
Camera Drones

Lecture – Camera drones overview

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Lecture contact

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- Sprechstunde nach Vereinbarung



Practical contact

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- TC Forum



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 course requires a significant amount of self-learning.

Course schedule

11.10.2023	HS i9	Lecture: Introduction lecture Introduction to practical
18.10.2023	HS i9	Lecture: Flight mechanics Dronespace introduction
20.10.2023	droneSpace	droneSpace introduction (individual groups)
25.10.2023	HS i9	Lecture: ROS Part 1
08.11.2023	HS i9	Lecture: ROS Part 2
15.11.2023	HS i9	Lecture: Sensors Practical Handout
22.11.2023	HS i9	Lecture: Sensors Lecture: Sensor fusion
29.11.2023	HS i9	Lecture: 3D data generation
06.12.2023	HS i9	Lecture: Flight planning
13.12.2023	HS i9	Lecture: UAV Regulations
20.12.2023	Christmas break	
10.01.2024	HS i9	Quiz
17.01.2024	HS i9	Presentations
24.01.2024	HS i9	Presentations
26.01.2024	droneSpace	Flight presentations

Practical part of the course

Course drone

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



Course drone

Specifications:

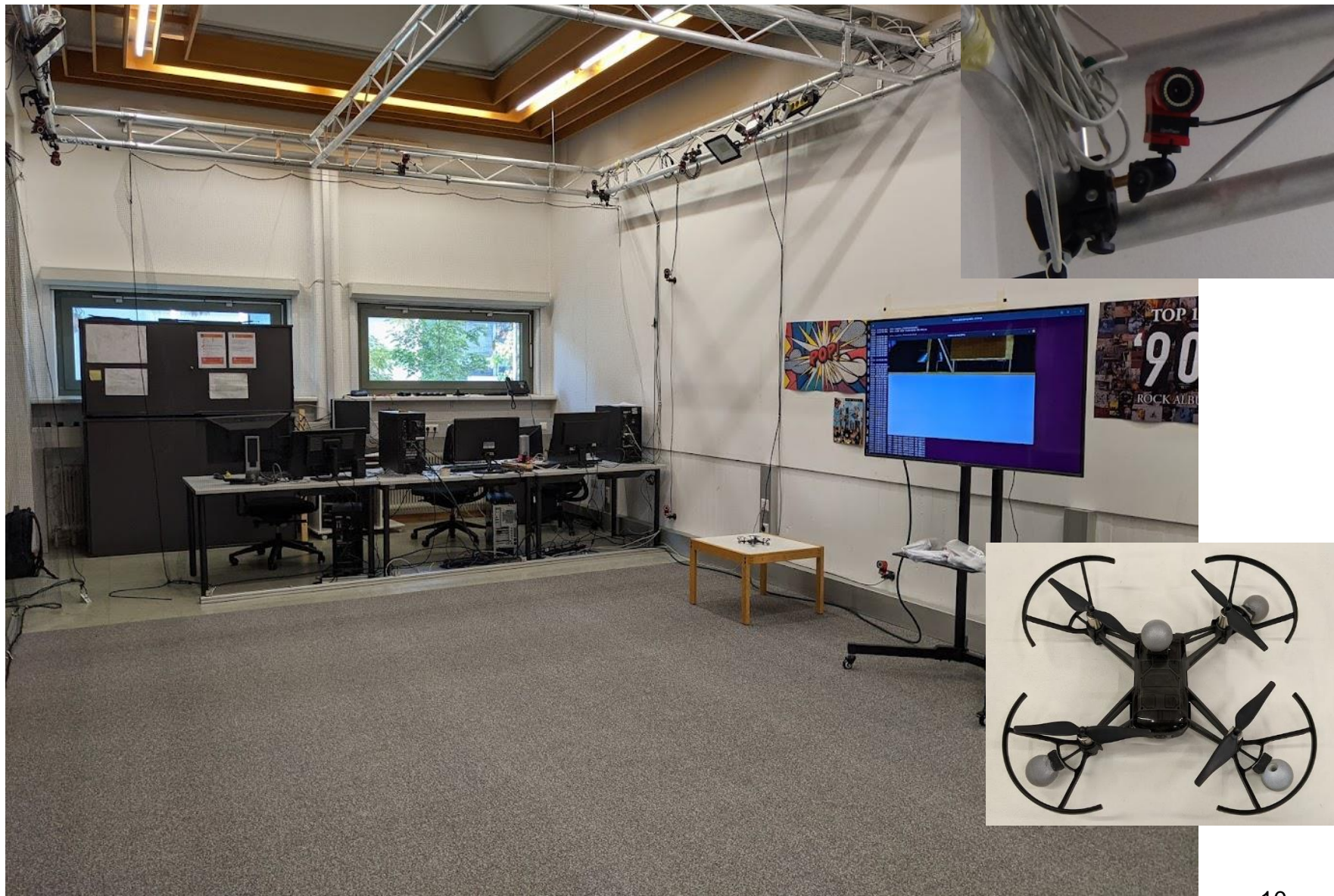
- 5MP front camera
- 1080x720px video resolution
- 13min flight time
- Python interface for programming
- Vision Positioning System
 - Downward-looking camera
 - Infrared distance sensors



Lab infrastructure (droneSpace)



Tracking cameras



Practical – Collision free navigation



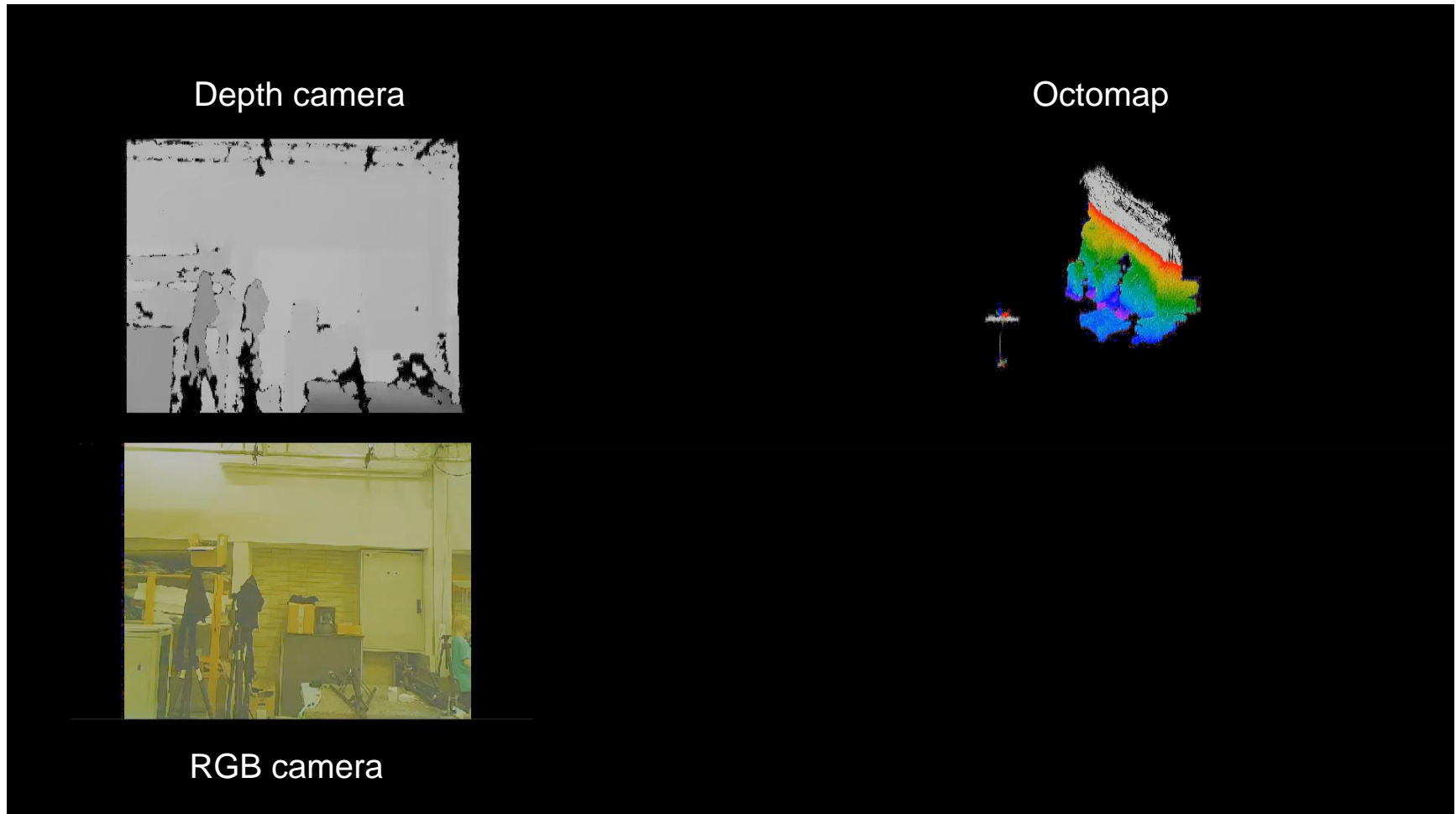
Practical 2022 - Collision free navigation

4 contiguous assignments:

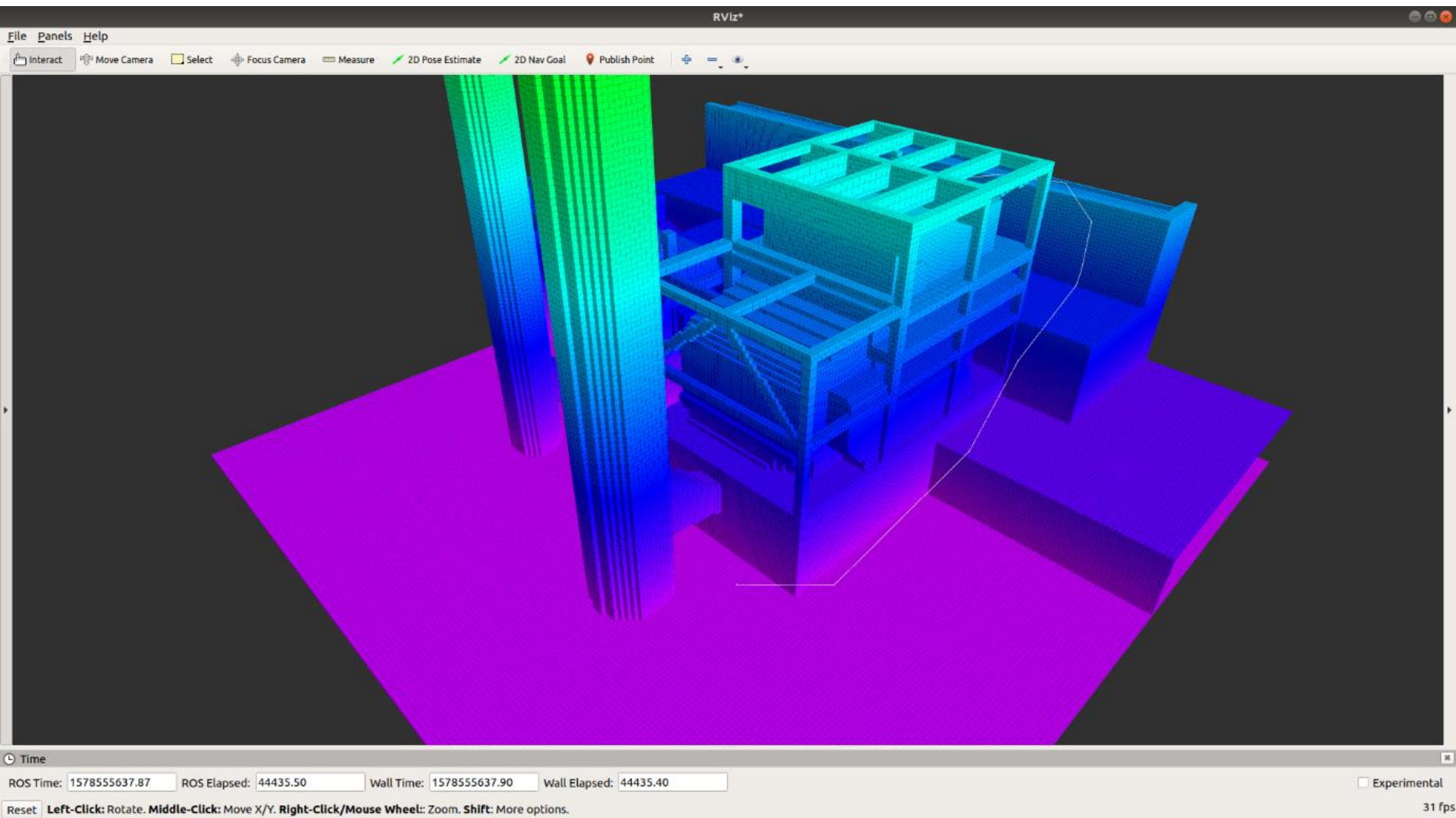
- 1. Mapping of the environment
 - Create Octomap from sensor input such that it provides a 3D map for path planning.
- 2. Path planning for safe navigation
 - Implement a path planning algorithm to navigate the drone collision-free to a goal position (e.g. RRT algorithm)
- 3. Smooth trajectory generation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

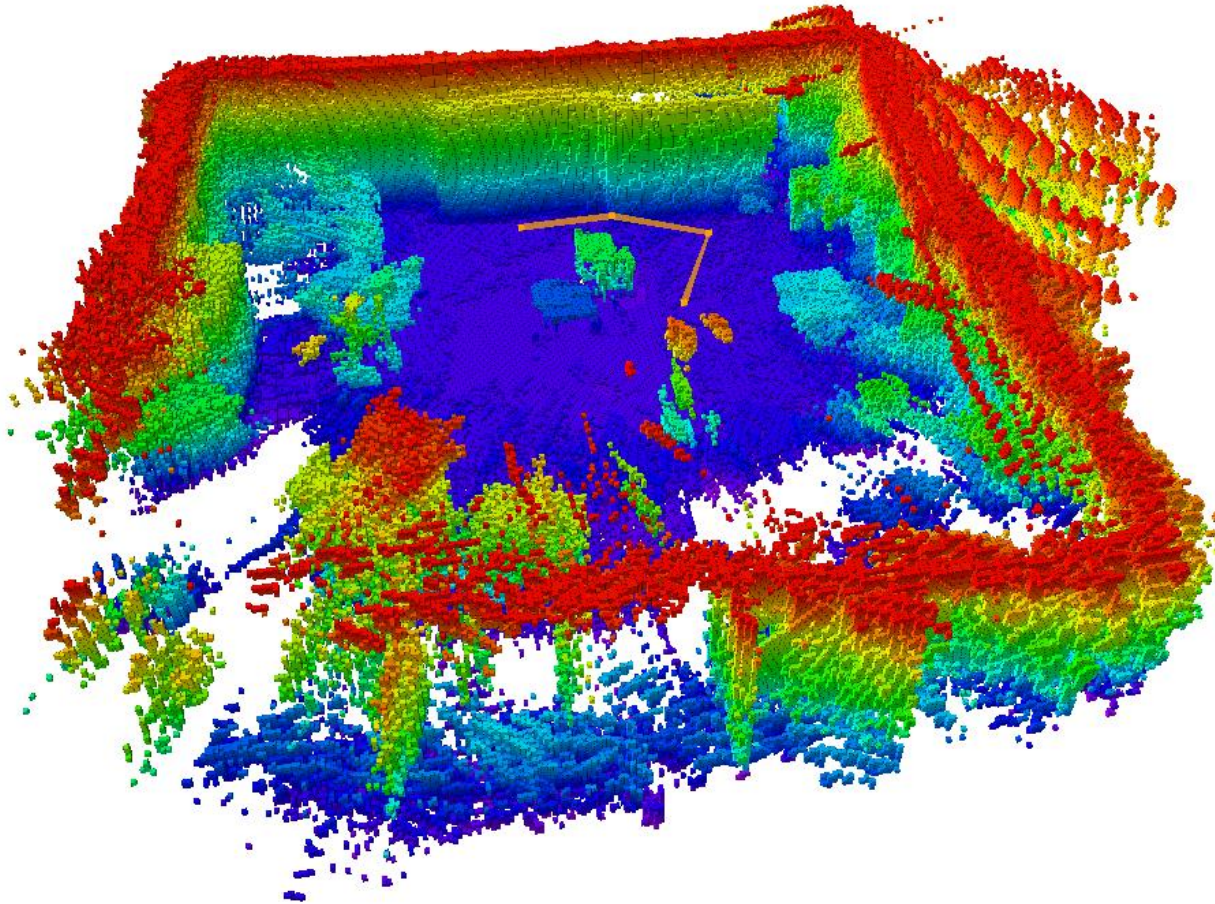
- Octomap creation from ROS-Bag



Task 2: Path planning



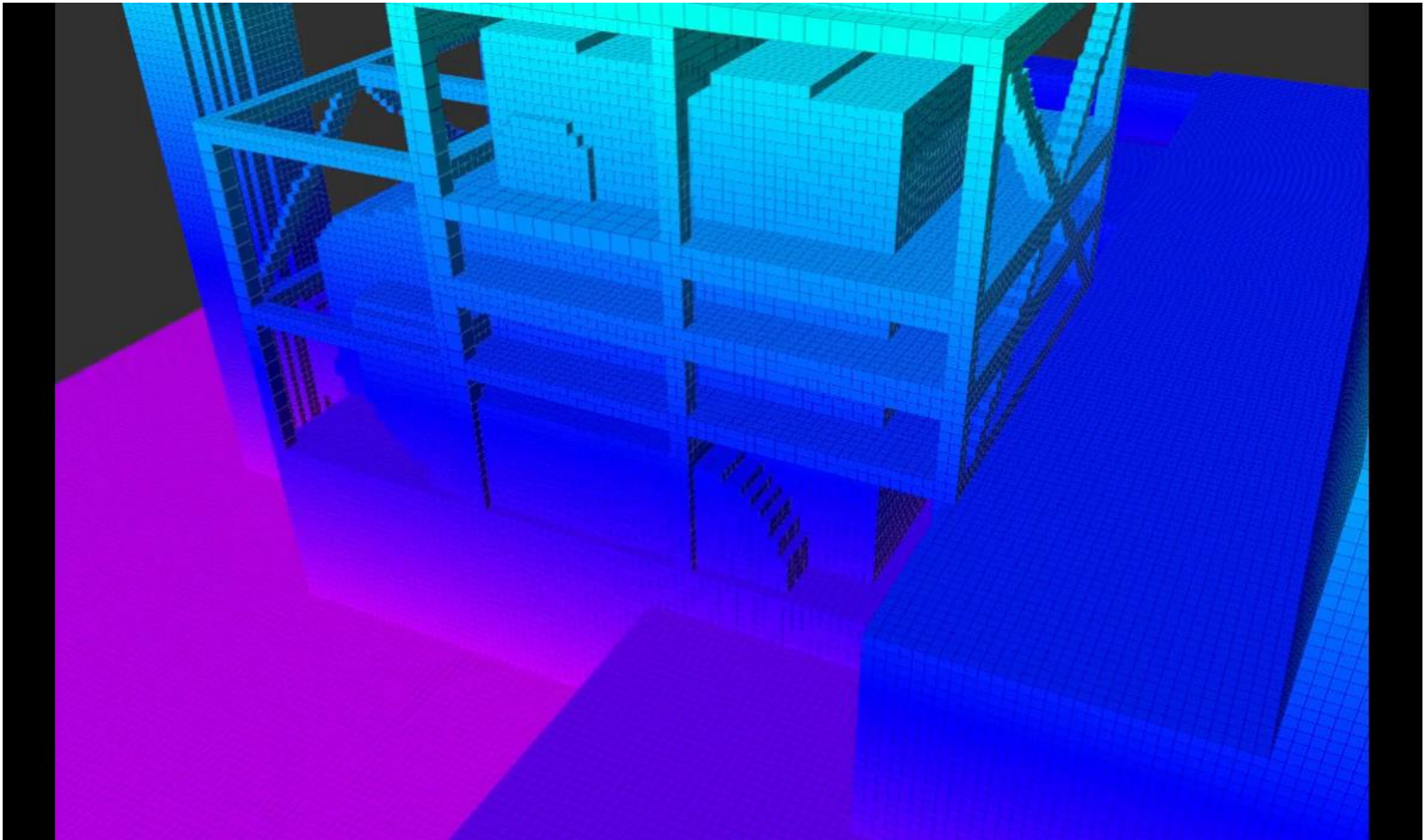
Task 2: Path planning



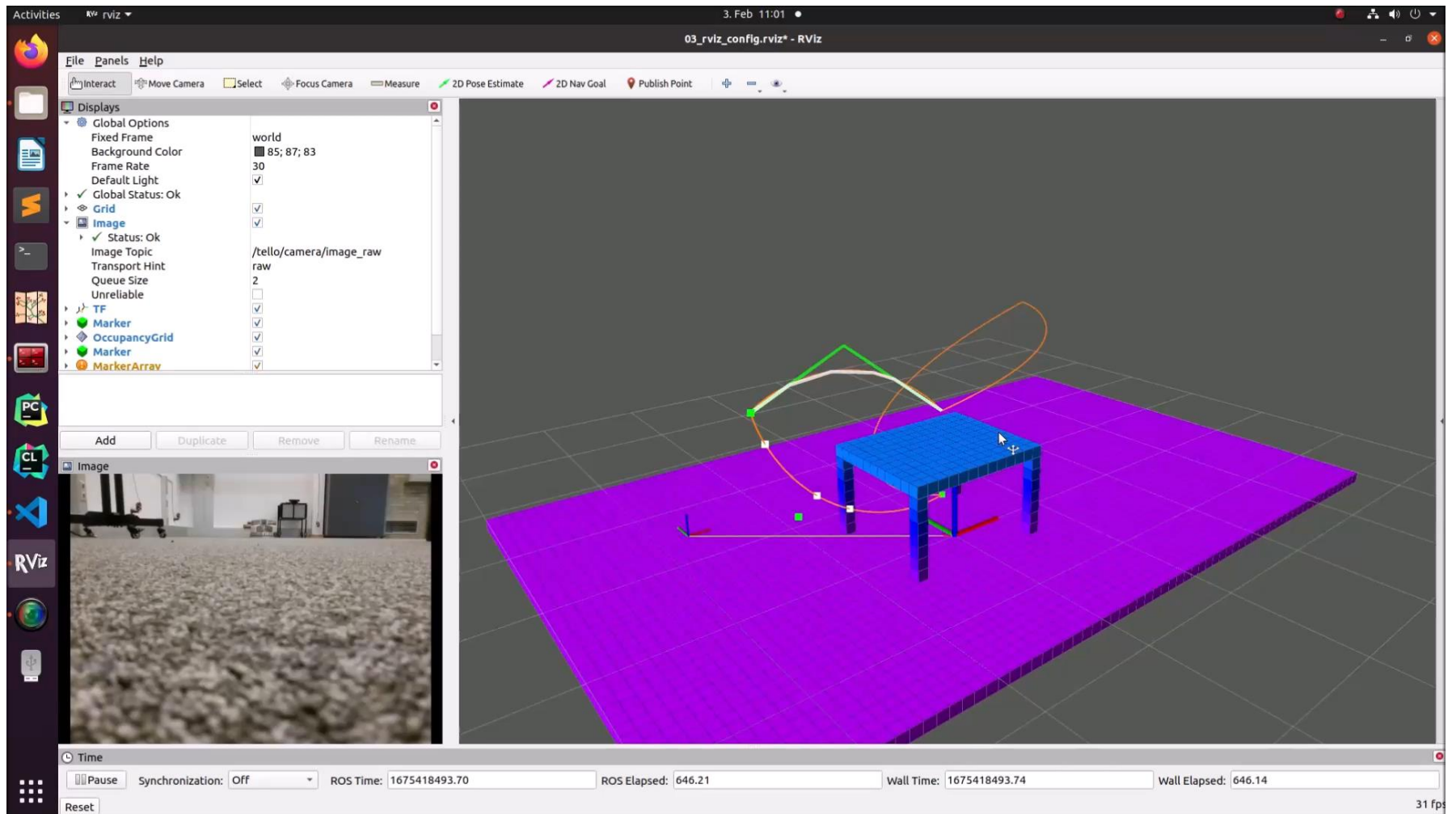
Task 3: Smooth trajectory generation

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



Parrot
AR.DRONE 2.0 >

[Image credit: Parrot]

Consumer drones



[Image credit: DJI]



[Image credit: Yuneec]



[Image credit: GoPro]



[Image credit: Parrot]

Consumer drones – The most advanced

- Skydio 2



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



Professional drones

- Sensefly Ebee
- Fixed wing, long endurance
- Photogrammetry



[Image credit: Sensefly]

Professional drones

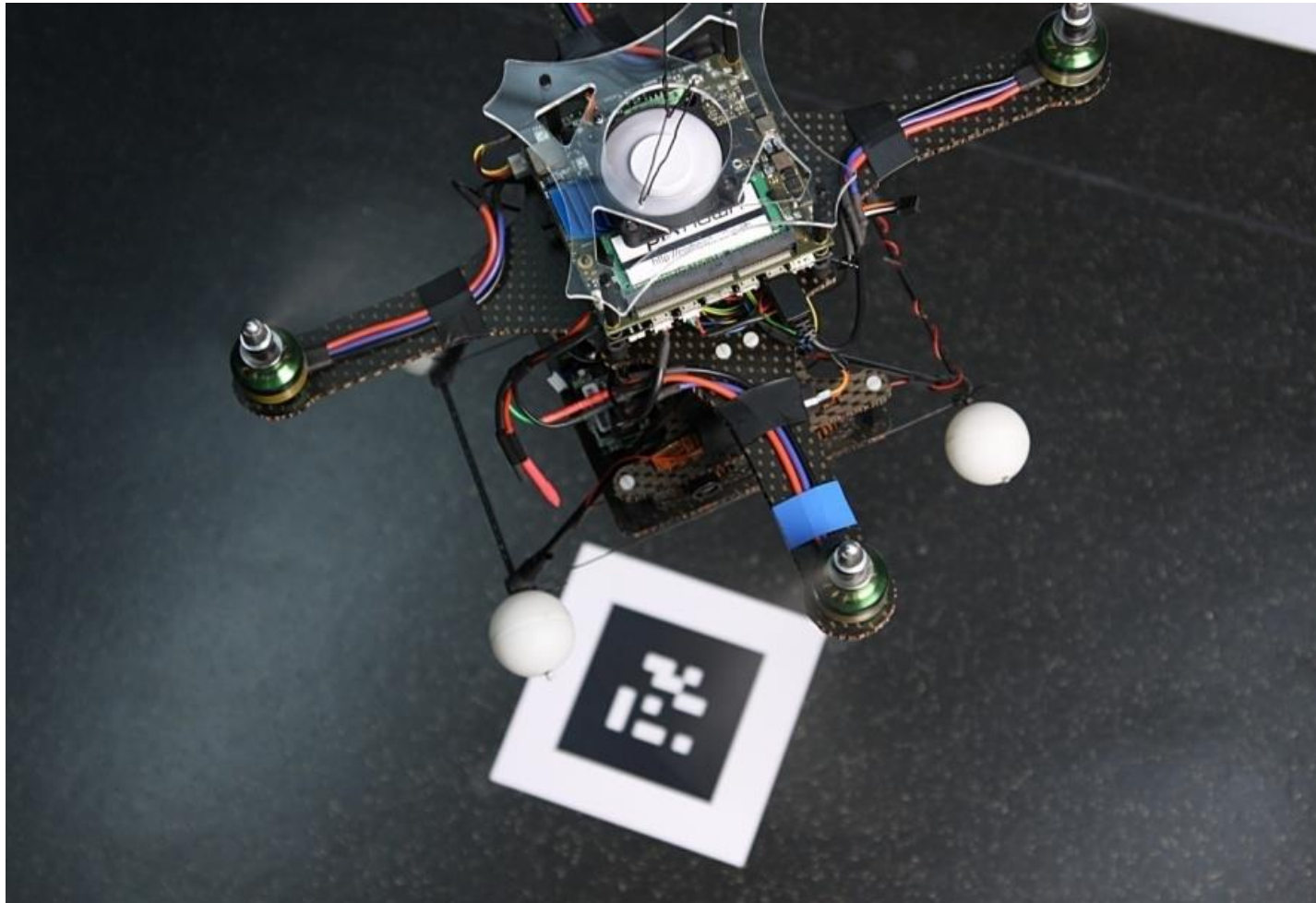
- Flir Nano-Drone
- Reconnaissance



[Image credit: Flir]

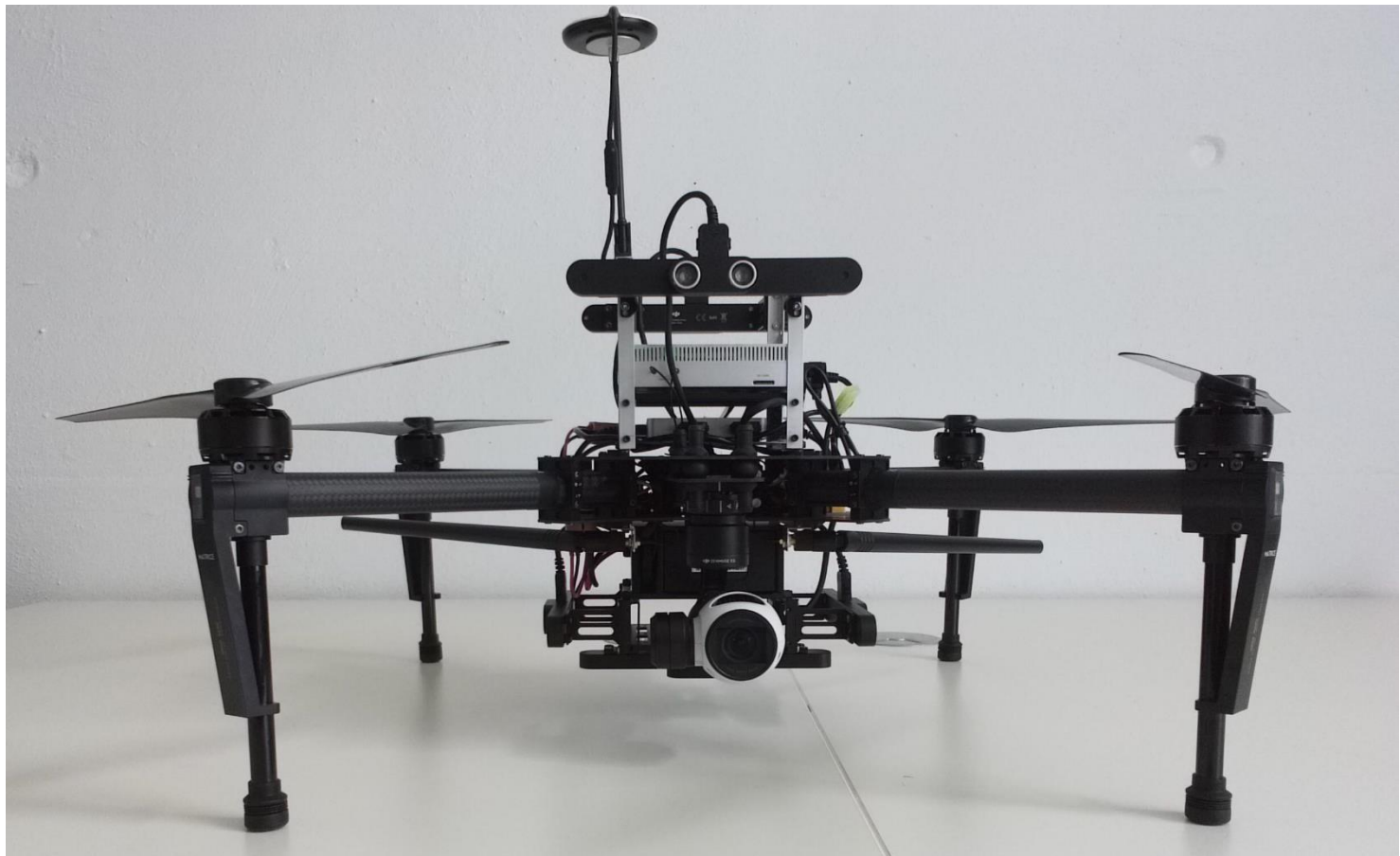
Research drone

- 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



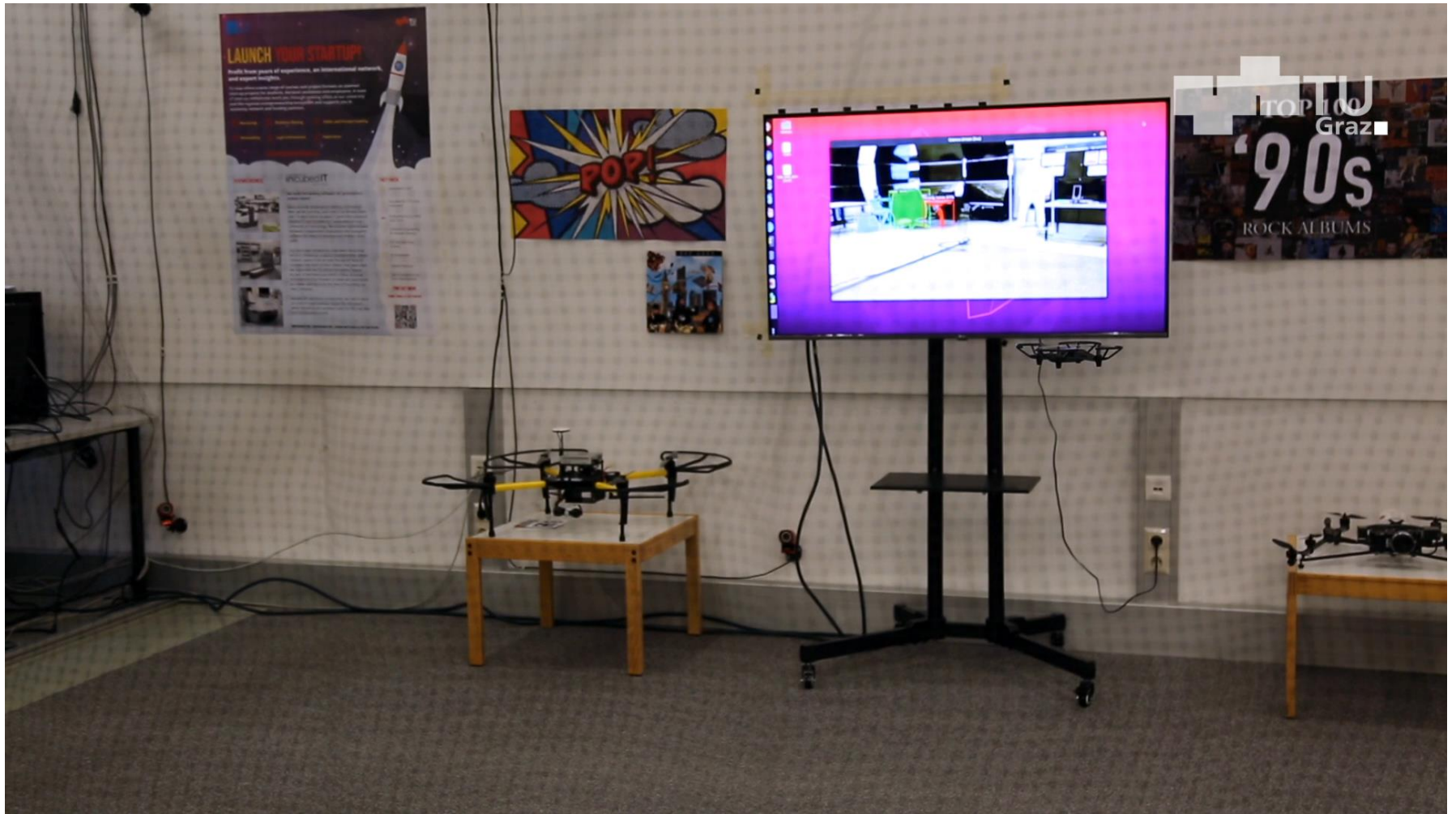
Resist project: Camera drones for bridge inspection



Camera drone applications and research

- Action filming
- Archeology ([3D Pitoti](#), [3D Model](#))
- Inspection (Bridges, Power pylons)
- Search and Rescue ([DJI Challenge](#))
- Agriculture
- Safe navigation
- Autonomous exploration
- Human-Robot Interaction
- 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"