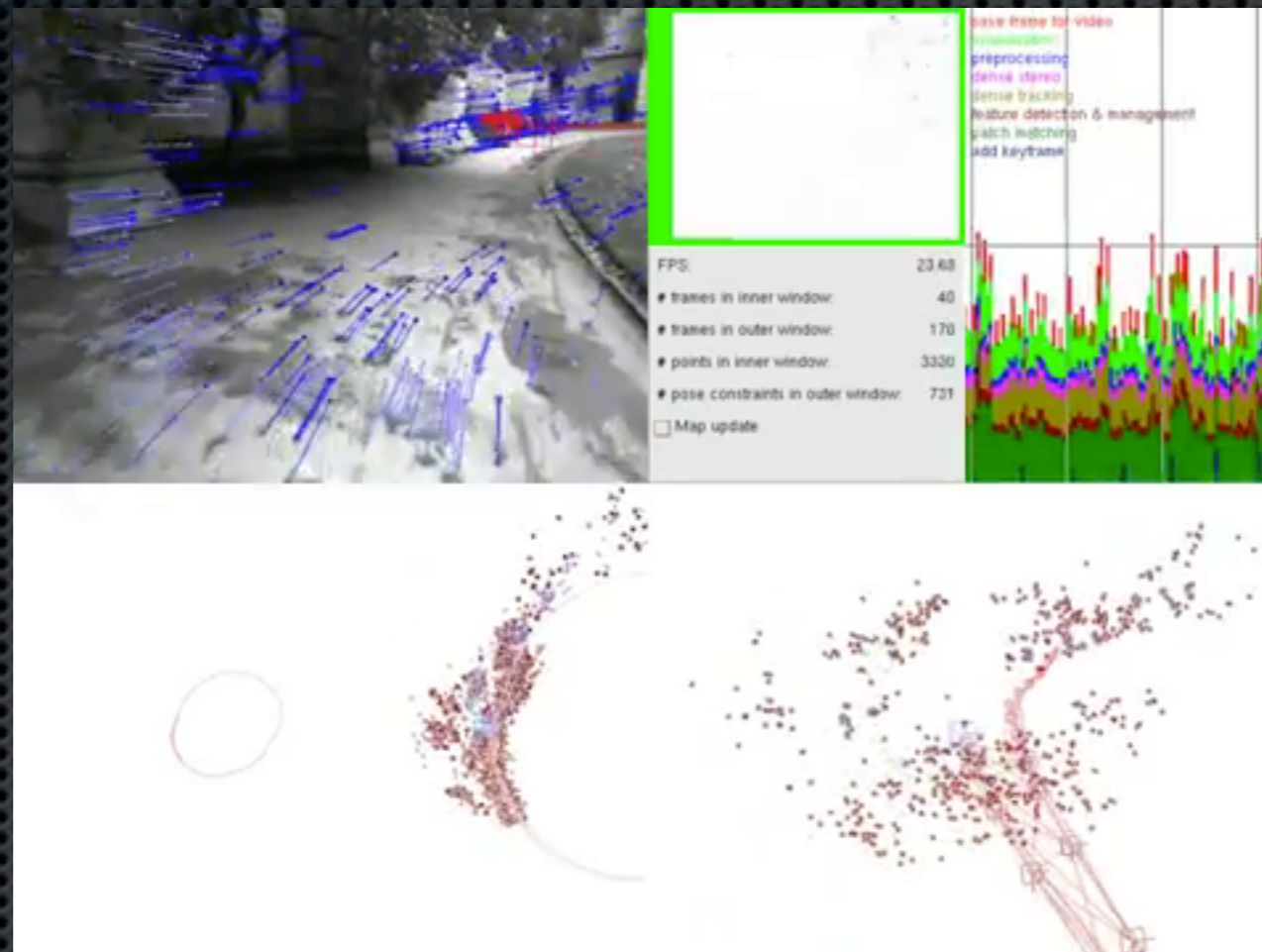
12.6.2014

Organisation



- ✦ 4 Weeks
- ✦ 17.06.2014: Presentation of Project Roadmap
- ✦ 2 Status meetings
- ✦ 08.07.2014 Final Presentation

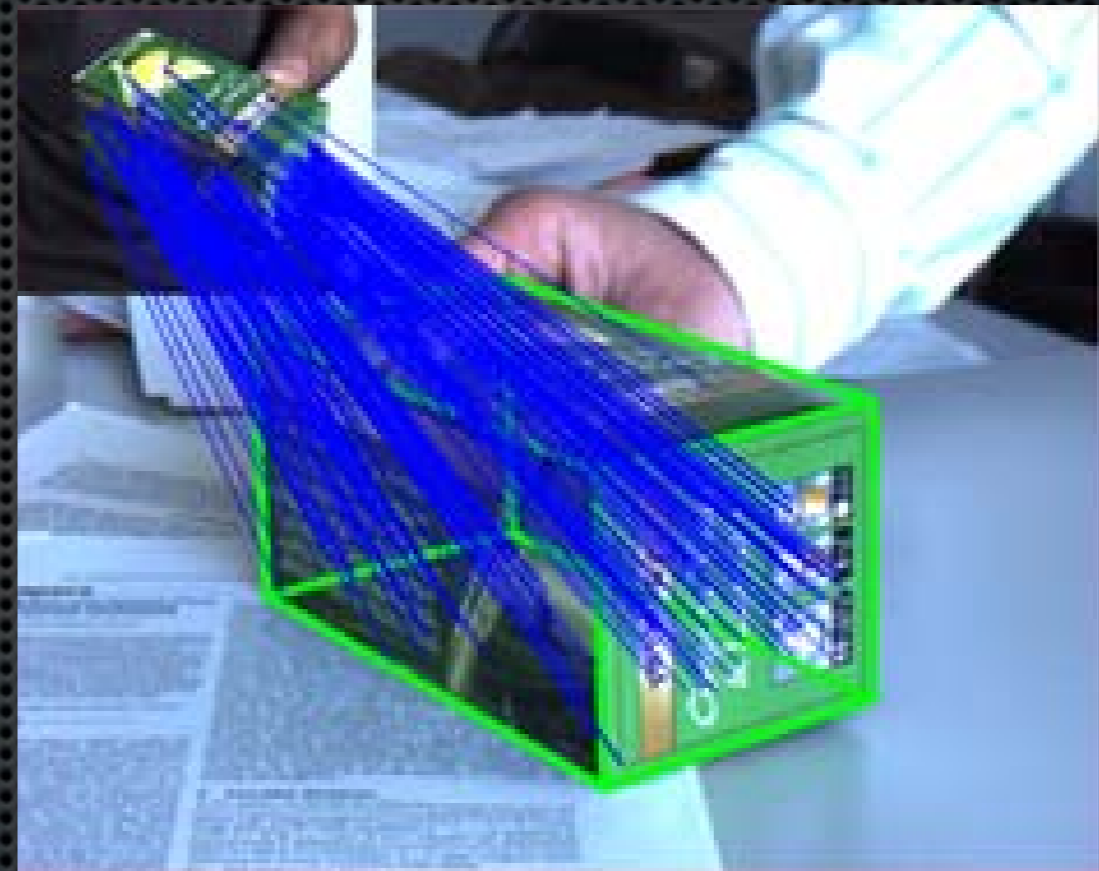
Key Frame based SLAM



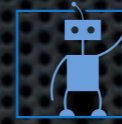
- Key Frame matching strategies for improved performance
- Create a feature map of the environment
- Kinect/Stereo/Mono
- Motionmodel, Filtering, 3D-3D, 3D-2D, Global Optimization

Object detection and pose estimation using Features and PnP

- ✦ Extract features from known object and their 3D position (e.g. box and 2D offset)
- ✦ Detect features and use 3D-2D correspondences with RANSAC to estimate object pose



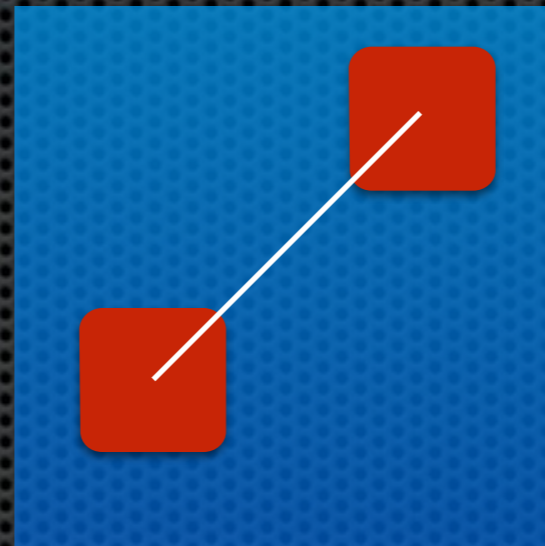
Binary Descriptors



Robotics and
Embedded Systems

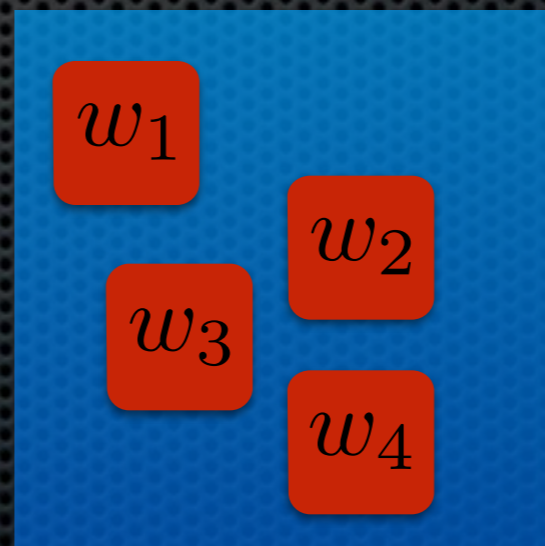


- ✦ Try more complex binary features
- ✦ Experiment with different schemes and perform an in detail evaluation



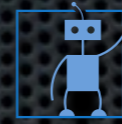
$$I_2 - I_1 > 0$$

$$w_1 \cdot I_1 + w_2 \cdot I_2 > \tau$$



$$\sum_i w_i \cdot I_i > \tau$$

Locally Sensitive Hashing



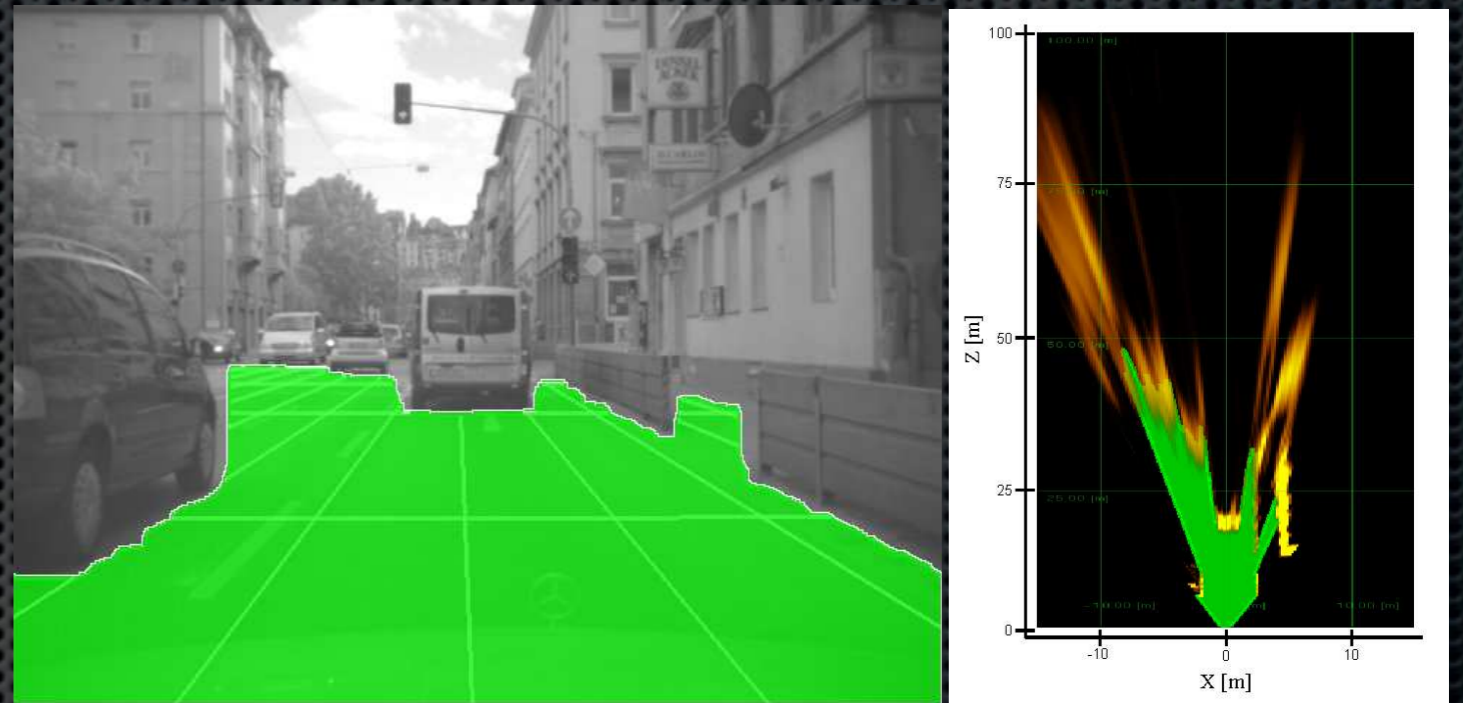
Robotics and
Embedded Systems



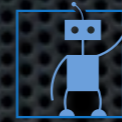
- ✦ Instead of performing a quadratic search to perform feature matching we can also apply hashing
- ✦ Evaluate and/or try Locally Sensitive hashing for different scenarios
- ✦ Try different hashing strategies for binary descriptors

Freespace, Ground-plane estimation and IPM

- ✦ Use stereo setup to estimate freespace
- ✦ Estimate ground plane
- ✦ Perform inverse perspective mapping of the ground plane



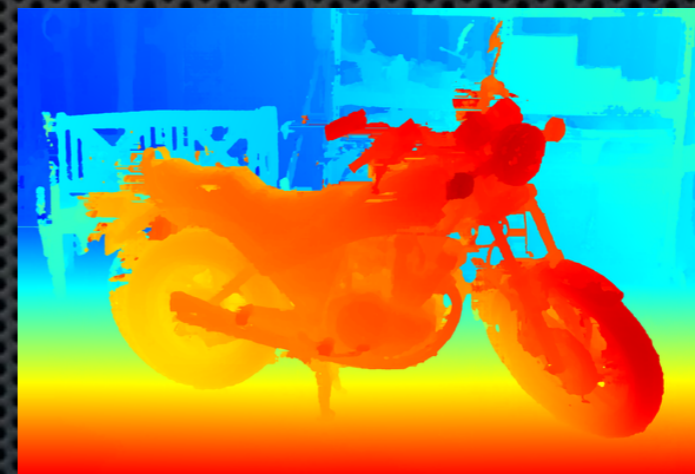
SGM (+Plane Sweep)



Robotics and
Embedded Systems



- ✦ Well known and good dense stereo algorithm
- ✦ CVPR2014 paper with several extensions and nice ideas (feature matching initialization, planes, local tiles)

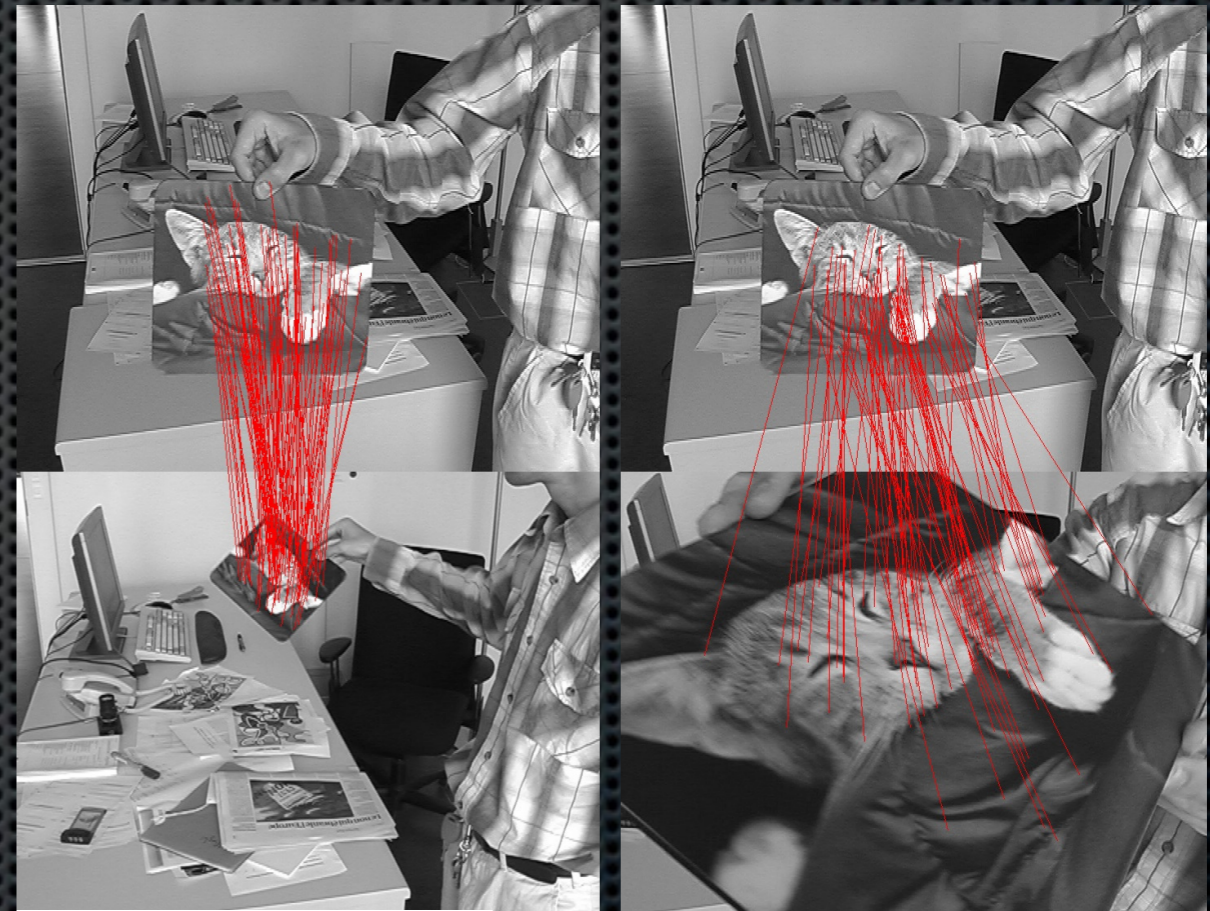


[1] H. Hirschmuller, “Stereo Processing by Semiglobal Matching and Mutual Information,” *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 30, no. 2, pp. 328–341, 2008.

[2] S. N. Sinha, D. Scharstein, and R. Szeliski, “Efficient High-Resolution Stereo Matching using Local Plane Sweeps,” *CVPR 2014*, pp. 1–8, Apr. 2014.

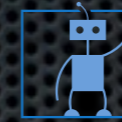
Ferns for traffic sign detection

- Keypoint recognition with learning phase - train special descriptors for certain templates
- Use learned descriptor for e.g. traffic sign detection, template detection



[1] M. Ozuysal, M. Calonder, V. Lepetit, and P. Fua, "Fast keypoint recognition using random ferns," IEEE Trans. Pattern Anal. Mach. Intell., vol. 32, no. 3, pp. 448–461, 2010.

Overview



Robotics and
Embedded Systems



Topic	Assigned Team
Key Frame based SLAM	
Object Detection and Pose Estimation	Lenna
Optimized Binary Descriptors	
Locality Sensitive Hashing	
Freespace, Ground Plane estimation and IPM	Bug Busters
Semi Global Matching + Plane Sweeping	
Ferns for Traffic Sign Detection	Triforce