Practical Course: Vision-based Navigation Winter term 2017/2018

Welcome

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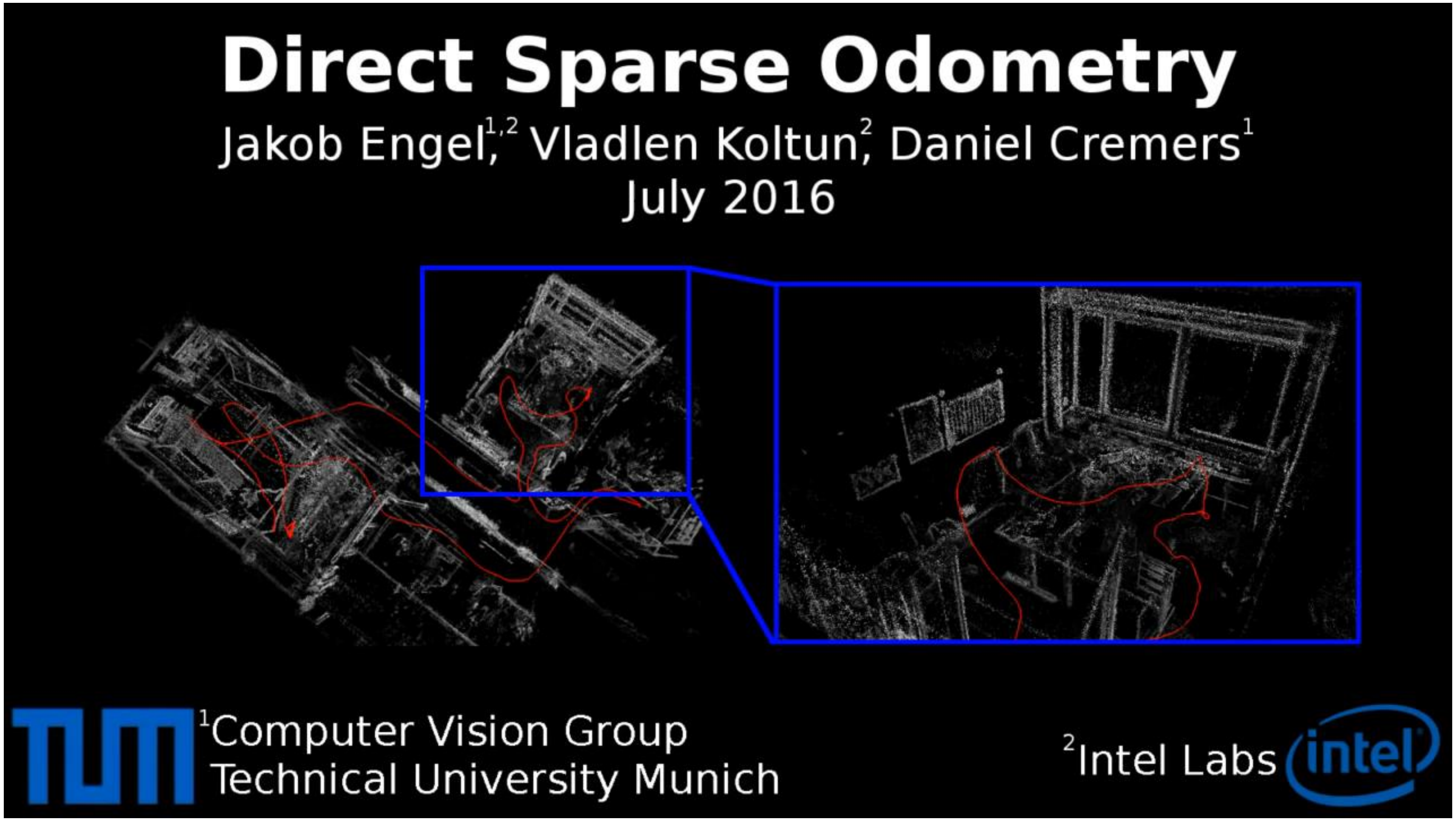
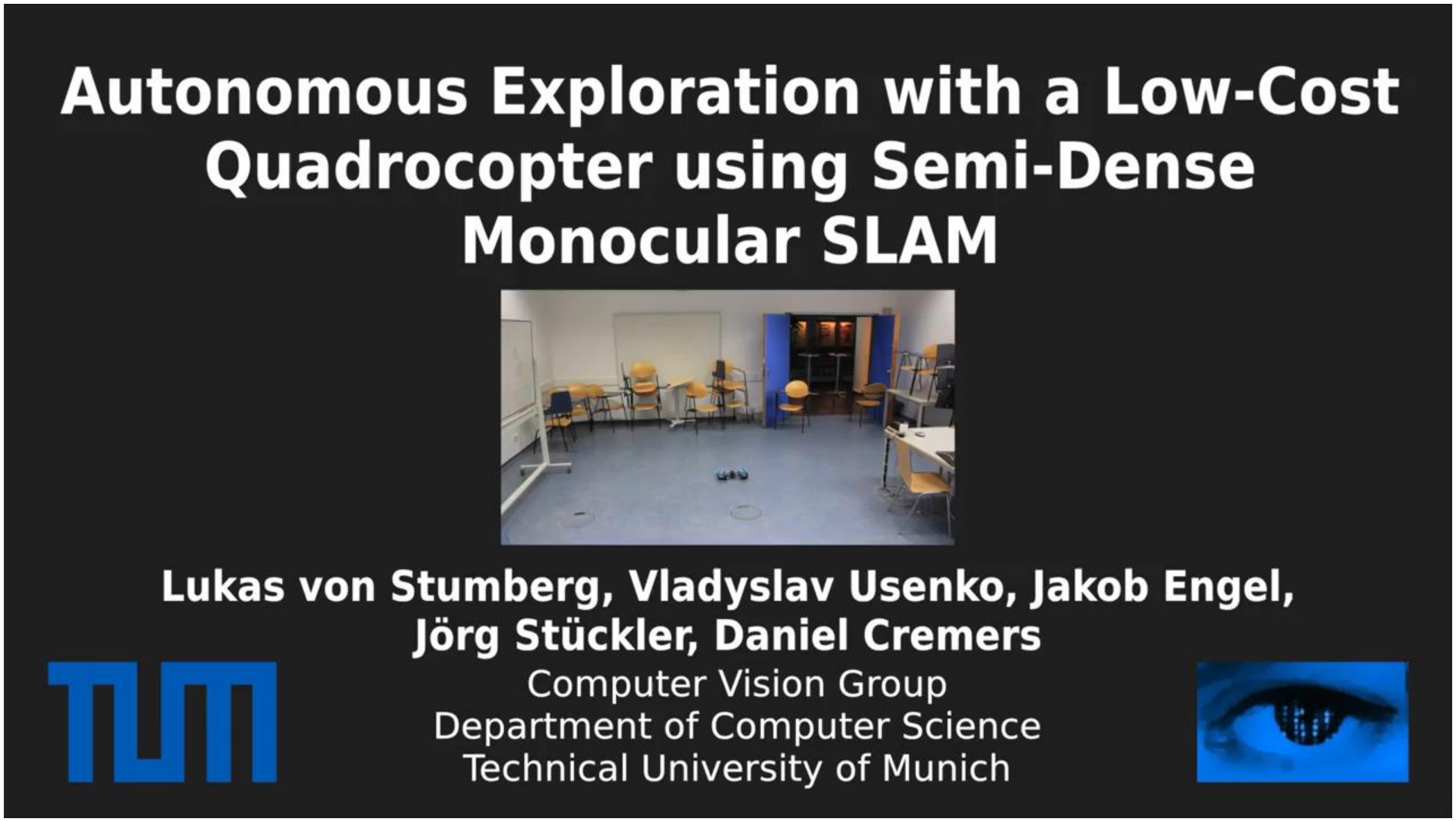
Direct Sparse Odometry with a Single Camera (2016)



Monocular SLAM with Quadrotors (2015)



Robotic Perception

(Usenko, von Stumberg, Pangercic, Cremers, IROS 2017)

Deep Learning for Visual Navigation (2016)

Giusti et al., A Machine Learning Approach to Visual Perception of Forest Trails for Mobile Robots, RA-L 2016

Current Trends in Robotics

- Robot technology becomes increasingly mature for applications

- Novel application domains
  - Shop floor logistics
  - Human-robot collaboration in industrial settings
  - Domestic service robots
  - Autonomous cars
  - Aerial inspection/maintenance

- Many of these robots need to navigate through their environment

- Vision sensors provide rich information
  - How to make use of it for navigation?

Content of this Course

- You can gain practical experience with
  - Visual odometry and localization/state estimation
  - Vision-based Simultaneous Localization and Mapping (SLAM)
  - Vision-based control of multicopters
  - Deep learning for visual navigation (if you have DL background)

- Implementation of algorithms

- Benefits/drawbacks of specific methods when applied to concrete, relevant problems

- Learn how to work in teams/on projects

- Improve your presentation skills

Available Robots in this Course

Parrot AR Drone 2 (1x)

Intel Aero (1x)

Parrot Bebop (1x)

Course Organisation

- Course takes place during the lecture period
- We register accepted students

- Initial phase (first 4 weeks): Lectures & Exercises
  - Lectures: Wednesdays 2pm to 4pm in seminar room 02.09.023
  - Tutored exercises: Wednesdays 4pm to 6pm in lab 02.05.014
  - Programming assignments will be handed out every week and checked/graded by the tutors
  - Small groups, each participant should be able to explain solution
  - Attendance to lecture & exercise sessions mandatory

- Second phase (remainder): Project
  - Work in small groups (2-3 people) on a project
  - Lab 02.05.014 available; tutors available Wednesdays 2pm-6pm
  - Implement a specific algorithm, which one tbd.
  - Present project outcome in talk&demo session (20min per group)
  - Written report on project outcome (10-12 pages, single column, single-spaced lines, 11 pt)

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

Warning

- Micro Aerial Vehicles (MAVs) are dangerous objects
- Read the instructions carefully before you start
- Always use the protective hull
- If somebody gets injured, report to us so that we can improve safety guidelines
- If something gets damaged, report it to us so that we can fix it
- Don’t fly MAVs outdoors or above persons
- **NEVER TOUCH THE PROPELLORS**
- **DO NOT TRY TO CATCH THE MULTICOPTER WHEN IT FAILS – LET IT FALL/CRASH!**

Questions ?