



# Practical Course: Vision-based Navigation

## Premeeting

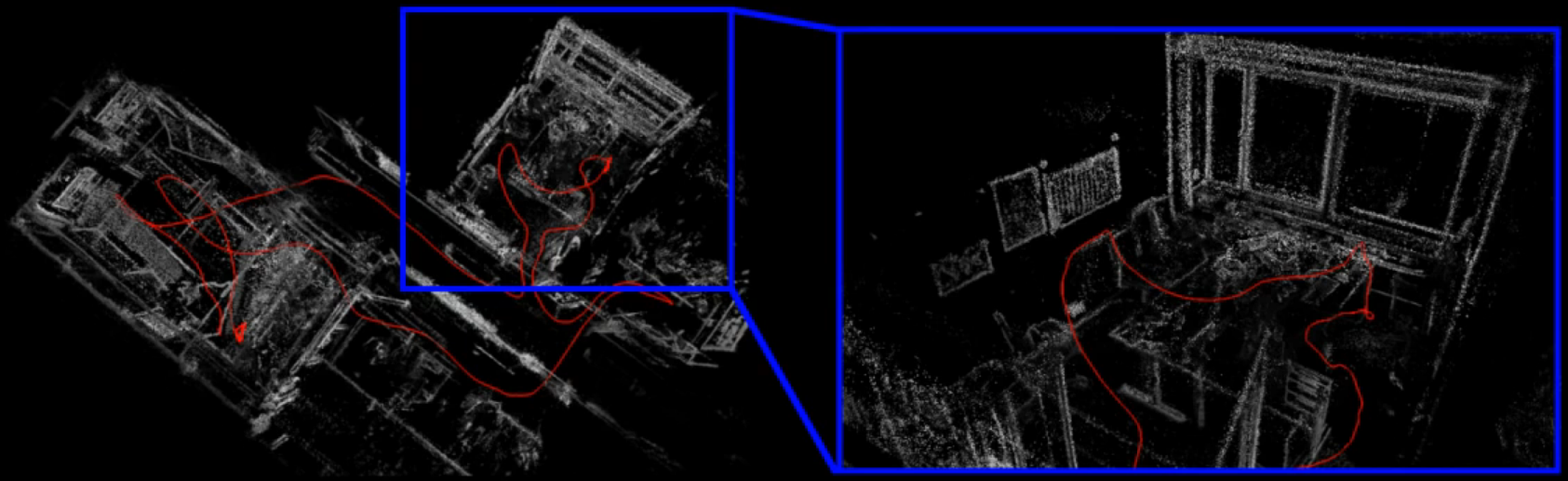
Vladyslav Usenko, Nikolaus Demmel

Prof. Dr. Daniel Cremers

# Direct Sparse Odometry

Jakob Engel[1,2], Vladlen Koltun[2], Daniel Cremers[1]

July 2016



[1]Computer Vision Group
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# ORB-SLAM

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# Content of this Course

- You can gain practical experience with
  - Visual odometry and localization/state estimation
  - Vision-based Simultaneous Localization and Mapping (SLAM)
  - Structure-from-Motion (SfM)
- Implementation of algorithms
- Benefits/drawbacks of specific methods when applied to concrete, relevant problems
- Get familiar with relevant software libraries (Eigen, ceres, opengv, …)
- Learn how to work in teams/on projects
- Improve your presentation skills

# Course Organisation

- Course takes place during the lecture period

- Initial phase (first 5 weeks): Lectures & Exercises
  - Mondays 2-4pm in seminar room 00.08.055, 4-6pm in lab 02.05.014
  - Programming assignments will be handed out every week and checked/graded by the tutors
  - Worked on indiviually by every student; each participant should be able to explain their solution
  - Attendance to lecture & exercise sessions mandatory

- Second phase (remainder): Project
  - Work in small groups (1-3 people) on a project
  - Lab 02.05.014 available; tutors available Mondays 2pm-6pm;
  - Mandatory weekly meeting with tutors to discuss progress and next steps
  - Implement a specific algorithm, which one tbd.
  - Present project outcome in talk&demo session (15min per group)
  - Written report on project outcome (10-12 pages, single column, single-spaced lines, 11 pt)

# Topics covered

- 3D geometry and camera models.
- Non-linear optimization and camera calibration
- Feature detectors and descriptors. Feature Matching. RANSAC.
- Offline Structure from Motion. Bundle Adjustment. Schur complement. Point parametrizations.
- Visual Odometry and SLAM (Online BA).
- Possible topics for projects: Large-scale consistency for SLAM, visual place recognition, optical flow for visual odometry, direct methods (odometry, BA), dense reconstruction, …

# Course Requirements

- Good knowledge of the C/C++ language and basic mathematics such as linear algebra, analysis, stochastics, and numerics is required
- Prior practical knowledge in robotics, and computer vision topics is a plus
- Participation in at least one of the following lectures of the TUM Computer Vision Group: Variational Methods for Computer Vision, Multiple View Geometry, Autonomous Navigation for Flying Robots. Similar lectures can also be accepted

# Course Registration

- You apply for courses through the matching system in TUMOnline: List your preference on courses
  - Please specify how you meet the course requirements / if you have attended any related computer vision courses before!
  - Send your transcripts with Computer Vision / Robotics lectures that you have attended to: visnav_ws2019@vision.in.tum.de

- We can only guarantee places to students assigned through the matching process (and fitting the course requirements)!

- Watch announcements on course website: https://vision.in.tum.de/teaching/ws2019/visnav_ws2019

- The course starts on Monday October 21st 2019

Demo

Questions?