Applied Computer Vision for Robotics
Mini-Projects

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Robotics and
Embedded Systems

Template Tracking using Linear Predictors

Robotics and Embedded Systems

Goals

- baseline implementation of ALPs
- tracking of BMW lab car using this approach
- estimation of position and orientation relative to known floor plane
- live (real-time) tracking should be possible on desktop pc

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Sheer Driving Pleasure

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Bundle Adjustment Evaluation

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Bundle Adjustment Evaluation

- Libraries of interest:
  - g2o (Freiburg)
  - ceres-solver (google)
  - GTSAM (Giorgia-Tech)
- Goals:
  - Definition of common message interface for “Keyframe” based SLAM like Bundle Adjustment
  - Implementation as nodelets
  - Selection of appropriate test datasets
  - Visualization in rViz
- Evaluation criteria: speed, accuracy, robustness

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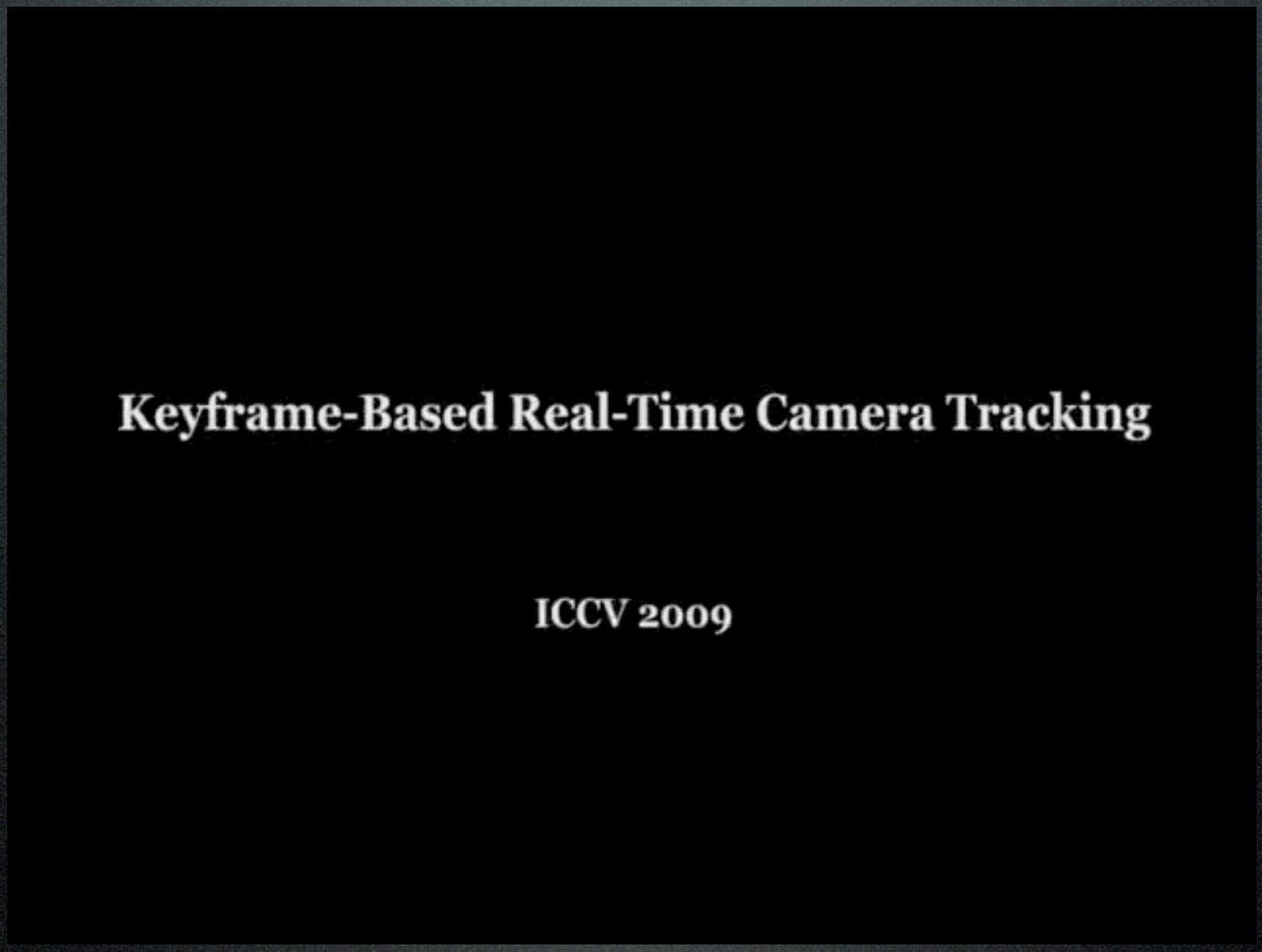
Keyframe-Based SLAM



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Keyframe-Based SLAM

- Goals:
  - Extend code from sheet 3 & 4 to use Keyframes
  - Trajectory output in real-time
  - Map-Optimization in separate thread (nodelet)
  - input trace from kinect (lab-car)

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Real-Time Spherical Mosaicing using whole image alignment

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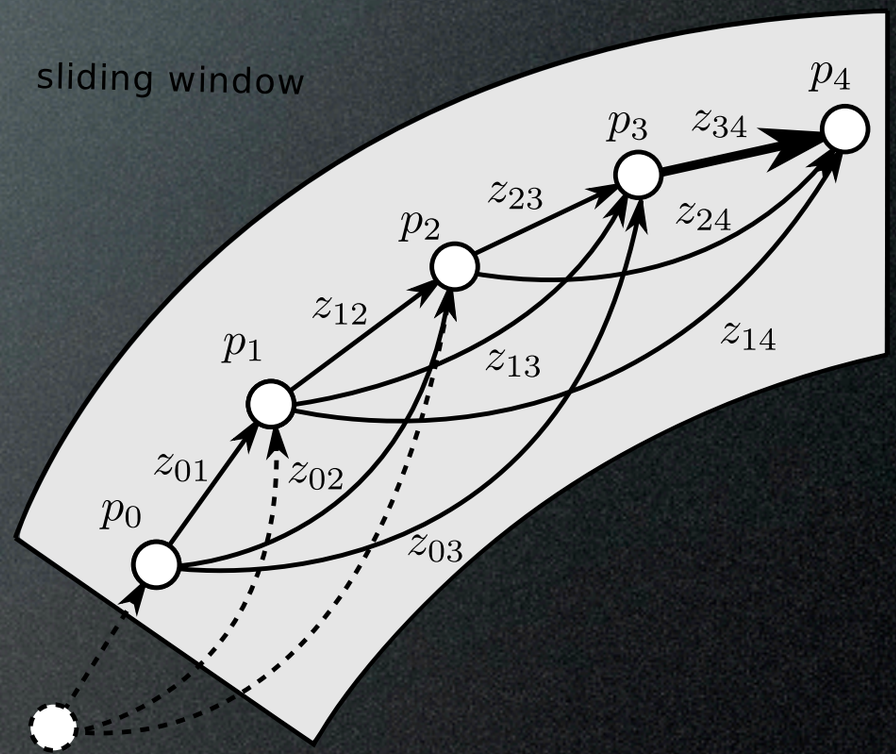
Real-Time Spherical Mosaicing using whole image alignment

- spherical panoramas using direct image alignment methods
- “keyframe” style optimization
- GPU implementation using OpenCL possible
- Applications:
  - Panoramas, In-Situ Stitching
- S. Lovegrove and A. J. Davison, “Real-time spherical mosaicing using whole image alignment,” presented at the ECCV'10: Proceedings of the 11th European conference on computer vision conference on Computer vision: Part III, 2010.

Robotics and Embedded Systems

Pose Graph Optimization

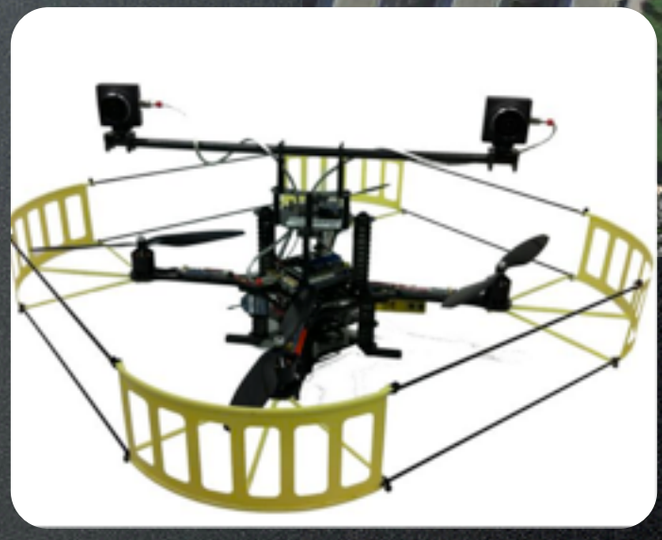
- Pose-Graph Optimization as extension to existing VO system
- Pose-Graph on Sliding-Window (gathered from 3D-3D point correspondences)
- optimize the current pose, using information from all frames in the window (only optimize the pose parameters)



Robotics and Embedded Systems

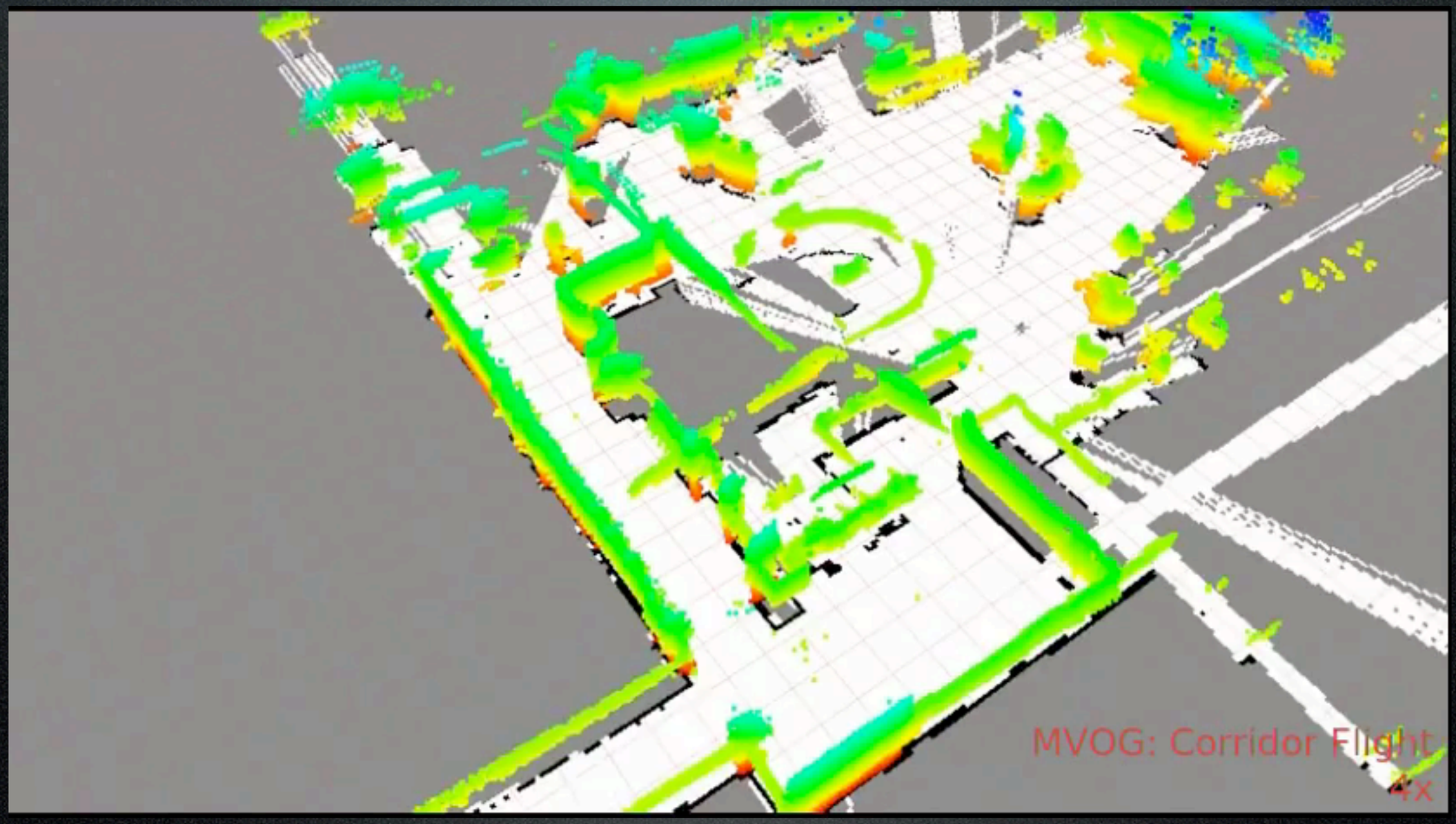
Fusing GPS and Stereo data

- GPS and Stereo Data track from quadrocopter
- Optimization-based fusion (e.g. ceres-solver)
- Visualization of path in google-maps (and rviz)



Robotics and Embedded Systems

Path Planning using 3D Occupancy Grids



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Robotics and Embedded Systems

Path Planning using 3D Occupancy Grids

- Use results of stereo-visual odometry from last two sheets
- Use the resulting point cloud to generate a 3D occupancy grid using octomap
- implement path-plannig algorithm on the grid
- Goal:
  - Collision free navigation between two points in the map
  - application to lab-car data

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Autonomous Robotino using RGBD Data

- Goals:
  - get familiar with robotino on ROS
  - use VO result from last sheet and apply it to kinect data on robotino
  - maybe use additional sensor information available from robotino (e.g. wheel-odometry)
  - position control: e.g. give relative/ absolute goal positions the robotino should drive to
  - if possible: use outcome of navigation project for collision free navigation

Robotics and Embedded Systems