ETH zürich

AERO TRAIN

Autonomous Systems Lab

Omnidirectional Aerial Robots for Inspection Tasks

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Inspection Tasks with Aerial Robots

- The amount of tasks inspection drones are used for grows by the day:
  - **Power Lines**
  - **Pipelines**
  - **Offshore Platforms**
  - **Concrete Infrastructure**
  - **…**

Are standard multirotors enough?

The End-Effector Paradigm

Trujillo, Miguel Ángel, et al. "Novel aerial manipulator for accurate and robust industrial NDT contact inspection: A new tool for the oil and gas inspection industry." *Sensors* 19.6 (2019): 1305.

The End-Effector Paradigm

A multilayer control for multirotor UAVs equipped with a servo robot arm

F. Ruggiero, M.A. Trujillo, R. Cano, H. Ascorbe, A. Viguria, C. Peréz, V. Lippiello, A. Ollero, B. Siciliano

Ruggiero, Fabio, et al. "A multilayer control for multirotor UAVs equipped with a servo robot arm." *2015 IEEE international conference on robotics and automation (ICRA)*. IEEE, 2015.

Omnidirectional Aerial Robots

Thrust Vectoring is Key

Bodie, Karen, et al. "Active interaction force control for contact-based inspection with a fully actuated aerial vehicle." IEEE Transactions on Robotics 37.3 (2020): 709-722.

Bodie, Karen, et al. "Active interaction force control for contact-based inspection with a fully actuated aerial vehicle." IEEE Transactions on Robotics 37.3 (2020): 709-722.

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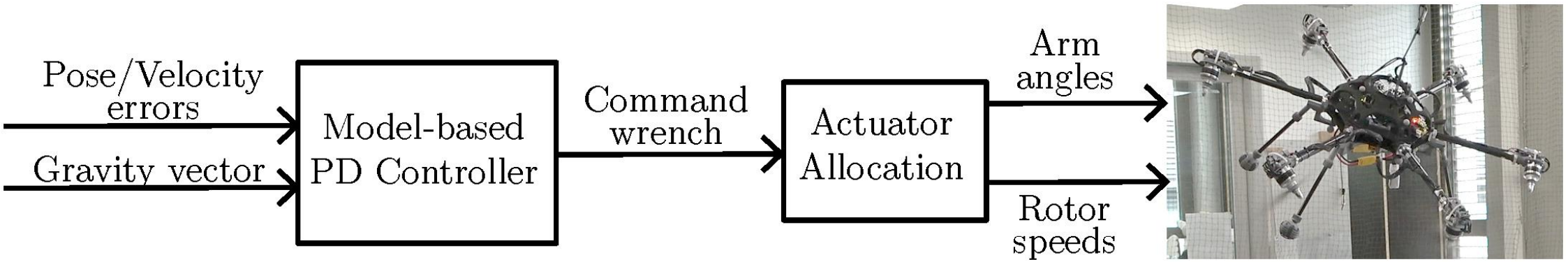
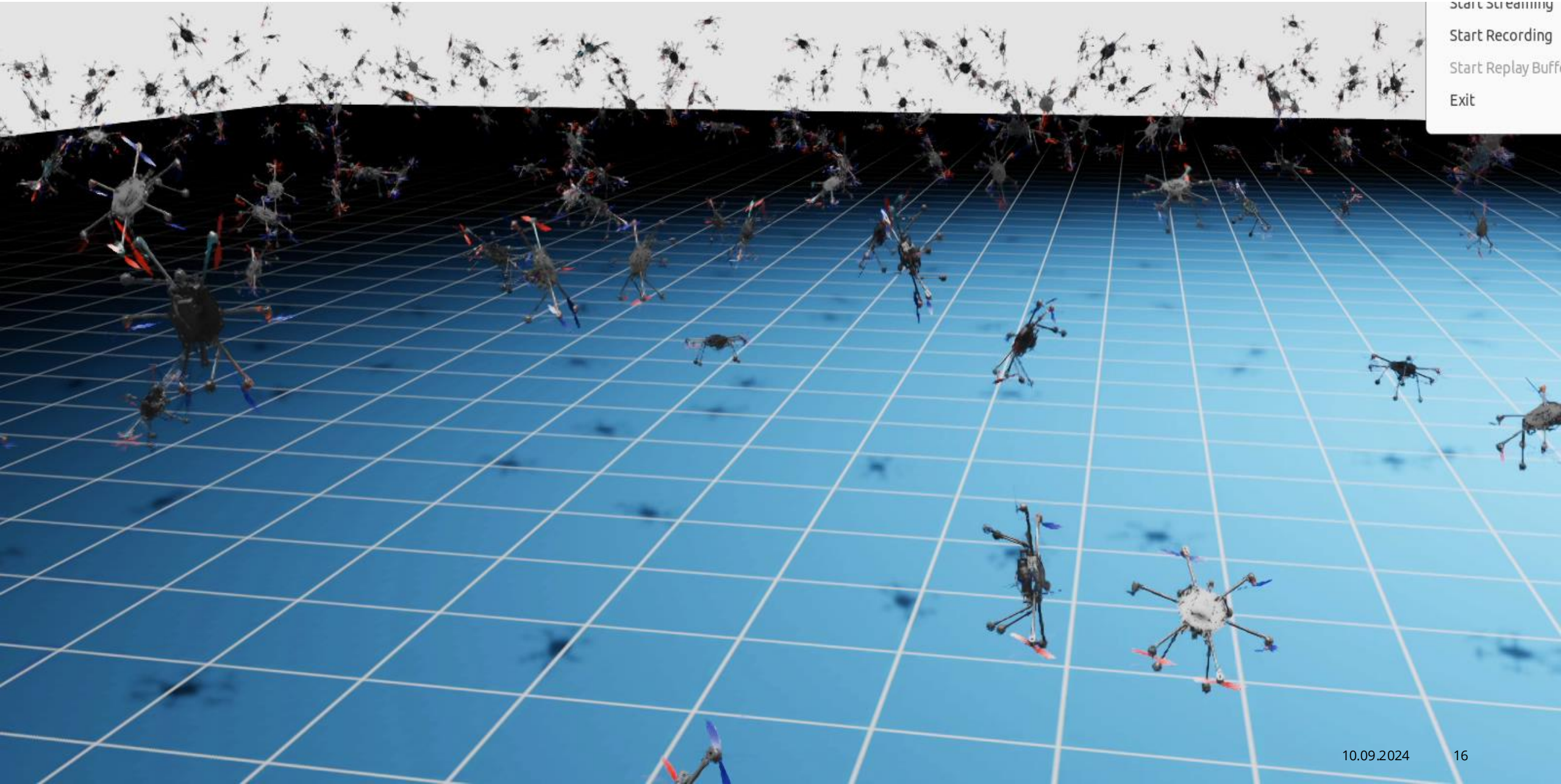
Current model-based approaches

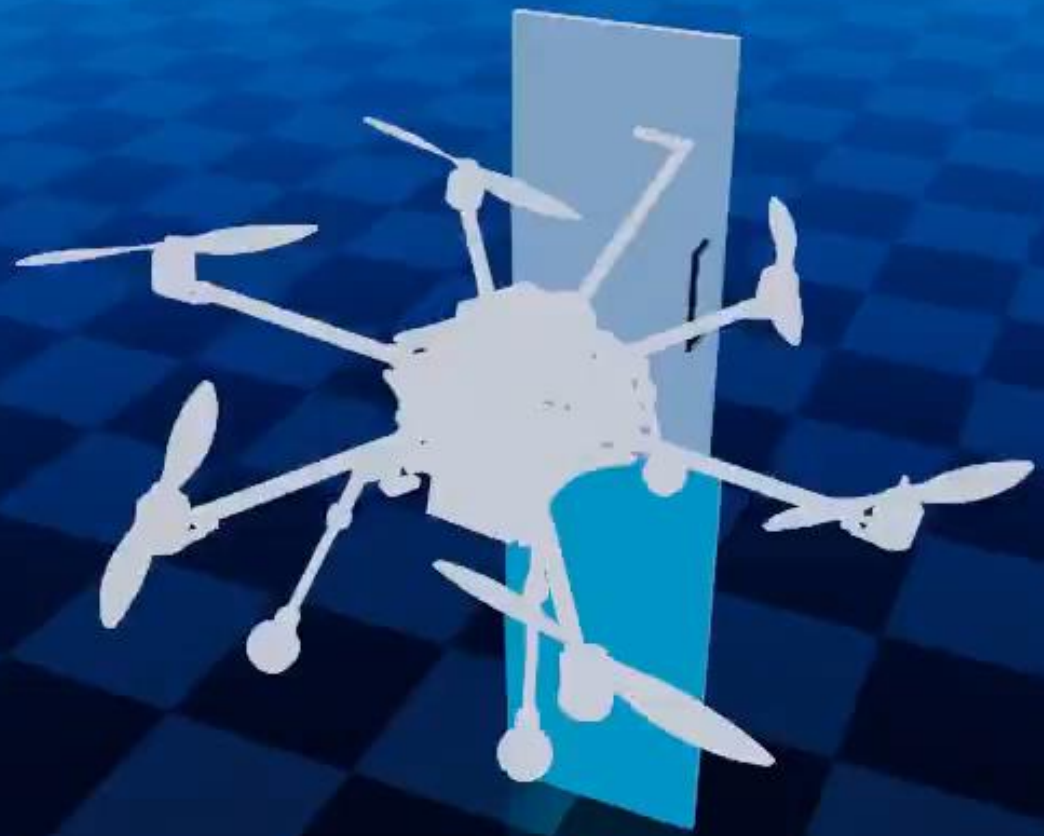
- Current model-based approaches mostly use a **decoupled** approach:
  - **Pose Control**
  - **Actuator Allocation**



Learning to fly



Learning to open doors



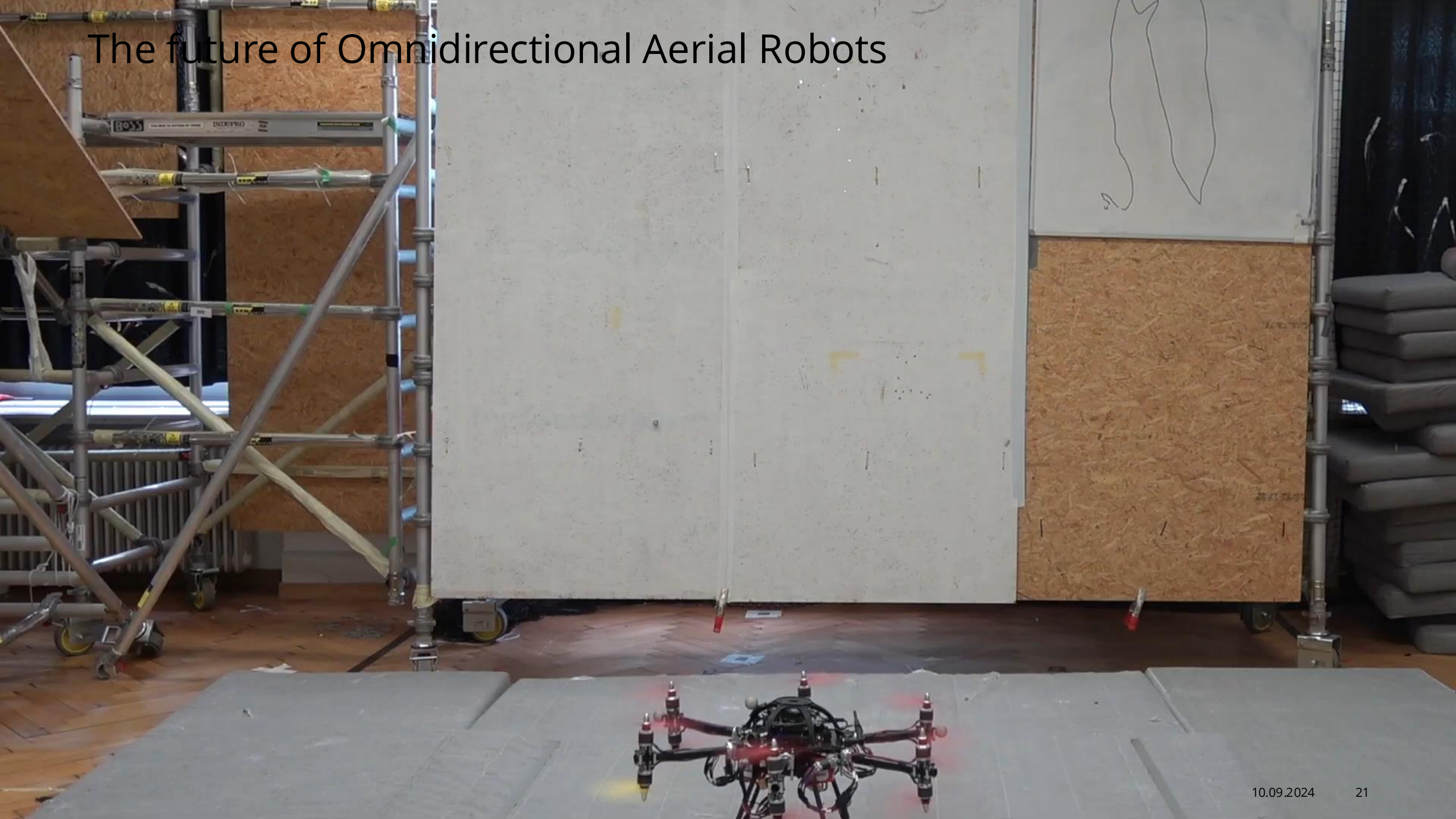
policy updates: 0
time-steps: 0

Learning to open doors

The future of Omnidirectional Aerial Robots

- **Omnidirectionality** is a great property!
  - Complete **decoupling** between orientation and translation.
  - Improved **disturbance rejection**.
  - Much **faster dynamics** than standard multirotors.

The future of Omnidirectional Aerial Robots



The future of Omnidirectional Aerial Robots

- **Omnidirectionality** is a great property!
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- Why don't we have Omnidirectional Aerial Robots around us already?
  - **Complexity**: many more sensors and actuators need to sync and work together to fly.
  - **Reliability**: there is no safety stop.