Advanced Topics in 3D Computer Vision

KickOff SS 2022 (IN2106, IN4023)

Dr. Benjamin Busam, Patrick Ruhkamp, Mahdi Saleh, Hyunjun Jung, Shun-Cheng Wu, Pengyuan Wang, Stefano Gasperini, Alexander Lehner, Lennart Bastian

Prof. Dr. Nassir Navab

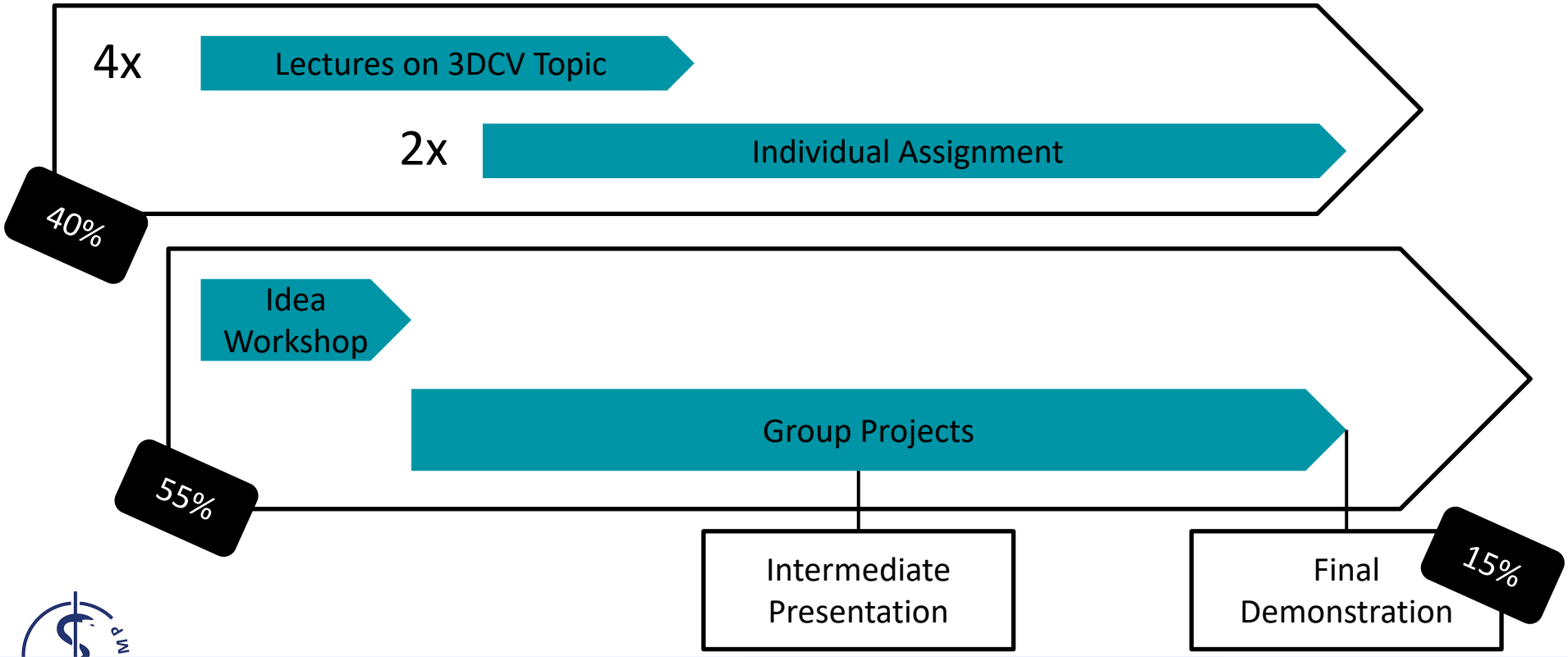
Feedback from previous Students

"AT3DCV is the best course I have ever taken at TUM. I really love this concept because we Master Students can get very detailed, fruitful, and patient supervision from researchers specialized in that field. As a master student who is about to graduate, I really recommend AT3DCV if you are a young fellow and want to do research someday in the future because in this course, you will get a LOT of support from the organizers and this really helps you enjoy research. I believe that is how and why we start doing research. We are being motivated instead of being pushed!"

Hanzhi Chen, MSc Robotics, Cognition, Intelligence

AT3DCV student in WS 2020/21

Lecture Structure



AT3DCV – Concept

1. Theoretical Foundation
   - "Flipped Class-room"
     - Pre-recorded lectures: to study in your own pace
     - Interactive Tutor sessions: your chance for discussion and questions (on lectures and assignments)
     - Pass 2 (out of 4) assignments (mostly practical and some theoretical parts)
2. Group projects:
   - Apply your 3DV and DL knowledge
   - Very close tutoring
   - "researchy" projects
     - Projects are purposely not strictly defined
     - Be innovative and creative
     - Final workshop: combination of scientific poster-session and start-up pitch
     - Present your working demo/code/application/results

Application

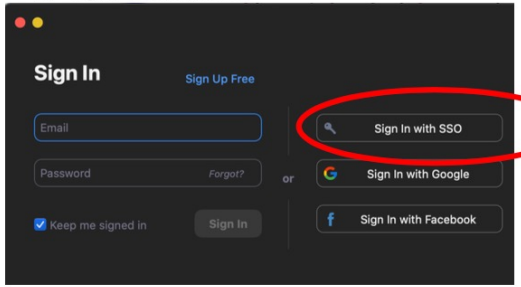
- **2 stage** process:
  - **Register in TUM Online**
    http://docmatching.in.tum.de/index.php/schedule
  - **Submit questionnaire and upload CV + Transcript**
    https://docs.google.com/forms/d/e/1FAIpQLScoykzsr9NKdc1B3lnwrL3FoFuL0F_LBaA1ZlPjGWA6_FvwWg/viewform
- Deadline: **15th of February 2022**
- 16 Students will be selected (usually 100+ applications)

Virtual/Hybrid/On-sight

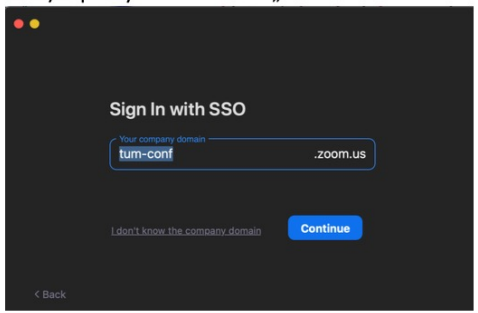
- Depending on government/TUM regulations
- Communication via Zoom (for virtual lectures and Chat)
- See website for updates (https://www.in.tum.de/campar/teaching/practical-courses/advanced-topics-in-3d-computer-vision/)

How-To: TUM-Zoom Chat

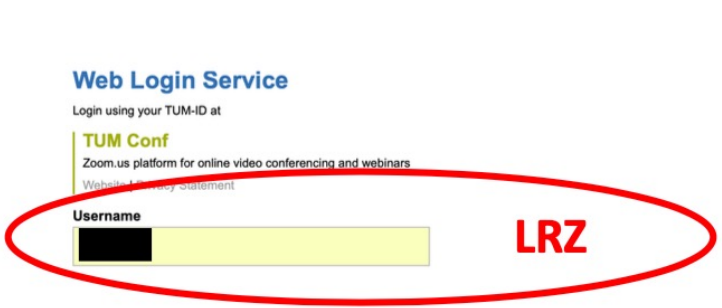
1) Download the Zoom App and install.
2) Sign in with the SSO



3) Specify the domain as „tum-conf"



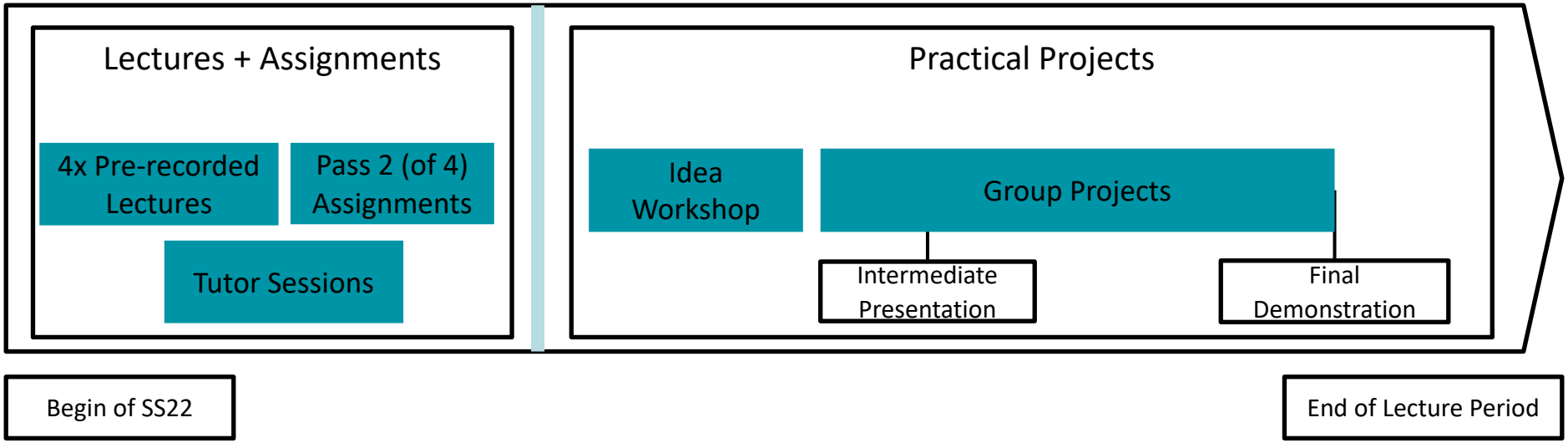
4) Log in with your LRZ credential on the web interface



5) Go back to Zoom app
6) Go to "Chat" -> Top right "Search" for "Patrick Ruhkamp" and text "AT3DCV"
7) You will be manually added to the group

Comment: If you have problems logging in for the first time, try to sign in first by directly opening https://tum-conf.zoom.us in your browser. Then follow the instructions from 2) again

Timeline


Lectures + Assignments
4x Pre-recorded Lectures
Pass 2 (of 4) Assignments
Tutor Sessions
Practical Projects
Idea Workshop
Group Projects
Intermediate Presentation
Final Demonstration
Begin of SS22
End of Lecture Period

Lectures

- Pre-recorded lectures on 3D Computer Vision and Deep Learning topics (tbd):
  - Basic Tips and Knowledge for Deep 3D Vision
  - Sensing Depth with 3D Computer Vision
  - Visual Self-Localization - Classical Methods and Learning-based Approaches
  - 3D Deep Learning

Group Projects

- Students will be matched by taking their preferences into account
- Potential project ideas will be suggested during lectures
- Final project proposals of the group will be discussed in workshop session
- We are open to suggestions and ideas!!!
- Projects can either be applied in real world problems OR try to solve open research questions

What to expect

- Gain detailed knowledge in modern computer vision problems
- Study relevant Deep Learning methods
- Understand to see the world in 3D
- Lectures provide starting point for your projects
- Solve 3D Computer Vision tasks
- Apply your acquired knowledge in real scenarios and/or push the boundaries of research in Computer Vision

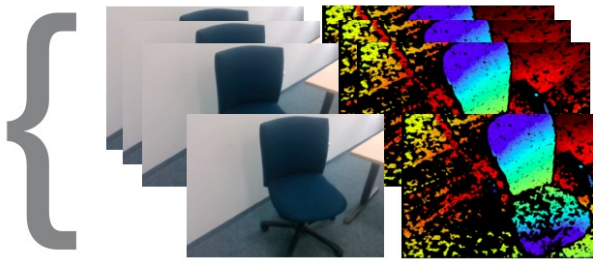
What we expect

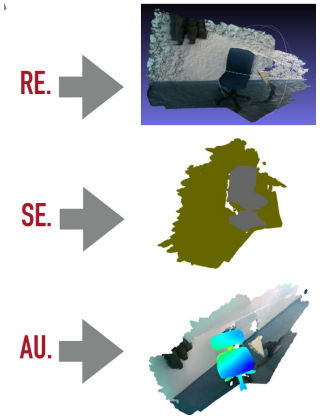
- Interest in Computer Vision
- Independent and pro-active participation
- Actively asking for help (team members and tutors)
- Coding knowledge
- Working dedicated in your team towards achieving the goals of your group project

Previous Projects
AT3DCV

1. Furniture Replacement

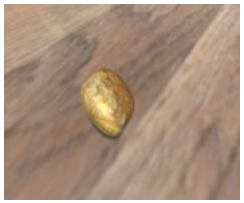
RE. CONSTRUCTION
SE. GMENTATION
AU. GMENTATION

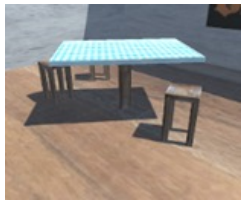


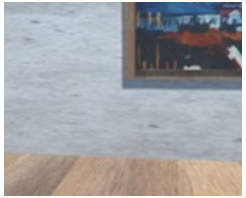


Point cloud from Scan-Net

2. Garbage Evaporating Autonomous Robot (a.k.a. Trash Hugger)







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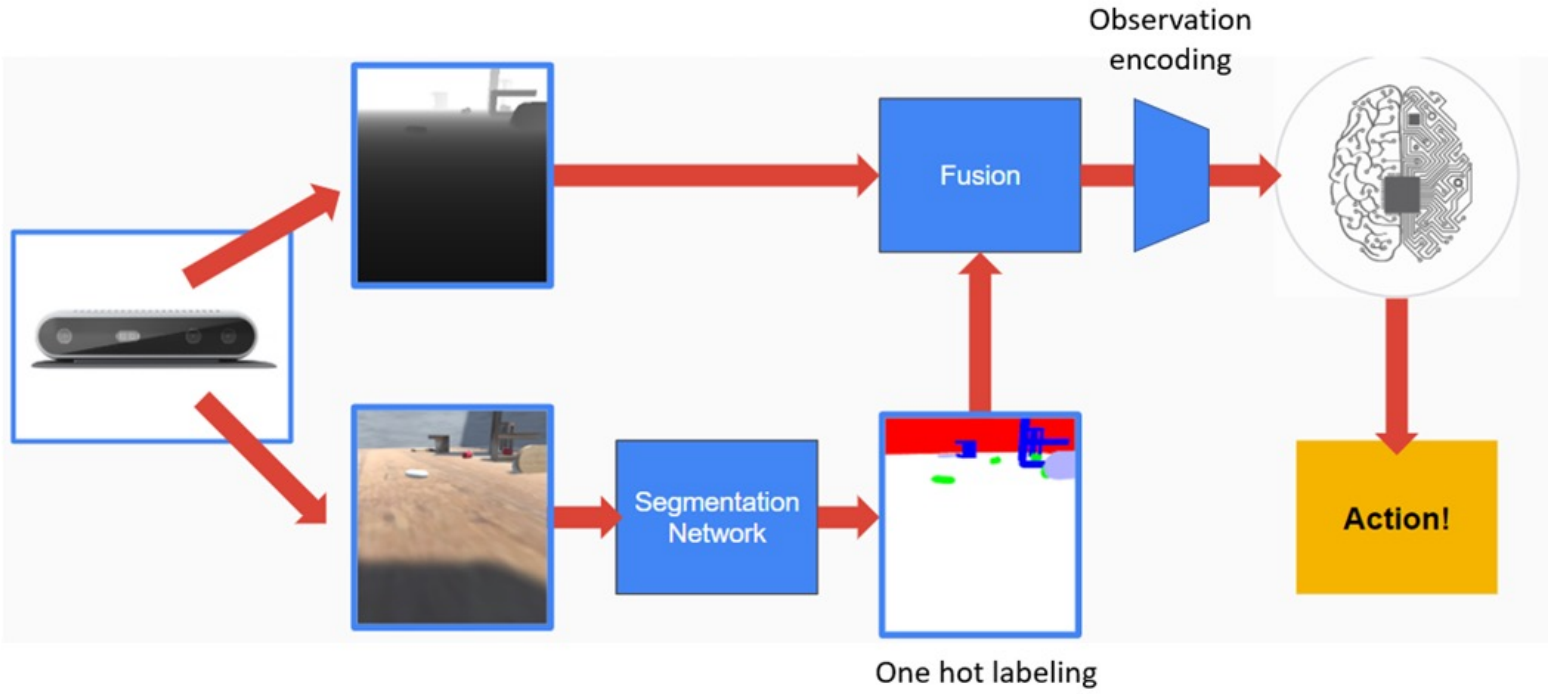
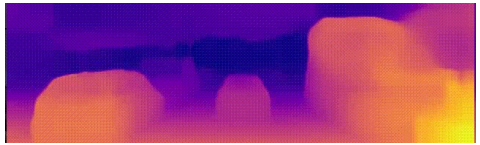


3. Consistent Depth Prediction

- In this work, we would like to take both **single-frame accuracy** and **multi-frame consistency** into account, without blurring edges, or huge computational overhead.

Inputs



Manydepth [1]

Ours

- With consistent predictions, we can achieve better results in augmented reality applications, 3D reconstruction, etc.

Inputs

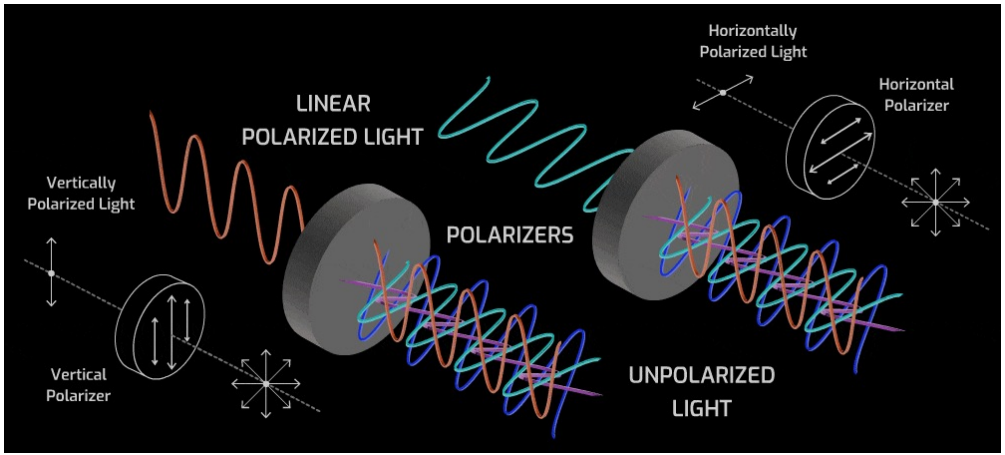
Manydepth [1]

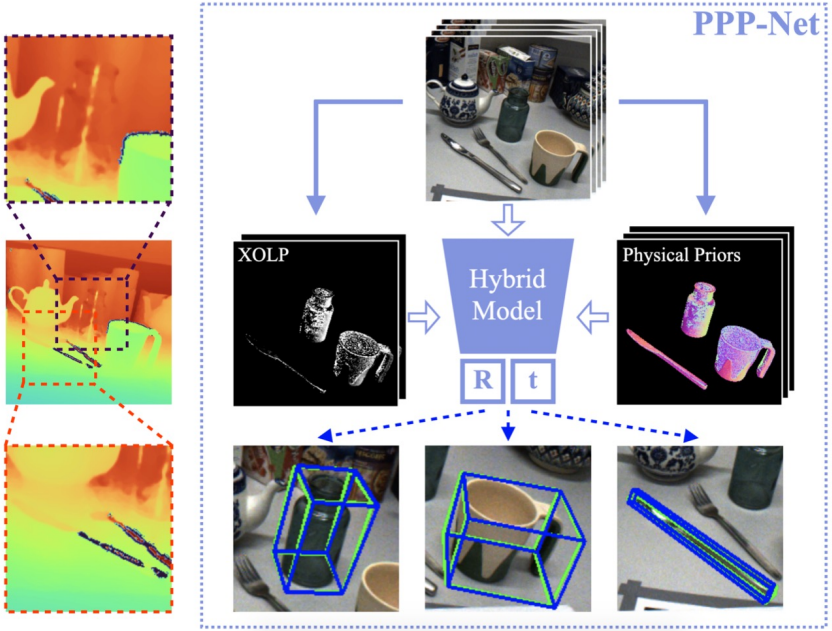
Ours

Ruhkamp, Gao, Chen, Navab, Busam “Attention meets Geometry”, 3DV 2021, ICCV-W 2021

[1] Watson, J., Mac Aodha, O., Prisacariu, V., Brostow, G., & Firman, M. “The Temporal Opportunist: Self-Supervised Multi-Frame Monocular Depth”. CVPR, 2021

4. Polarimetric Pose Prediction





Gao et al. “Polarimetric Pose Prediction”, Under Review

Questions

- Benjamin Busam: b.busam@tum.de
- Patrick Ruhkamp: p.ruhkamp@tum.de
- Mahdi Saleh: m.saleh@tum.de
- Hyunjun Jung: hyunjun.jung@tum.de
- Shun-Cheng Wu: shuncheng.wu@tum.de
- Pengyuan Wang: pengyuan.wang@tum.de
- Stefano Gasperini: stefano.gasperini@tum.de
- Alexander Lehner: alexander.lehner@tum.de
- Lennart Bastian: lennart.bastian@tum.de
- Web: https://www.in.tum.de/campar/teaching/practical-courses/advanced-topics-in-3d-computer-vision/