Camera Drones
Lecture – Camera drones overview

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WS 2022

About me

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- Sprechstunde nach Vereinbarung

Course schedule

- See dates for lecture slots in TUG-Online
- Project work
  - Drone navigation practical
  - Presentation
  - Documentation

- Practical is group work (groups of two)
- 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
- The course requires a significant amount of self-learning.

Course schedule

12.10.2022	HS FSI 1 "Magna Steyr Hörsaal" (FSEG054)	Introduction lecture Introduction to practical
21.10.2022	droneSpace	droneSpace introduction (individual groups)
2.11.2022	Allerseelen	no lecture
09.11.2022	HS i9	Lecture: Flight mechanics / Sensors
16.11.2022	Webex	Online ROS lecture / Practical handout
23.11.2022	Webex	Online ROS lecture
30.11.2022	HS i9	Lecture: Sensors, Sensor fusion
07.12.2022	HS i12	Lecture: 3D data generation
14.12.2022	HS i9	Lecture: Flight planning, UAV Regulations
21.12.2022	Weihnachtsferien	
11.01.2023	HS i9	Quiz
18.01.2023	HS i9	Presentations
25.01.2023	HS i5	Presentations
27.01.2023	droneSpace	Flight presentations (individual groups)

Practical part of the course

Course drone

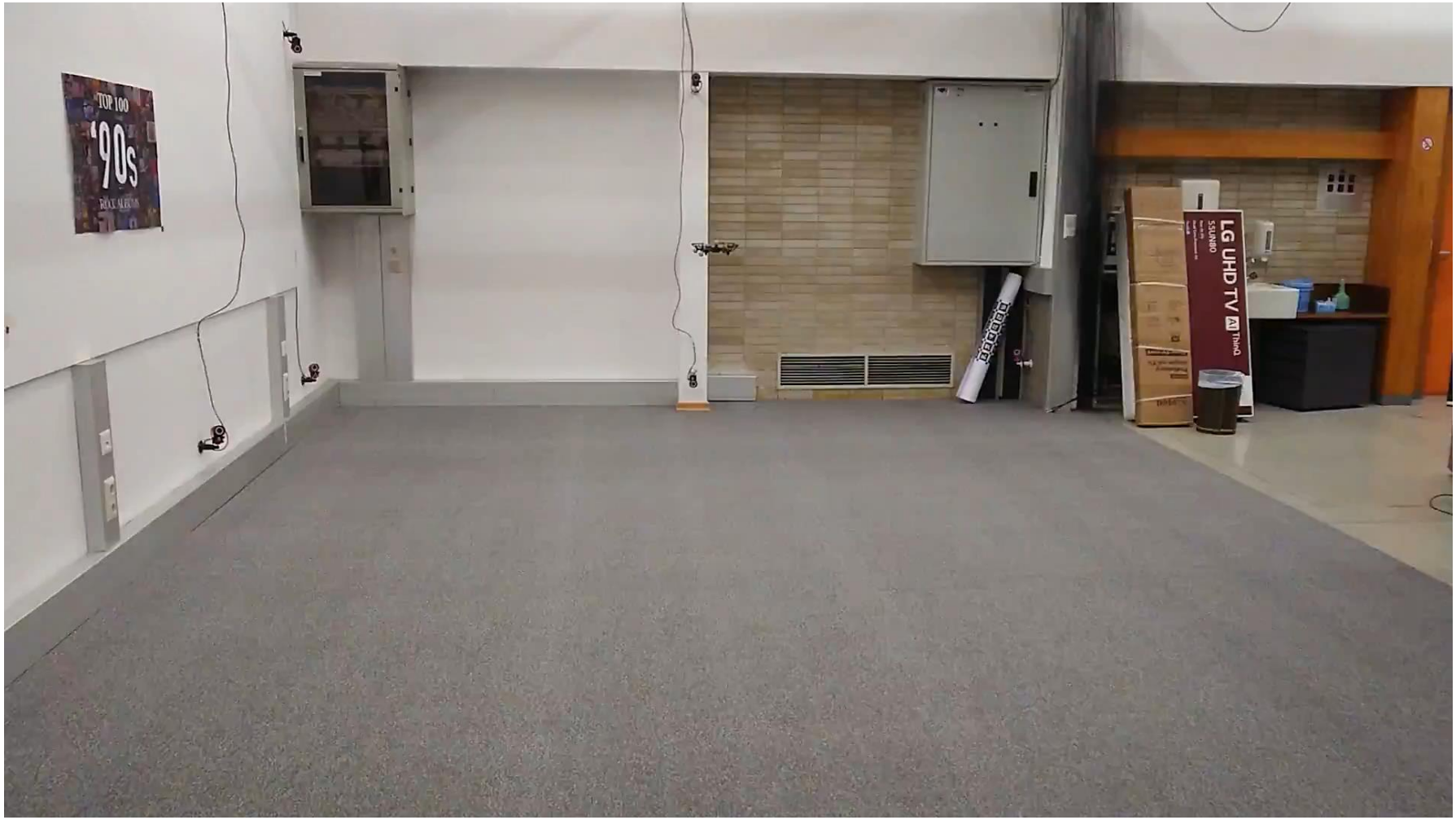
- Ryze Tech Tello EDU (10x10 cm, 80g)

Course drone

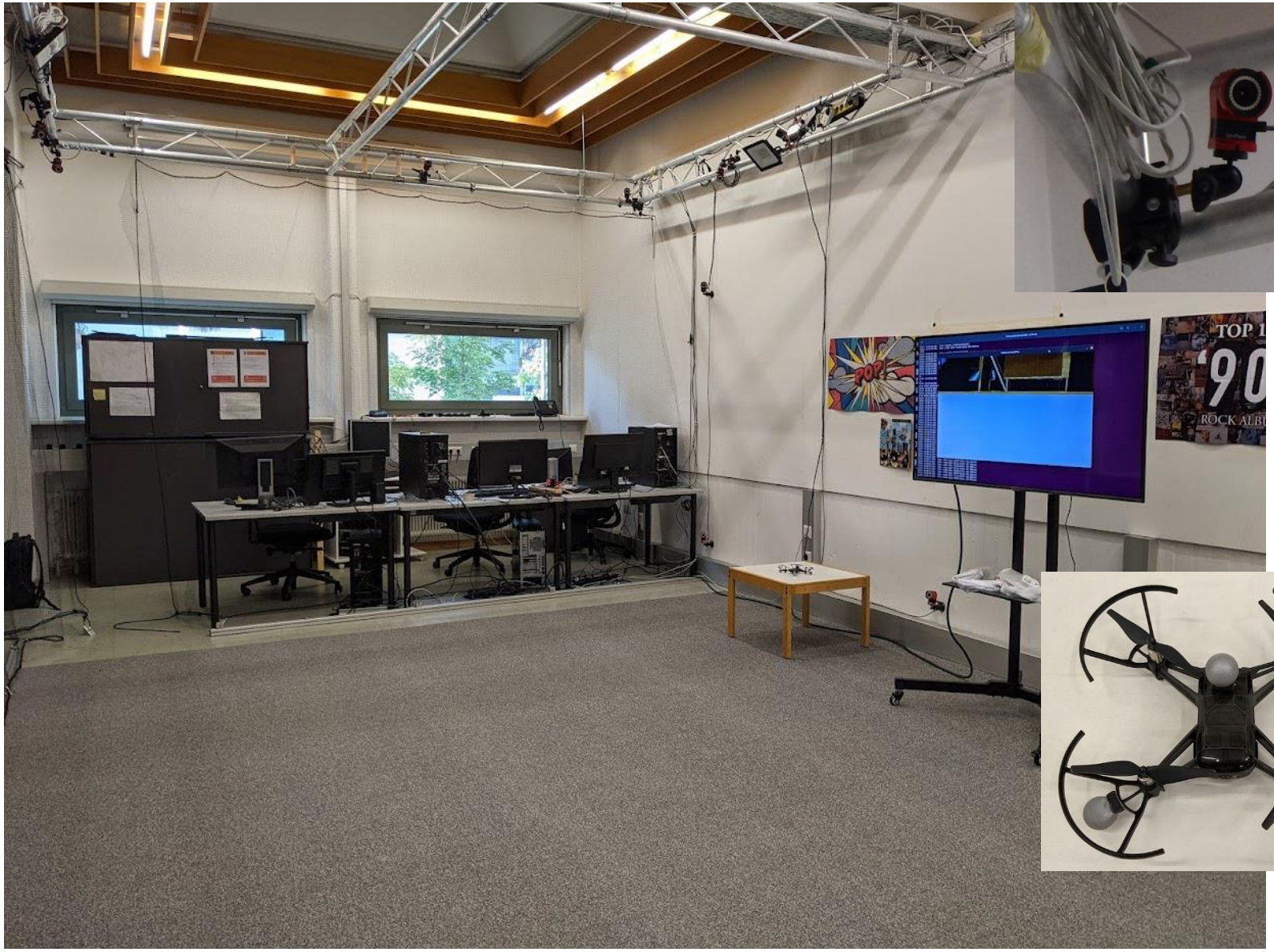
Specifications:

- 5MP front camera
- 1080x720px video resolution
- 13min flight time
- Python interface for programming
- Vision Positioning System
  - Downward-looking camera
  - Infrared distance sensors

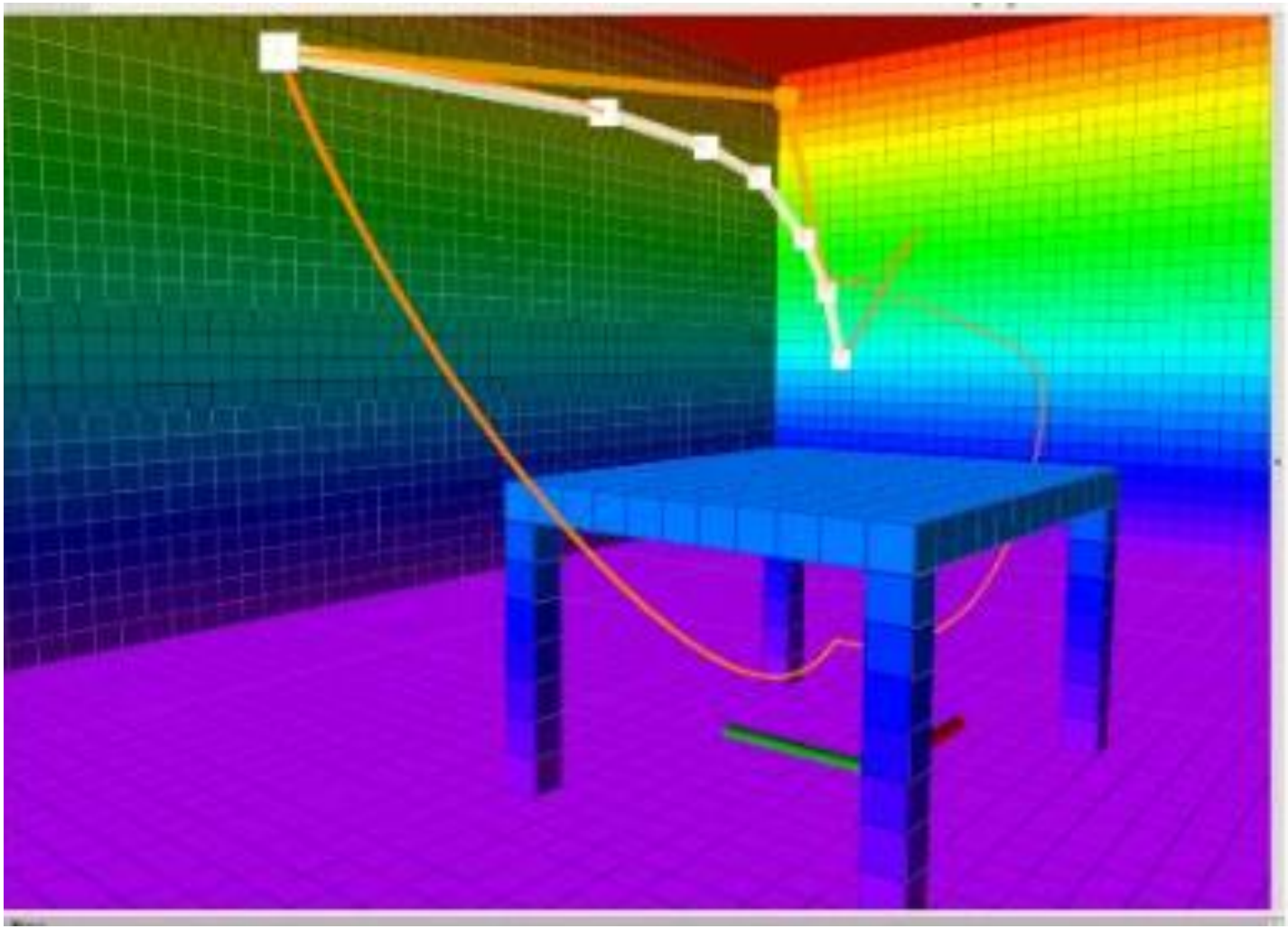
Lab infrastructure (droneSpace)



Tracking cameras



Practical – Collision free navigation



Practical 2022 - Collision free navigation

4 contiguous assignments:

- 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. Smooth trajectory generation
  - Generate a smooth trajectory for a planned path
- 4. Flight experiment
  - Pre-calculation of trajectories for flight experiment and flight tests

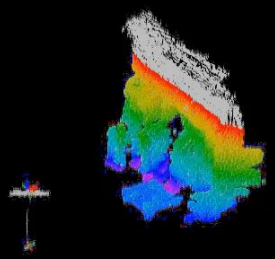
Task 1: Mapping of the environment

- Octomap creation from ROS-Bag

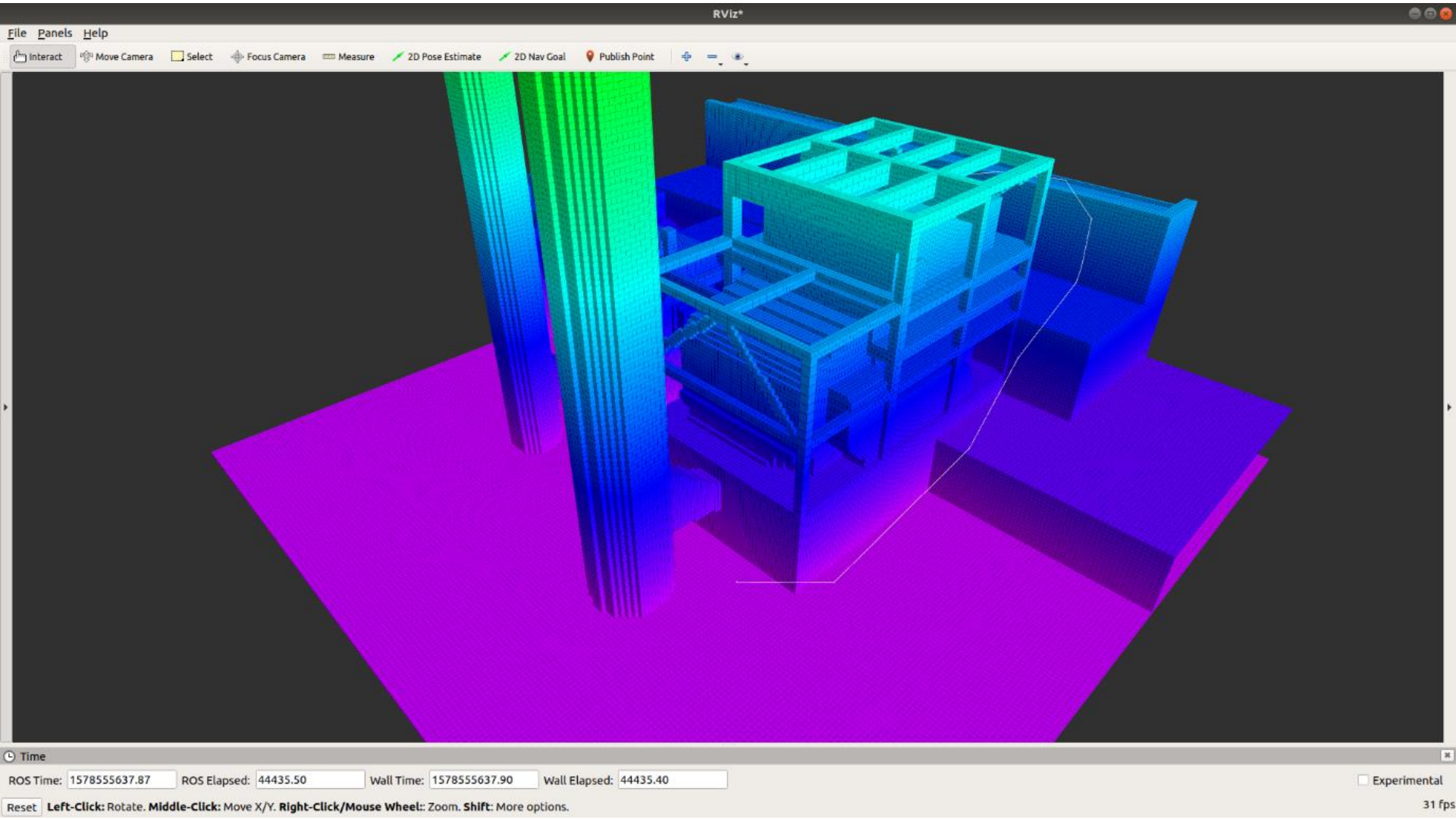
Depth camera

RGB camera

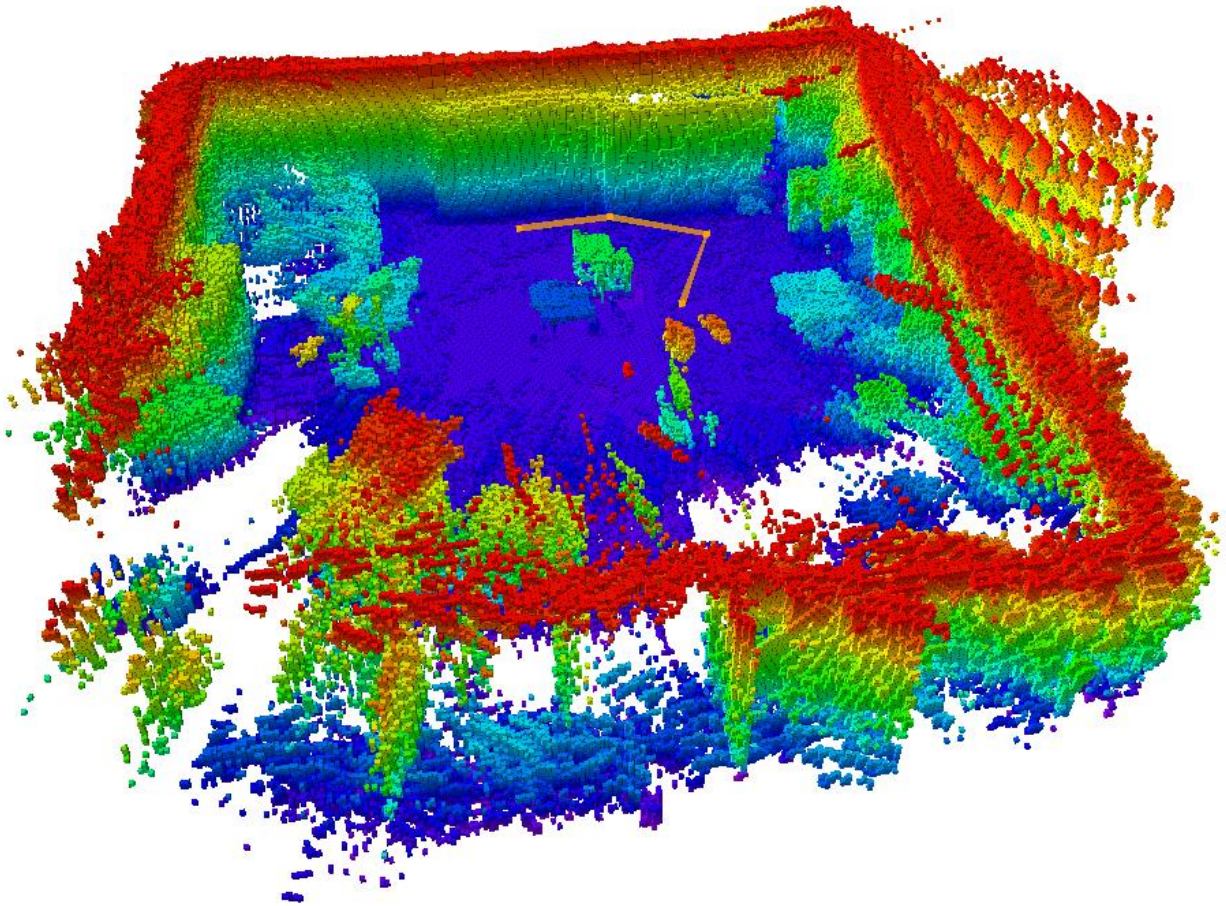
Octomap



Task 2: Path planning



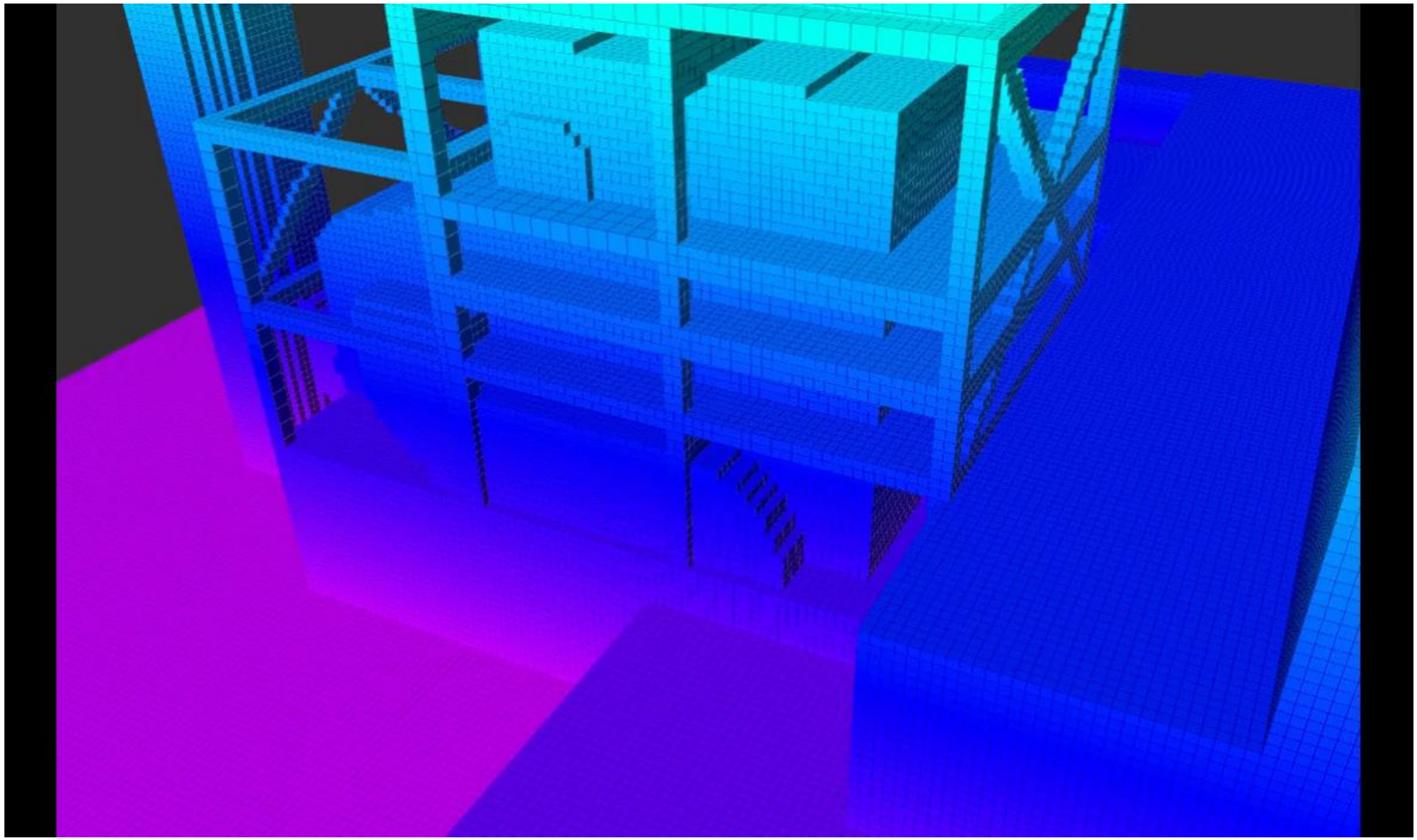
Task 2: Path planning



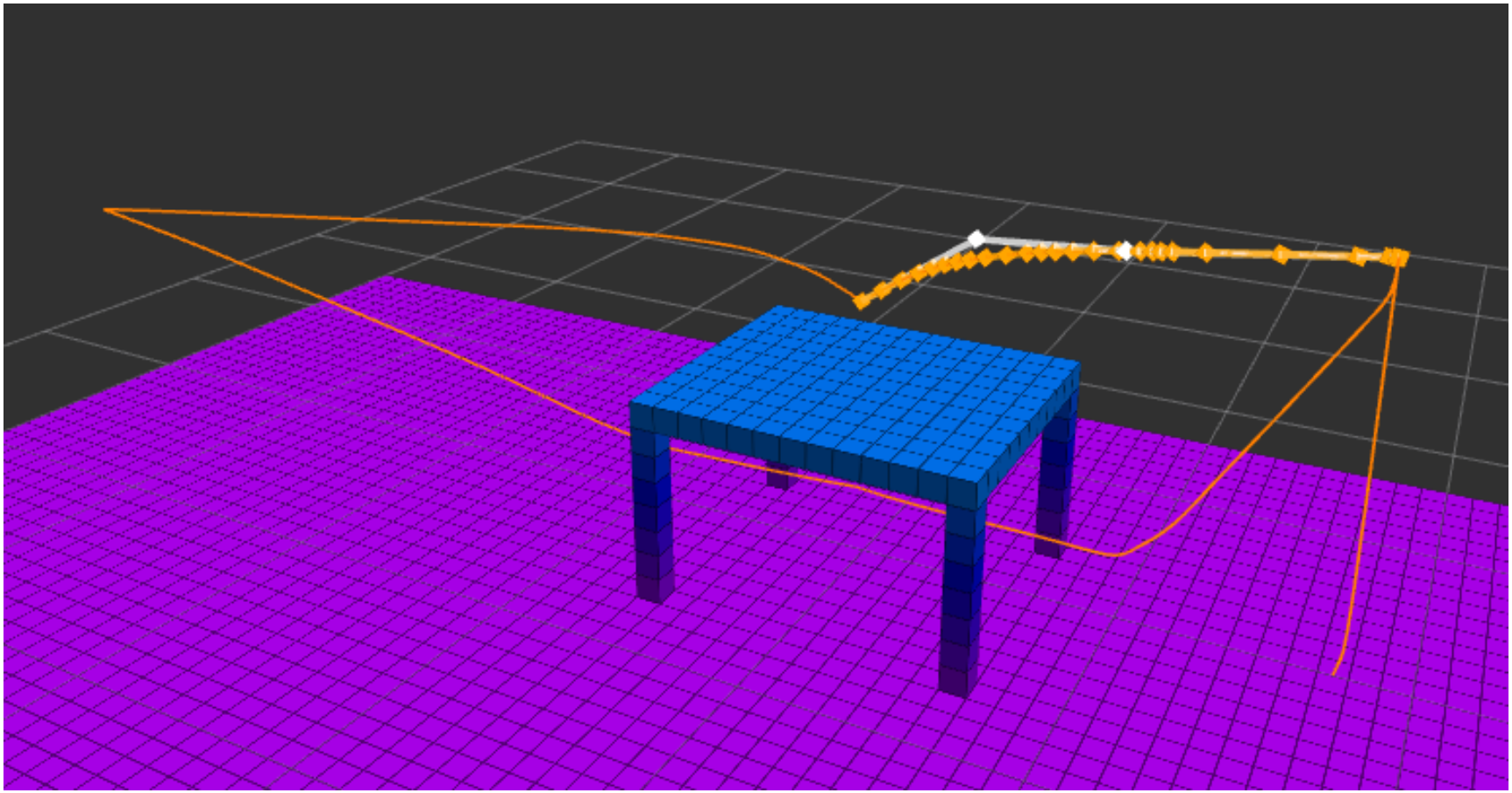
Task 3: Smooth trajectory generation

MAV trajectory generation

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



Task 4: Flight experiment



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 – The most advanced

- Skydio 2

[Image credit:Skydio

Professional drones

- DJI Matrice 300 RTK
- Aerial photography and inspection

[Image credit: DJI]

Professional drones

- Leica/Aibotix drone
- Inspection and measurement tasks

[Image credit: Leica]

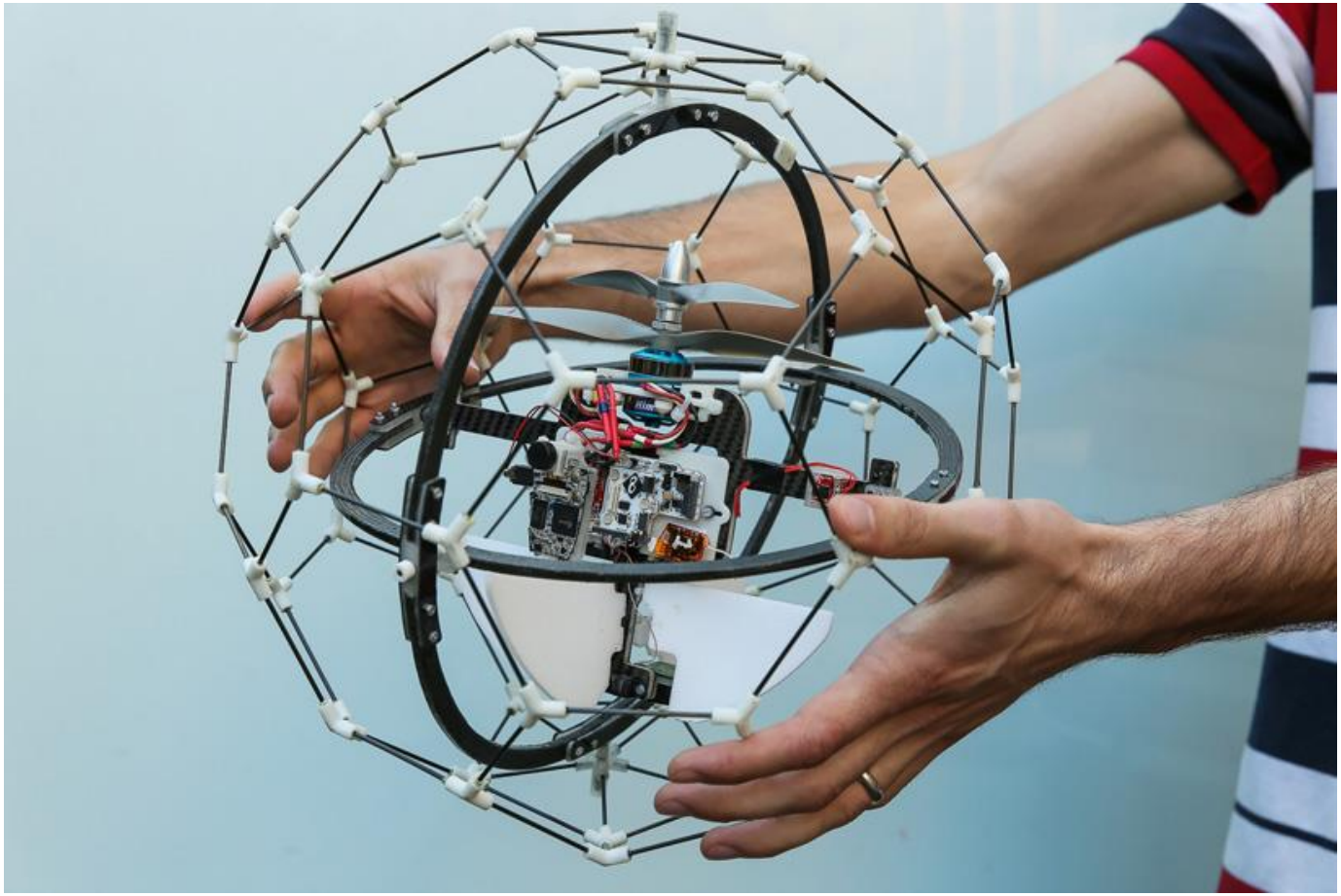
Professional drones

- 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]

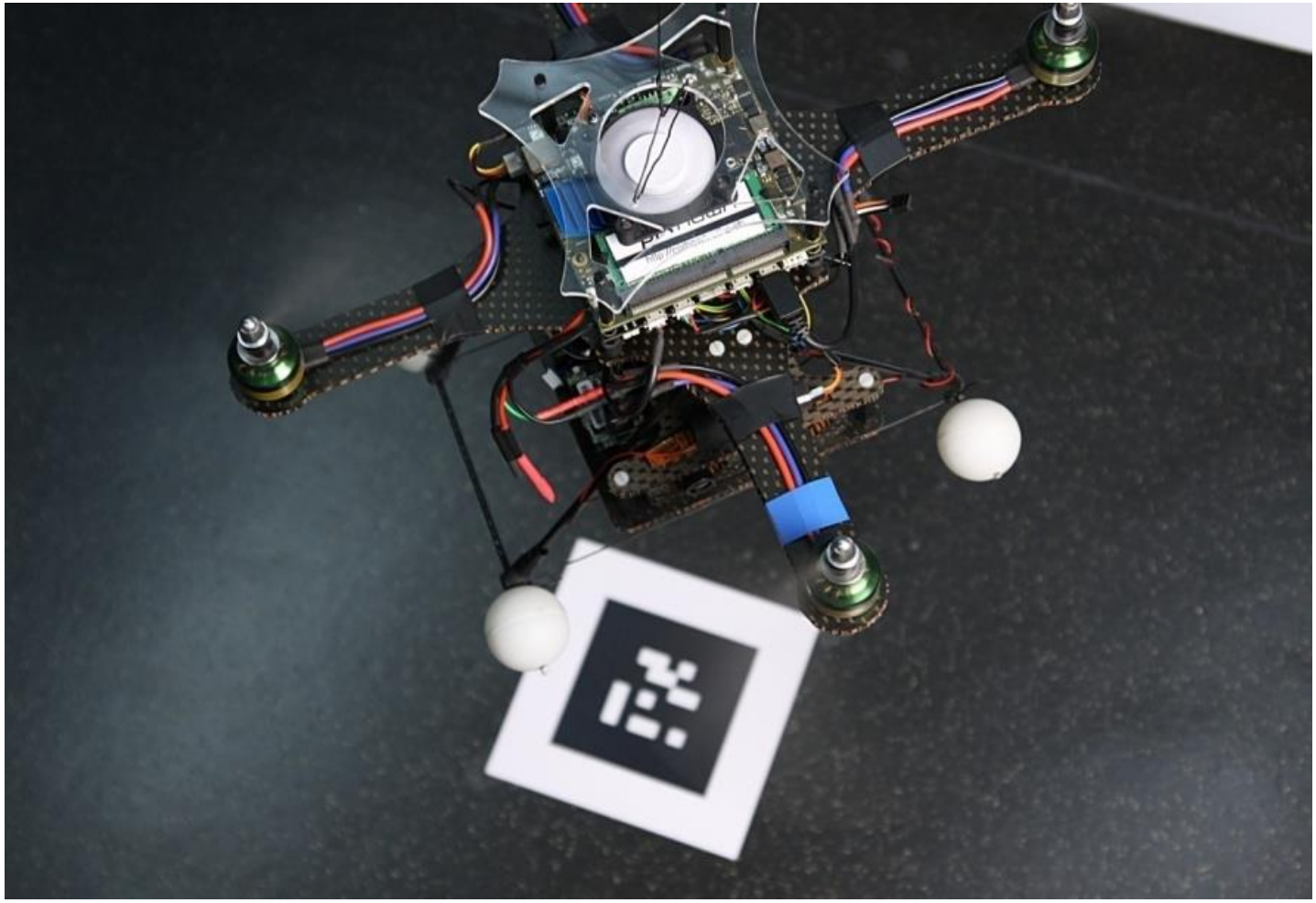
Professional drones

- Flir Nano-Drone
- Reconnaissance

[Image credit: Flir]

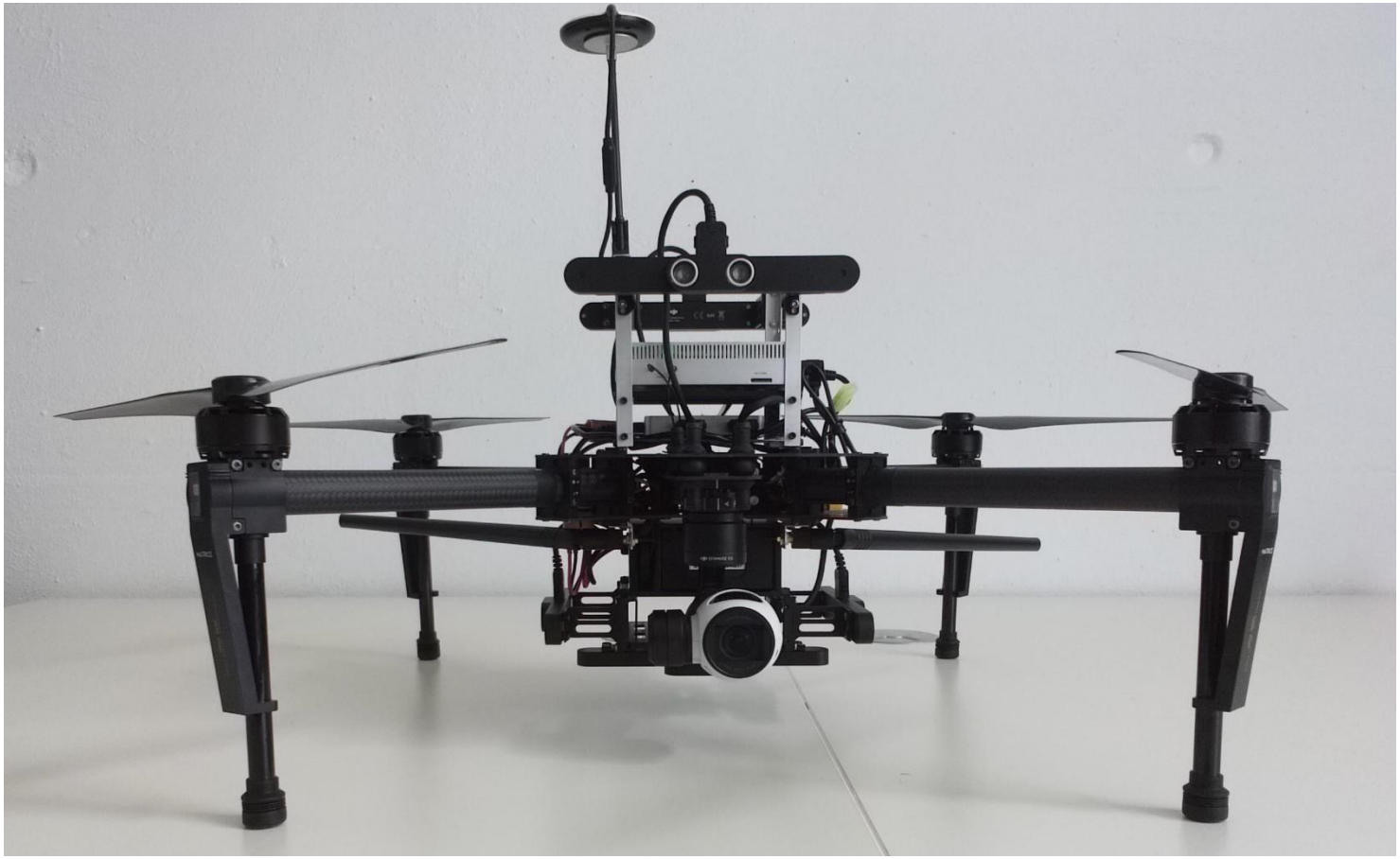
Research drone

- Pixhawk drone
- 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



Resist project: Camera drones for bridge inspection

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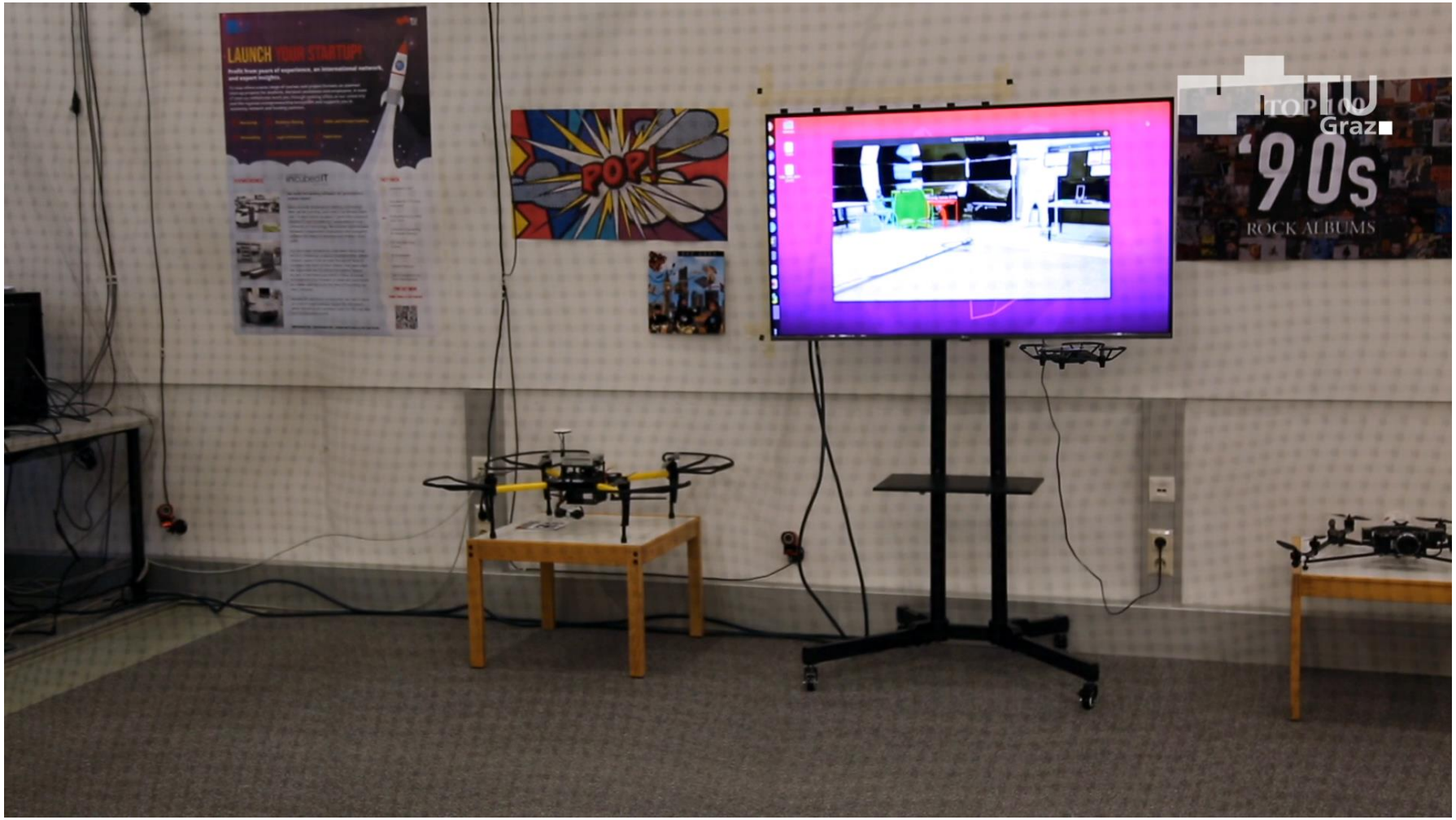
Camera drone applications and research

- 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)
- Inventory drone (Video)

Student project



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"