Camera Drones
Lecture 1 – Camera drones overview

Prof. Friedrich Fraundorfer

WS 2020

About me

- Assoc. Prof. Dr. Friedrich Fraundorfer
- Email: fraundorfer@icg.tugraz.at
- Institut für Maschinelles Sehen und Darstellen
- Inffeldgasse 16/II
- +43 (316) 873 - **5020**
- Sprechstunde nach Vereinbarung

Course schedule

- See dates for lecture slots in TUG-Online (lectures will be recorded videos, live Q&A sessions will be offered)
- Project work
  - Drone navigation practical
  - Presentation
  - Documentation

- Course grade will be based on the grades for the project work including documentation, project presentation and a questionnaire (60/10/30).
- Start of project work leads to grading of the course
- The project work is the partial course assignment that can be repeated or supplemented

Course schedule

- Lecture topics:
  - Quadrotor Basics
  - Control and Sensors
  - 3D Data generation (SFM, dense matching)
  - Visual Odometry
  - Flight planning for 3D reconstruction
  - Drone regulations in Austria

- Hands-on-ROS tutorial (video recording)
- Quiz (13.01.2021)
- Final presentations (20.1.2021/27.1.2021)

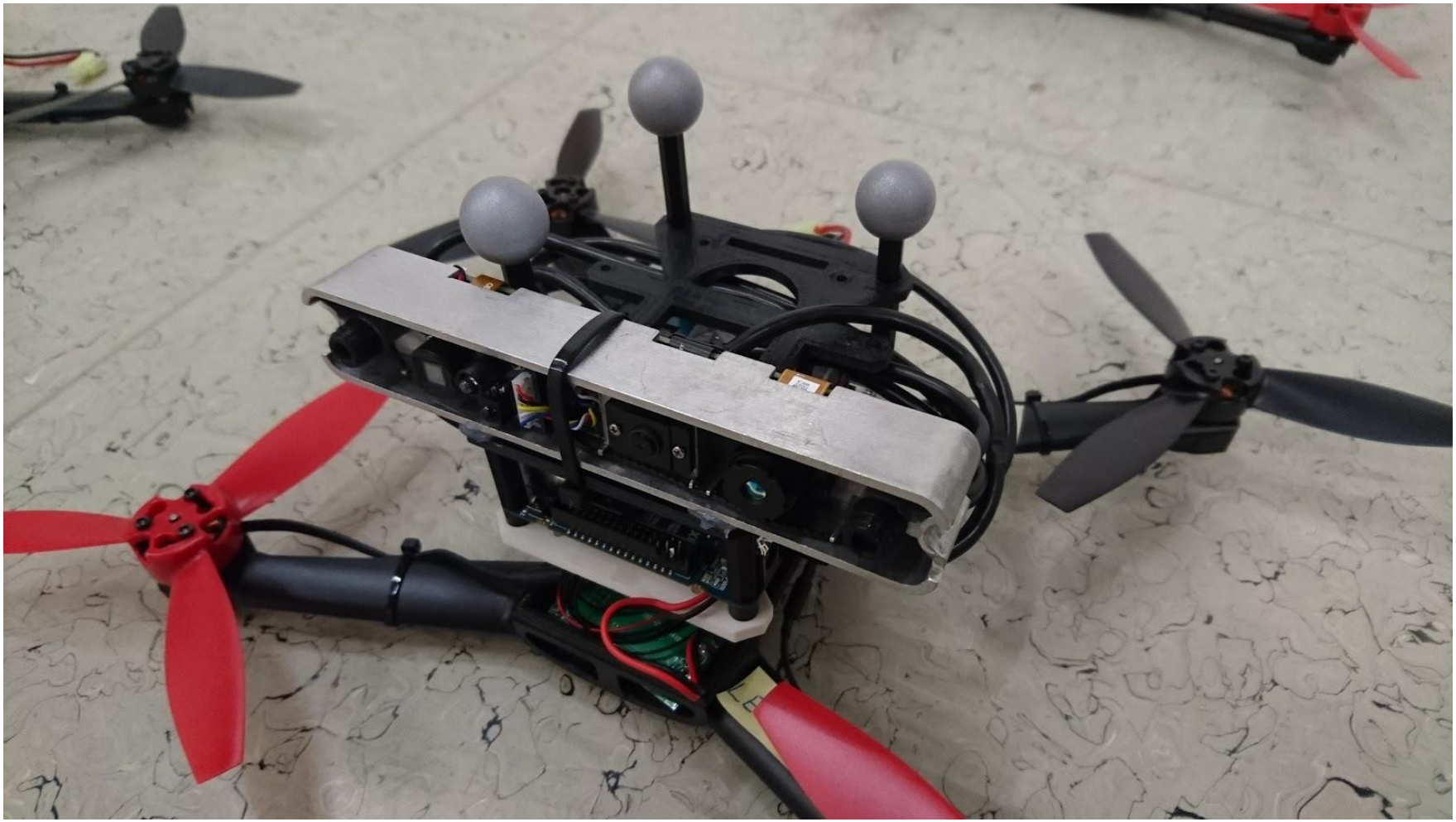
Practical part of the course

Course drone

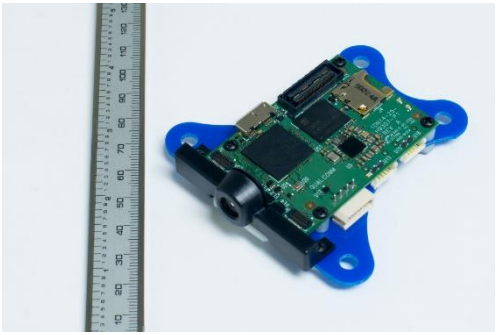
- A drone based on the Bebop 2 frame (32x38cm) with Pixhawk flight controller

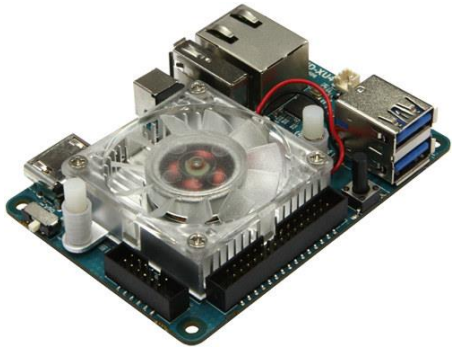
Course drone

- Equipped with Odroid UX4 board and depth camera.



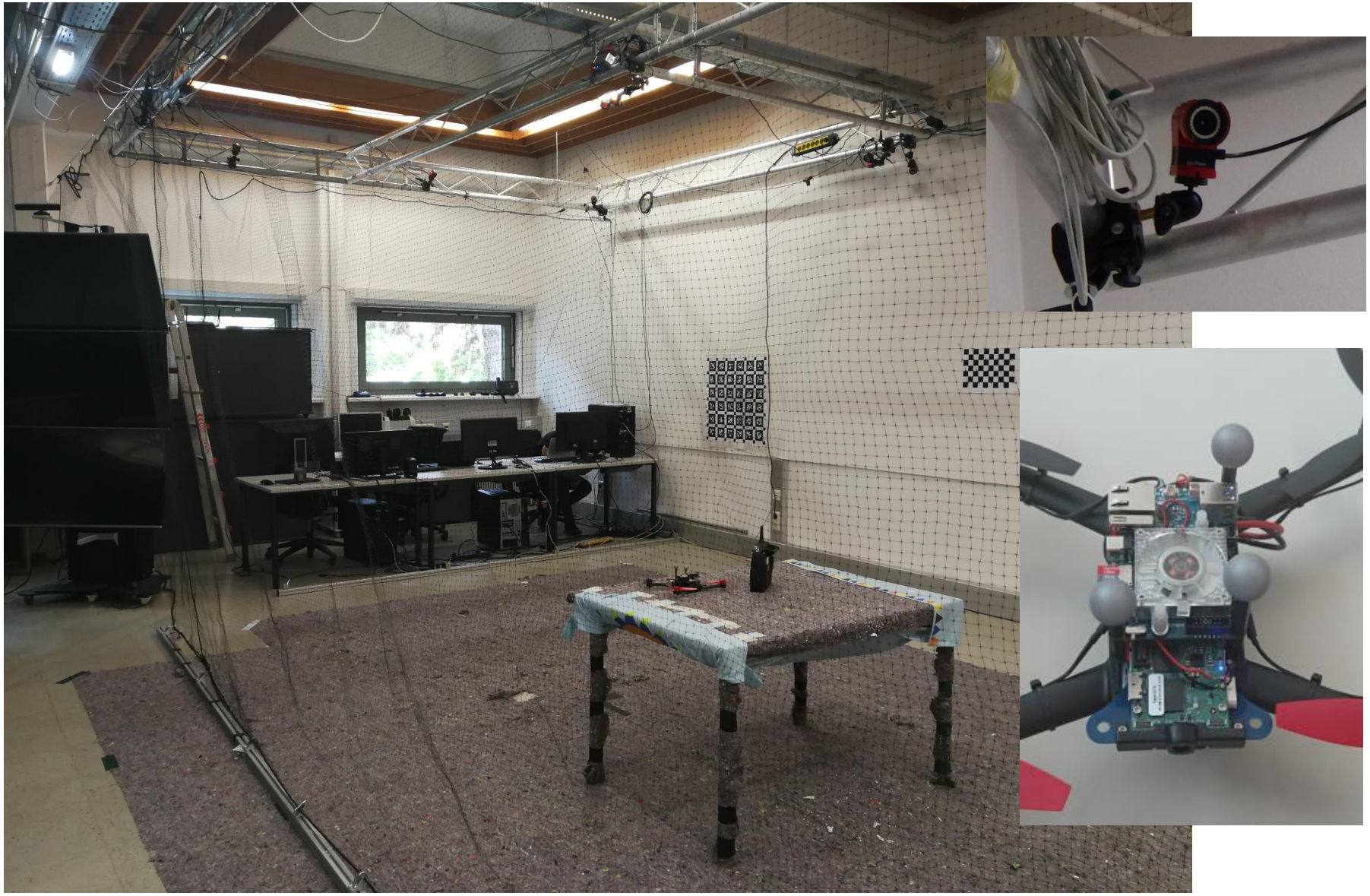
Course drone components





Lab infrastructure (droneSpace)

Tracking cameras



Practical 2020 – Collision free navigation

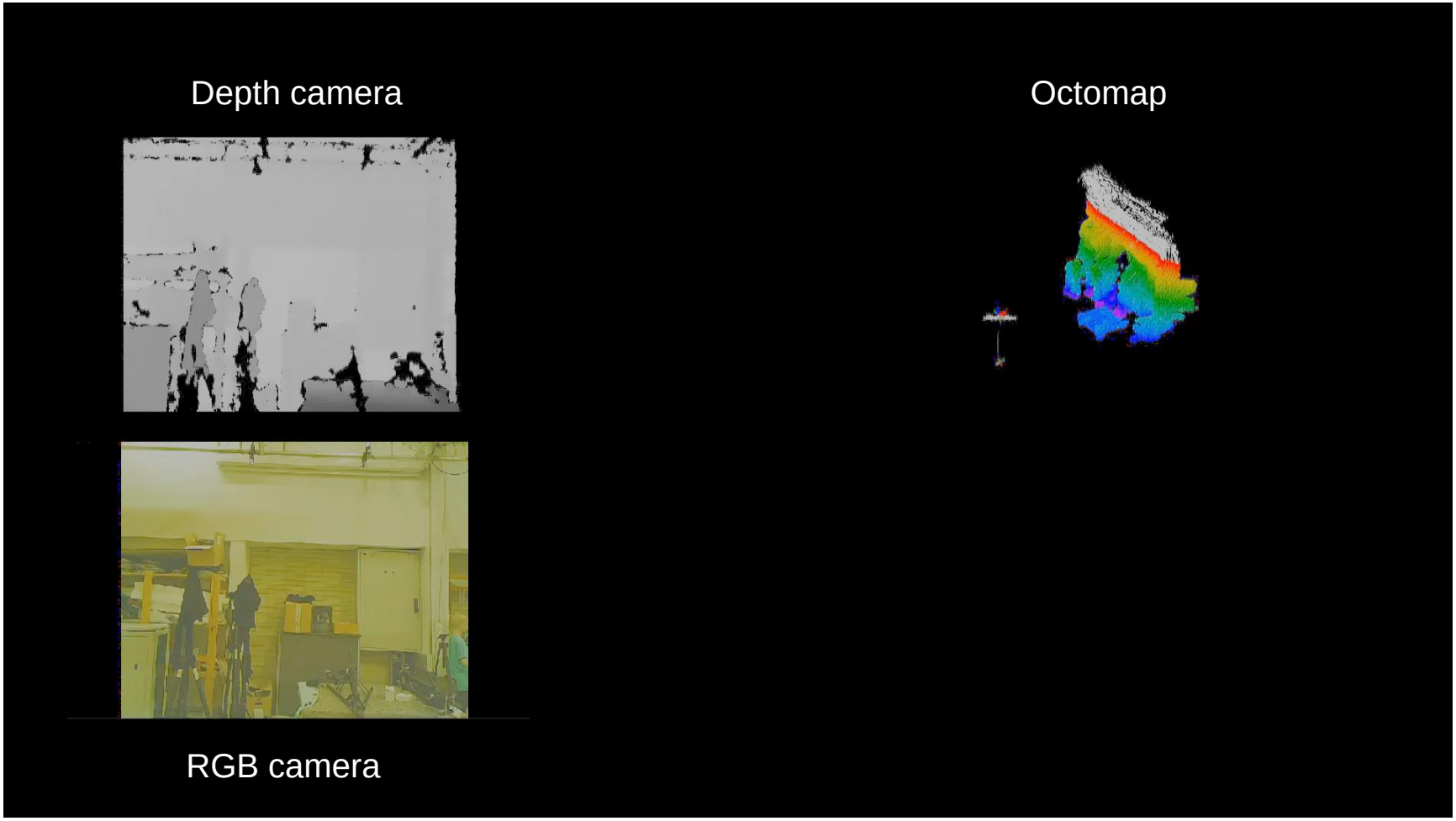
Practical 2020 - Collision free navigation

Main tasks:

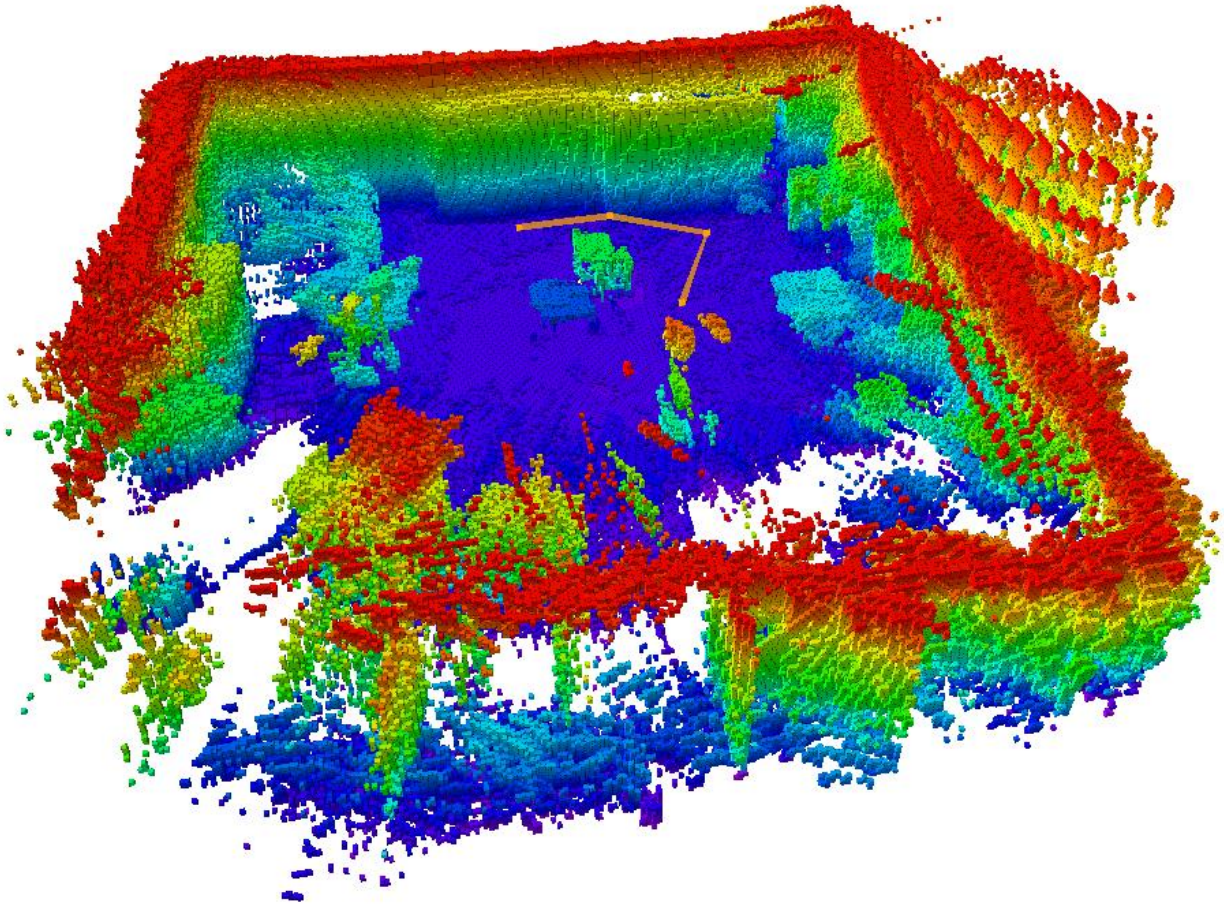
- 1. Mapping of the environment
  - Create Octomap from sensor input such that it provides a 3D map for path planning.
- 2. Path planning for safe navigation
  - Implement a path planning algorithm to navigate the drone collision-free to a goal position (e.g. RRT algorithm)
- 3. Trajectory generation and flight
  - Perform flight and videotape it

Task 1: Mapping of the environment

- Octomap creation from ROS-Bag



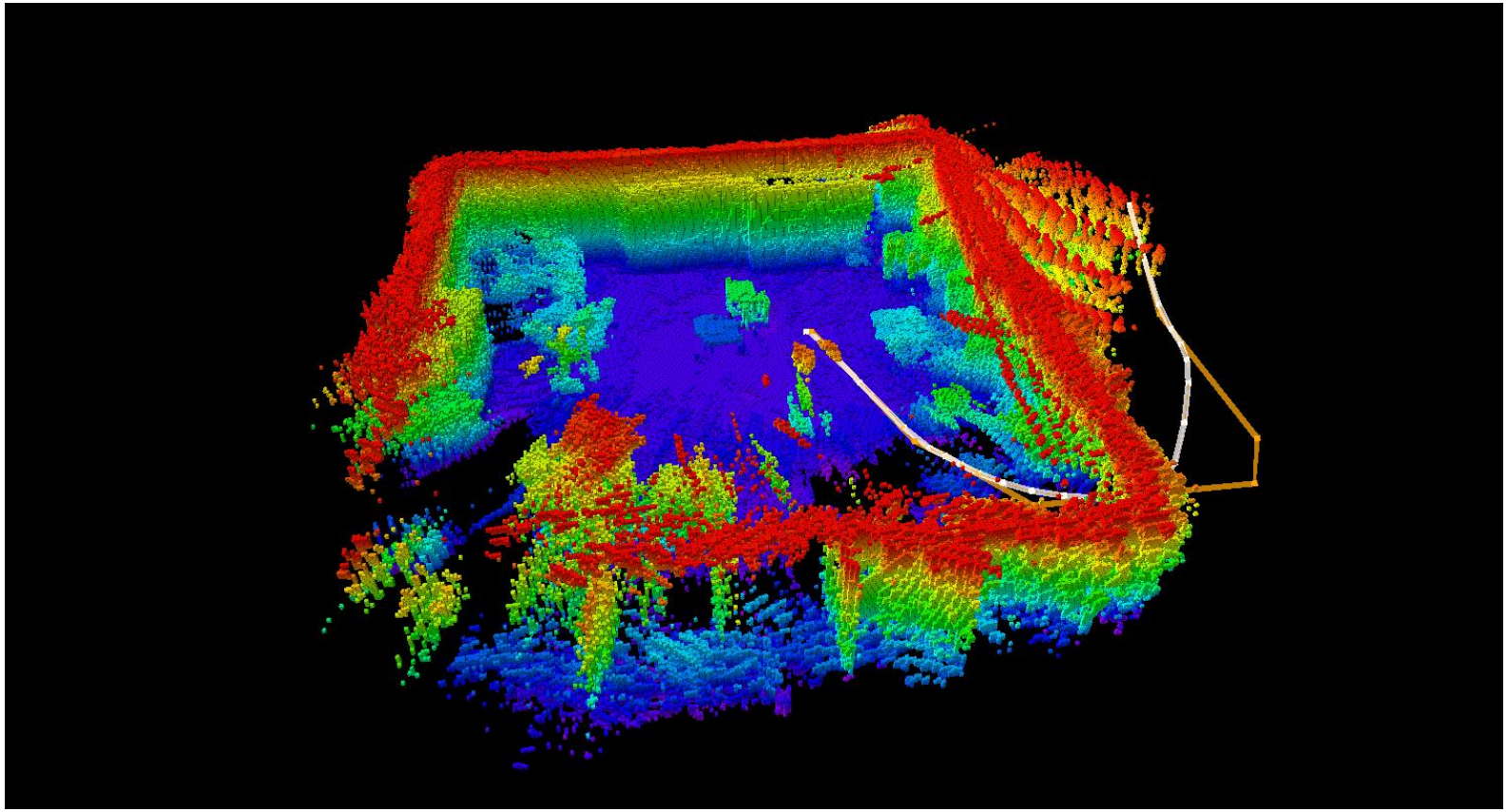
Task 2: Path planning



Task 3: Trajectory generation and flight

MAV trajectory generation

- Smooth trajectory from path
- Impose position derivatives (speed, acceleration, jerk, snap)



Camera drones overview

Camera drones overview

- Consumer drones

[Image credit: DJI]

- Professional drones

[Image credit: Leica]

- Research drones

Consumer drones – The First

[Image credit: Parrot]

Consumer drones

[Image credit: DJI]

[Image credit: Yuneec]

[Image credit:GoPro]

[Image credit: Parrot]

Consumer drones

- Sykdio R1

[Image credit:Skydio

Professional drones

- Asctec Falcon
- Aerial photography and inspection

[Image credit: Asctec]

Professional drones

- Leica/Aibotix drone
- Inspection and measurement tasks

[Image credit: Leica]

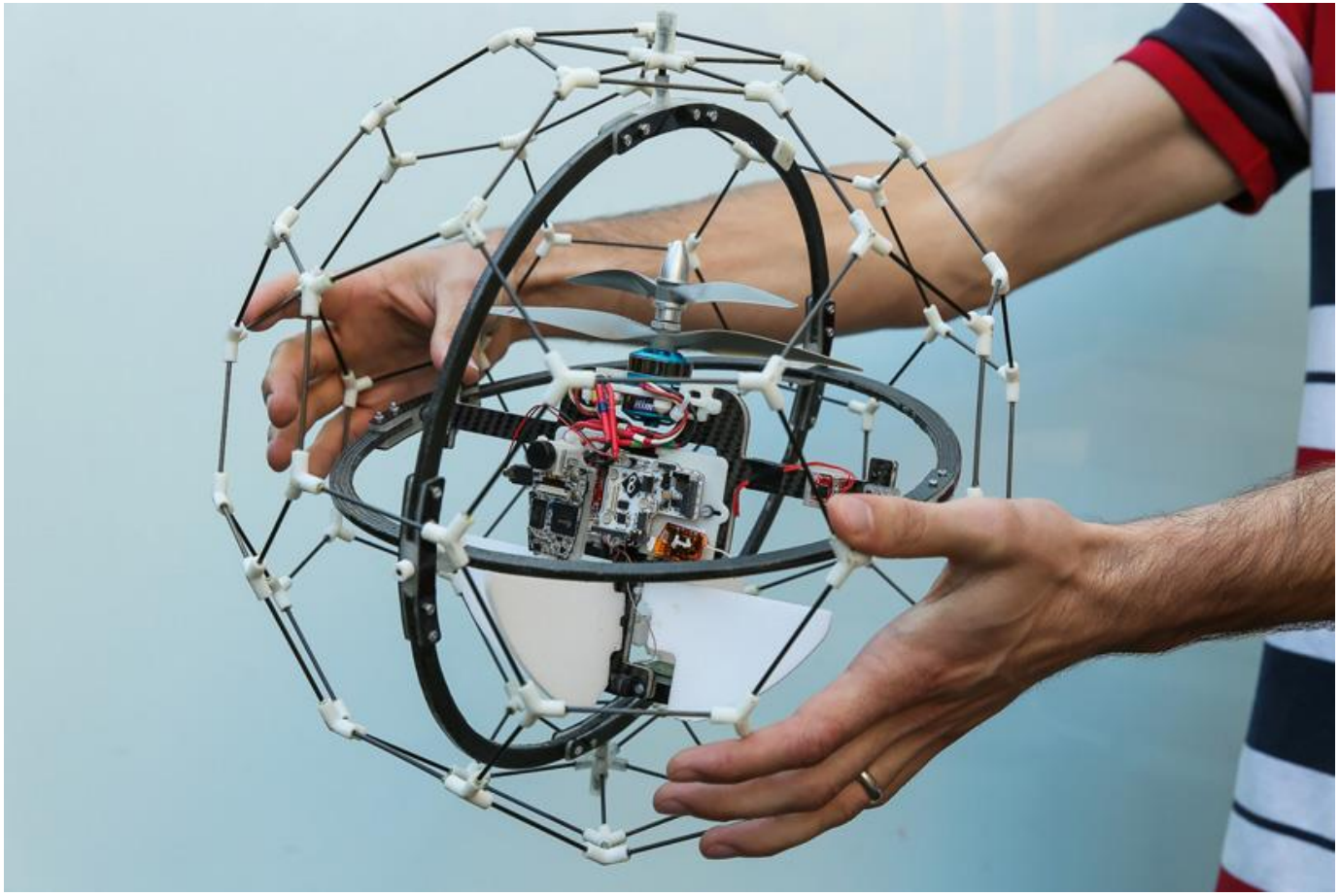
Professional drones

- Riegl Ricopter
- Photogrammetry and Laser scanning
- 25kg!

[Image credit: Riegl]

Professional drones

- Flyability drone
- Indoor inspection



[Image credit: Flyability]

Professional drones

- Honeywell RQ-16 T-Hawk
- Reconnaissance, long endurance drone

[Image credit: Wikipedia]

Professional drones

- Schiebel Camcopter
- Industrial inspection, long endurance drone

[Image credit: By User:Stahlkocher, CC BY-SA 3.0]

Professional drones

- Sensefly Ebee
- Fixed wing, long endurance
- Photogrammetry

[Image credit: Sensefly]

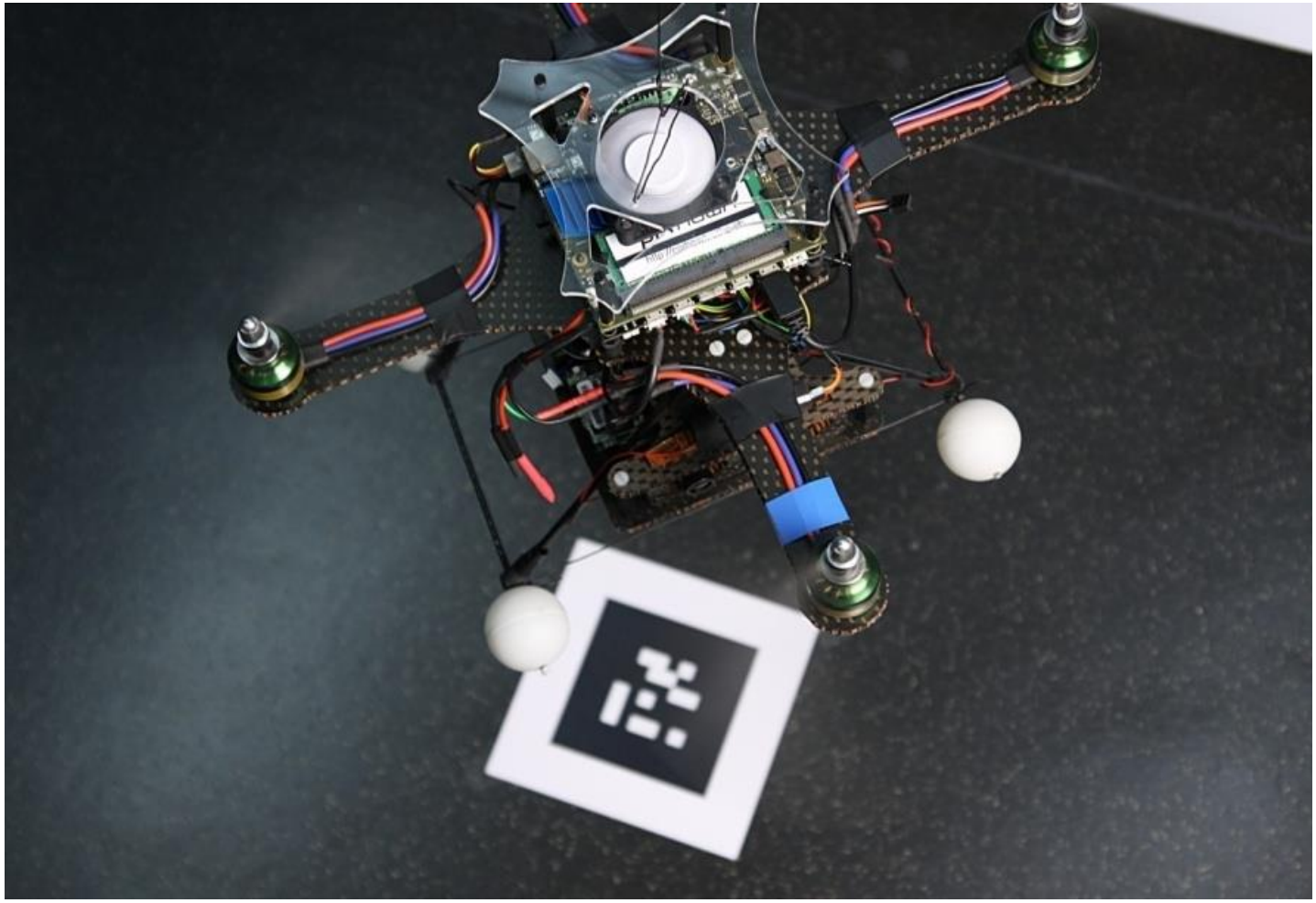
Professional drones

- Swarmsys Nano-Drone
- Reconnaissance

[Image credit: Swarmsys

Research drone

- Pixhawk drone
- Modular research platform with onboard computer and cameras

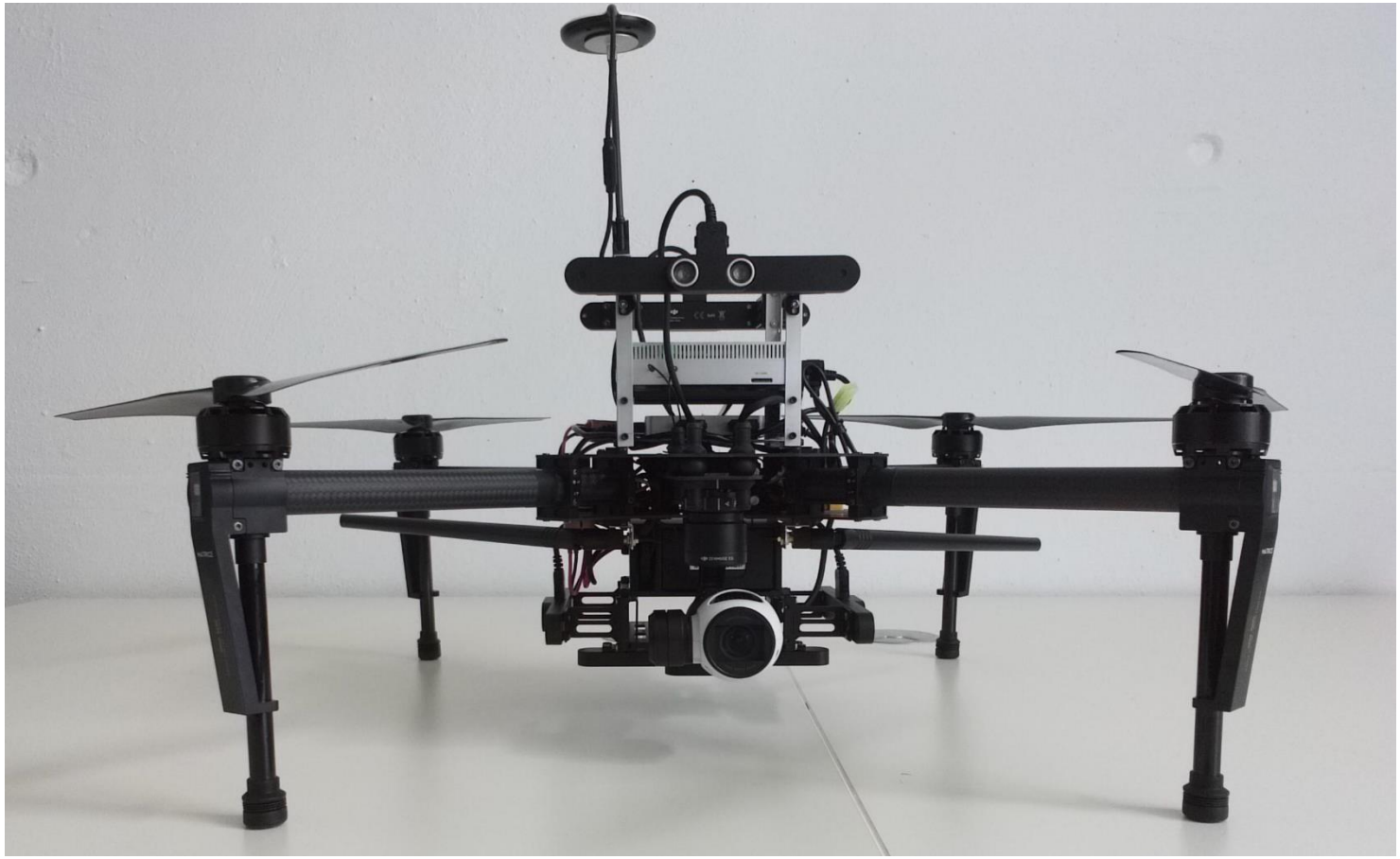


Research drone

- Asctec Firefly
- Modular research platform with onboard computer and cameras

Research drone

- DJI Matrice 100
- Modular research platform with onboard computer and cameras
- Onboard stereo depth sensors



Camera drone applications and research

- Action filming
- Archeology (3D Pitoti, 3D Model)
- Inspection (Bridges, Power pylons)
- Search and Rescue (DJI Challenge)
- Agriculture
- Safe navigation (Video)
- Autonomous exploration (Video)
- Human-Robot Interaction (Video)
- Delivery (Video)
- Industrial application (Video)

Past student projects

- "Don’t Throw Things At Drones!“
- "Optitrack & RGBD-Sensor Based Indoor Mapping“
- "Hand-Gesture Based Drone Control“
- "Visual Marker Following Drone“
- "Hula Hoop Following Drone“
- "ORB2 SLAM Based Indoor Reconstruction“
- "Snapdragon Flight Based Object Recognition And Waypoint Following"