Practical Course: Vision-based Navigation

Premeeting

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Direct Sparse Odometry

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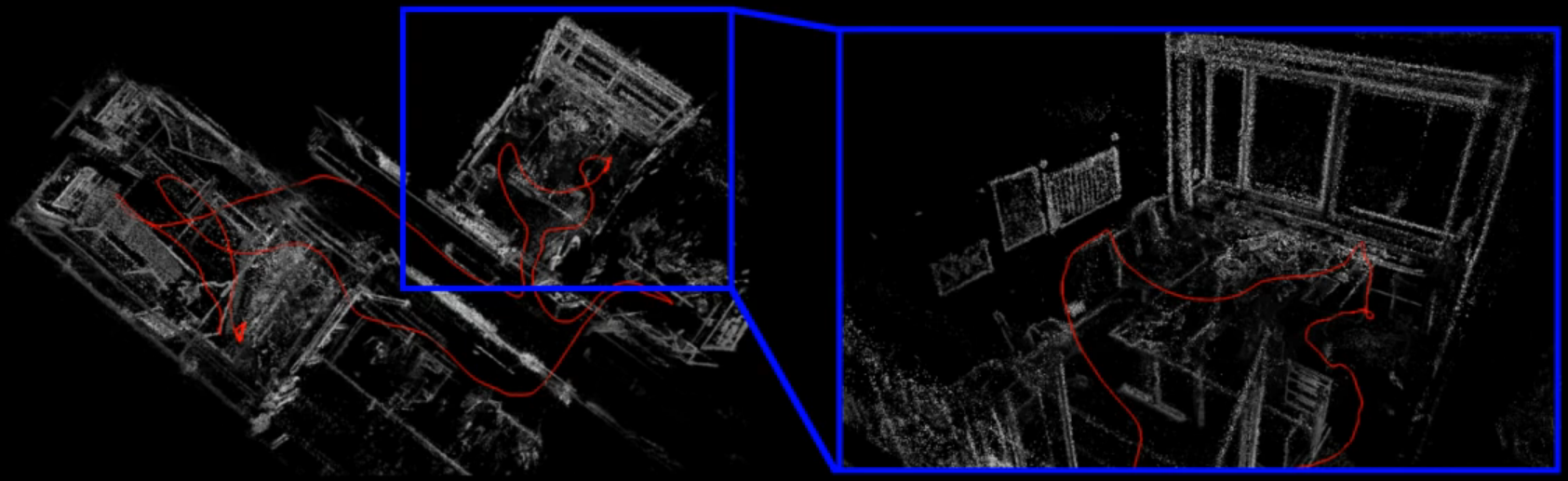

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ORB-SLAM

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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 02.09.023, 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 (1-2 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 and Q&A 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.
  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!
  - Comment on your programming experience, in particular in C++!
  - Send your transcripts with Computer Vision / Robotics lectures that you have attended to: visnav_ws2020@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/ss2020/visnav_ss2020

- The course starts on Monday April 20th

Demo

Questions?