Practical Course: Vision Based Navigation

Premeeting
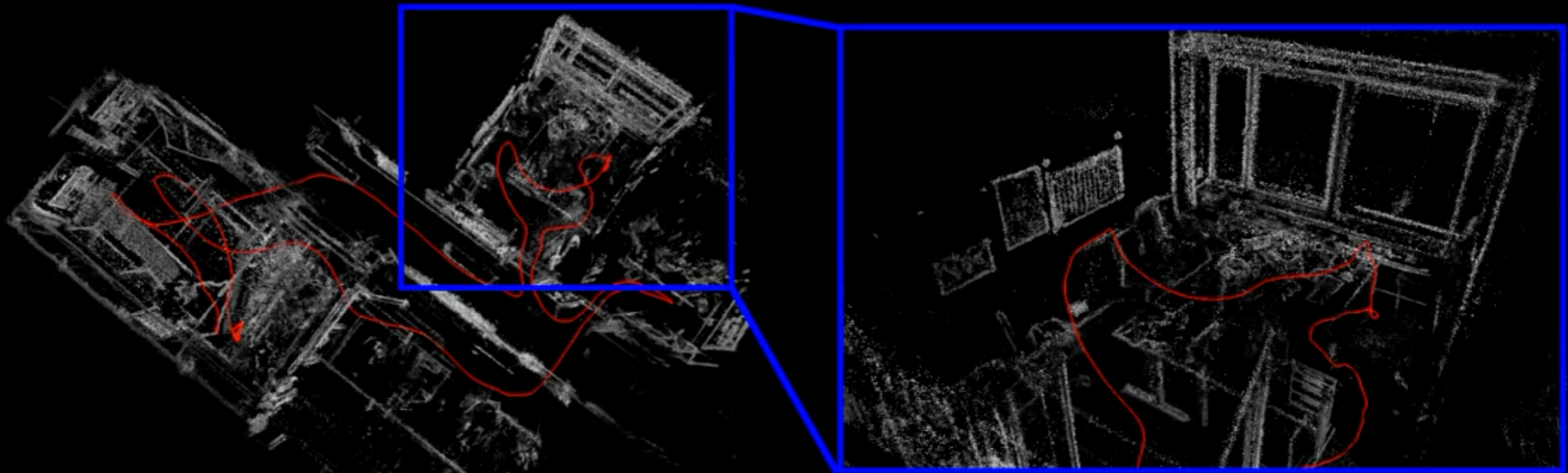
Nikolaus Demmel, David Schubert,
Prof. Dr. Daniel Cremers
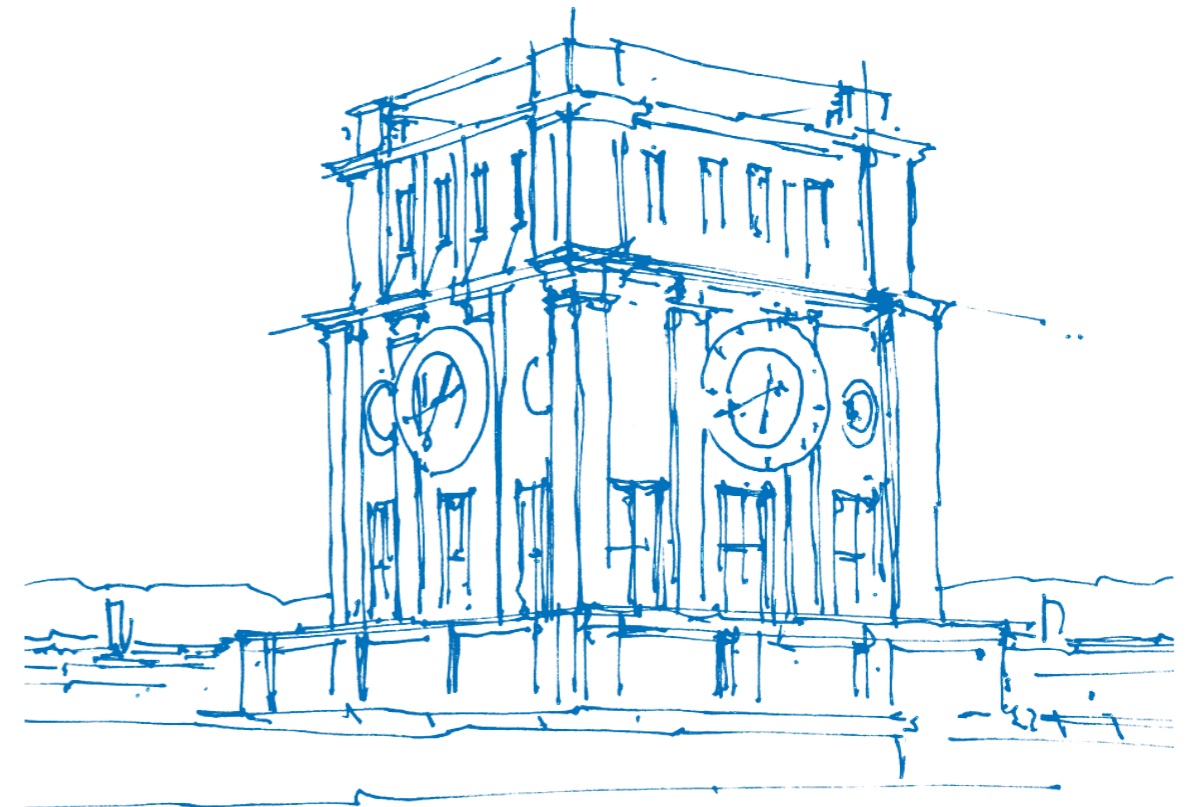
Version: 06.07.2020

ORB-SLAM

Raúl Mur-Artal, J. M. M. Montiel and Juan D. Tardós

{raulmur, josemari, tardos} @unizar.es

Instituto Universitario de Investigación
en Ingeniería de Aragón
Universidad Zaragoza

Universidad
Zaragoza

Content of this course

- You can gain practical experience with
  - Visual odometry and localisation / 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

- Whether the course will be virtual is still to be decided

- Initial phase (first 5 weeks): Lectures & Exercises
  - Mondays 2-4 pm lecture (watch video, or beforehand in you own time)
  - Mondays 4-6 pm exercise session (lab 02.05.014 or via video conference (tbd))
  - Programming assignments will be handed out every week and checked / graded by the tutors
  - Assignments are worked on individually by every student; each participant should be able to explain their solution
  - Attendance to lecture and exercise sessions voluntary (but **highly** encouraged)

- Second phase (remainder): project
  - Work in small groups (1-2 people) on a project
  - Lab 02.05.14 might be available (tbd); tutors available Mondays 2-6 pm
  - 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 (15 min per group)
  - Written report on project outcome (10-12 pages, single column, single-spaced lines, 11pt)

Topics covered

- 3D geometry and camera models
- Non-linear optimisation and camera calibration
- Feature detectors and descriptors, feature matching, RANSAC
- Offline Structure from Motion, bundle adjustment, Schur complement
- 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 is essential**

- Good knowledge of 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
  - Computer Vision I: Variational Methods
  - Computer Vision II: Multiple View Geometry
  - Similar lectures can also be accepted

Course registration

- You apply for this course through the matching system: https://matching.in.tum.de/

- Additionally, you have to send us an email:
  - Please specify how you meet the course requirements / if you have attended any related computer vision courses before!
  - **Comment on you programming experience in C++!** List concrete examples of projects you have worked on.
  - Send all your grade transcripts, in particular showing any lectures on pre-requisite topics (computer vision / robotics / maths) that you have attended to: visnav_ws2020@vision.in.tum.de

- The deadline for the matching system and prerequisite email is 21.07.2020.

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

- Watch announcements on the course website: https://vision.in.tum.de/teaching/ws2020/visnav_ws2020

- The course starts on Monday, October 19th, 2020

Demo

Questions?