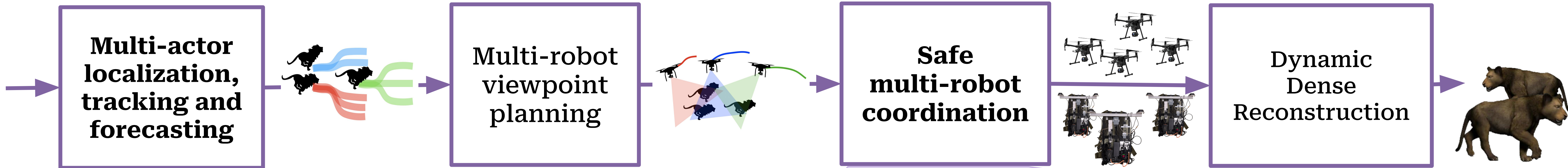
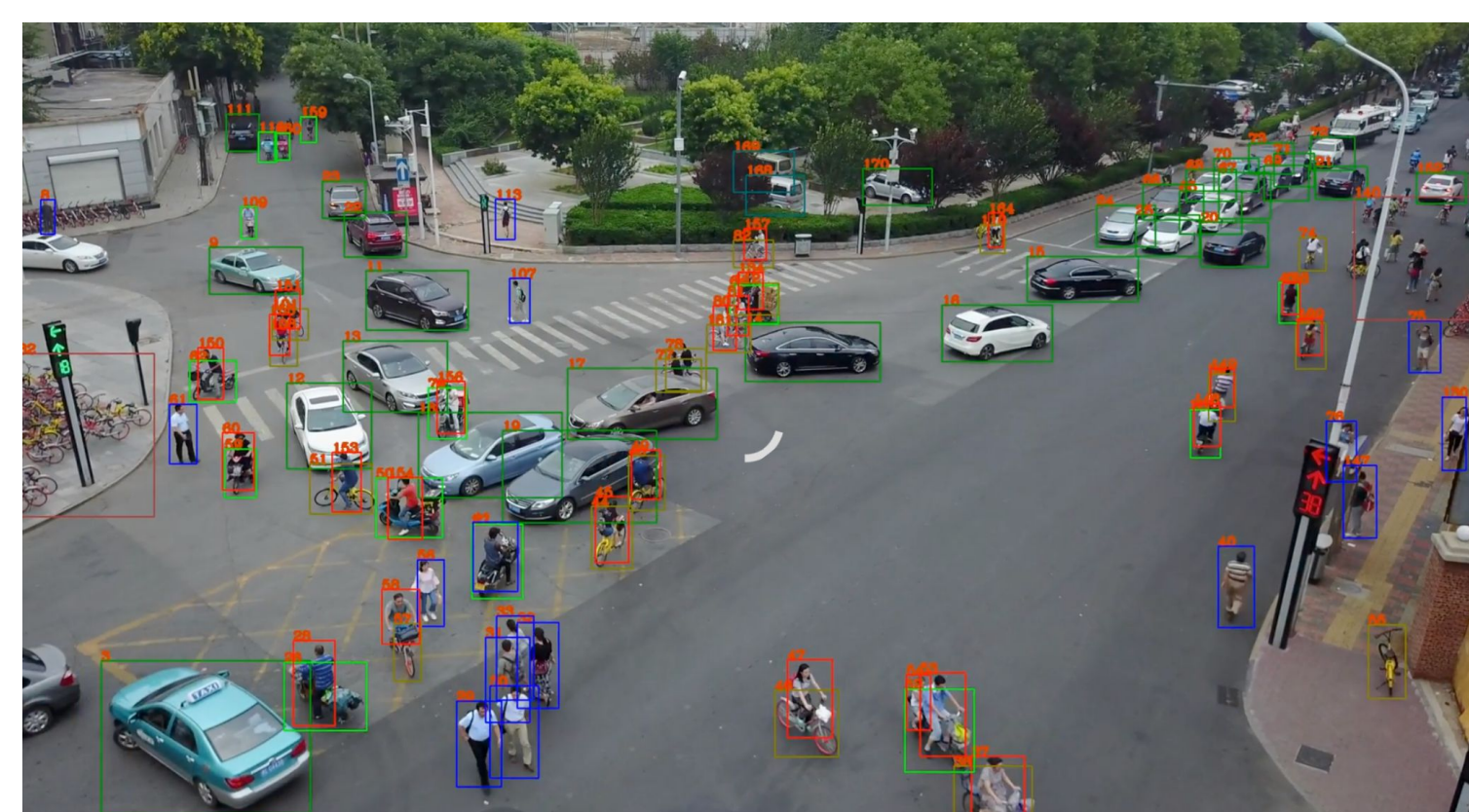
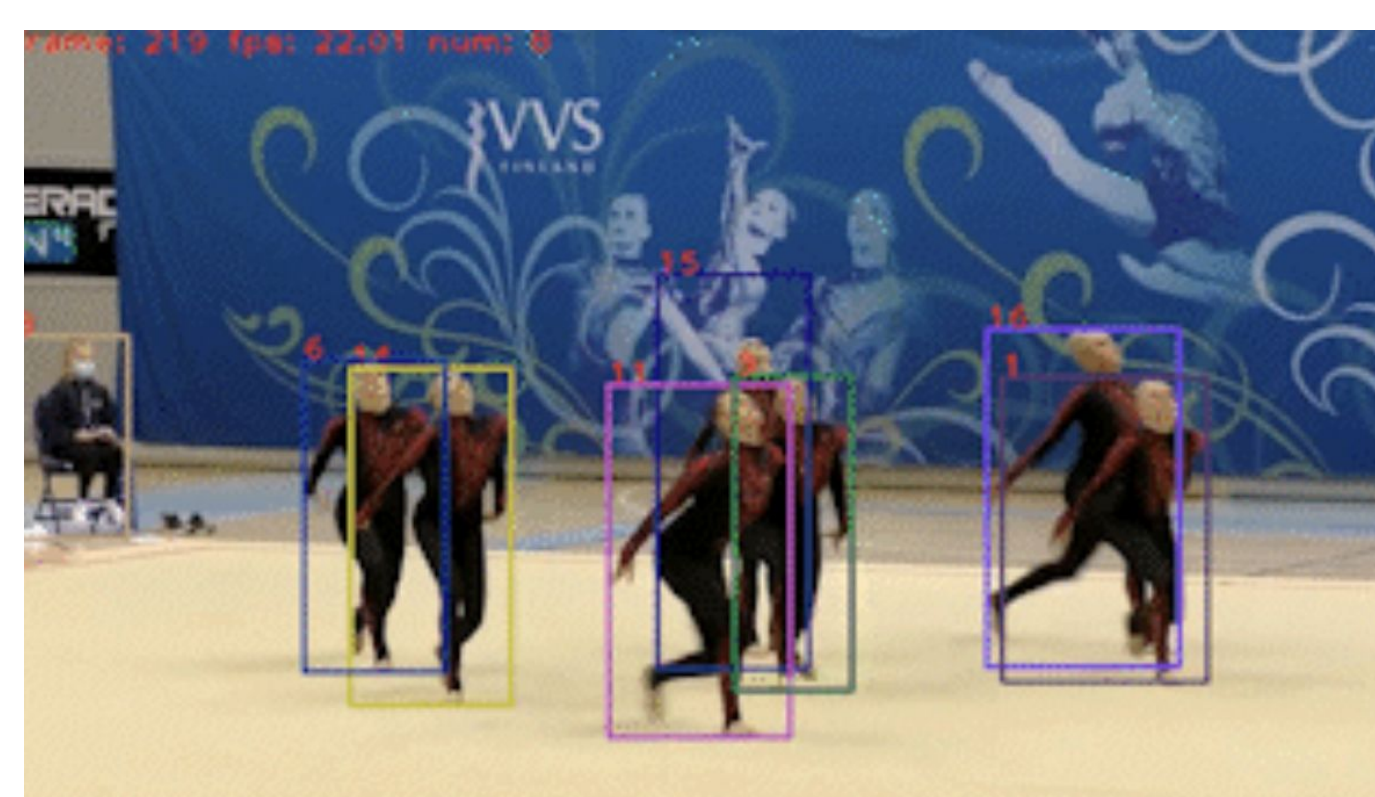
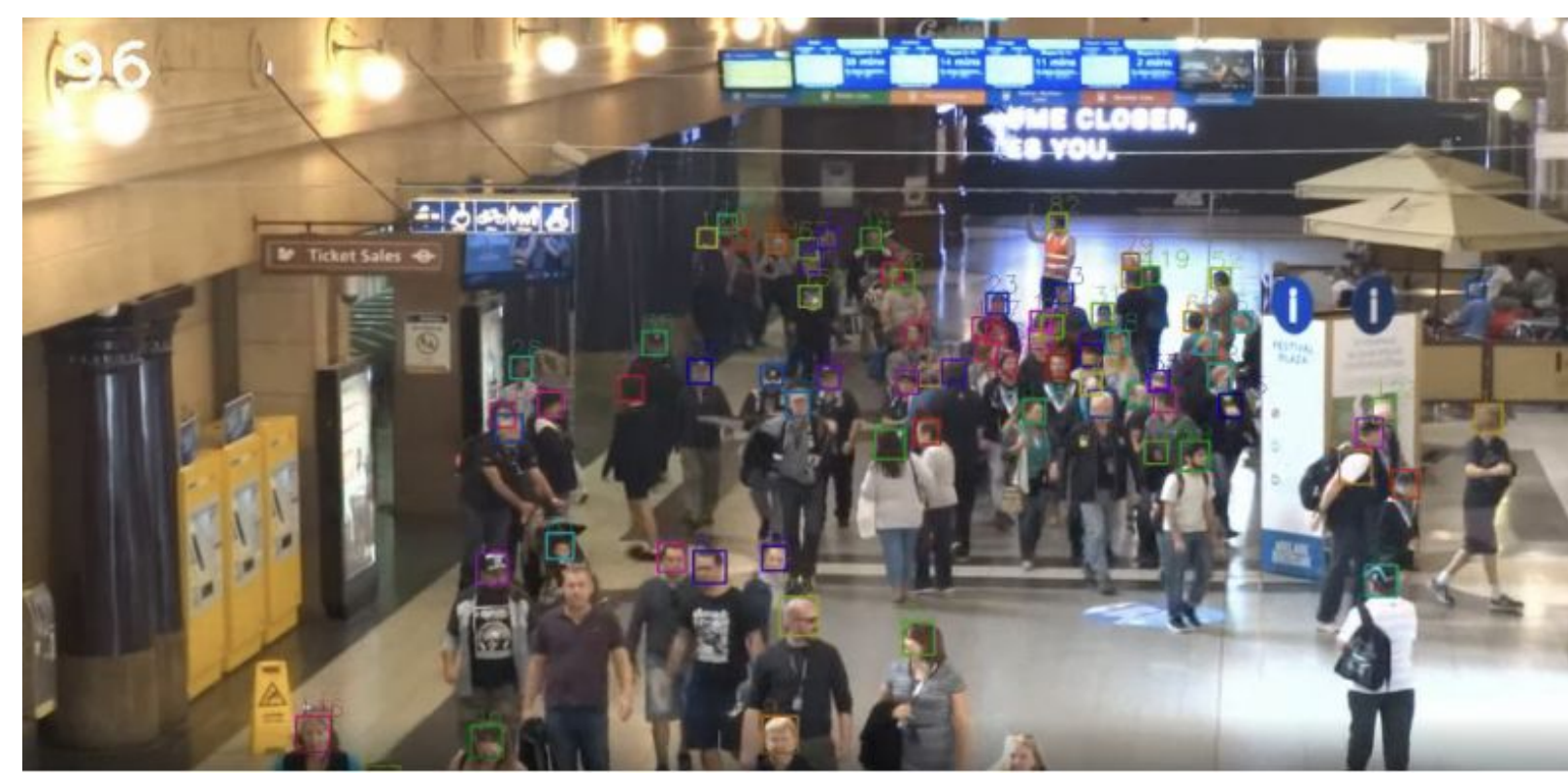


# DroneOpticStudio: Filming and Reconstructing Groups of Moving Actors in the Wild

Sebastian Scherer, Kris Kitani, Jinkun Cao, Micah Corah, Aditya Rauniyar, Yuehuan Hou  
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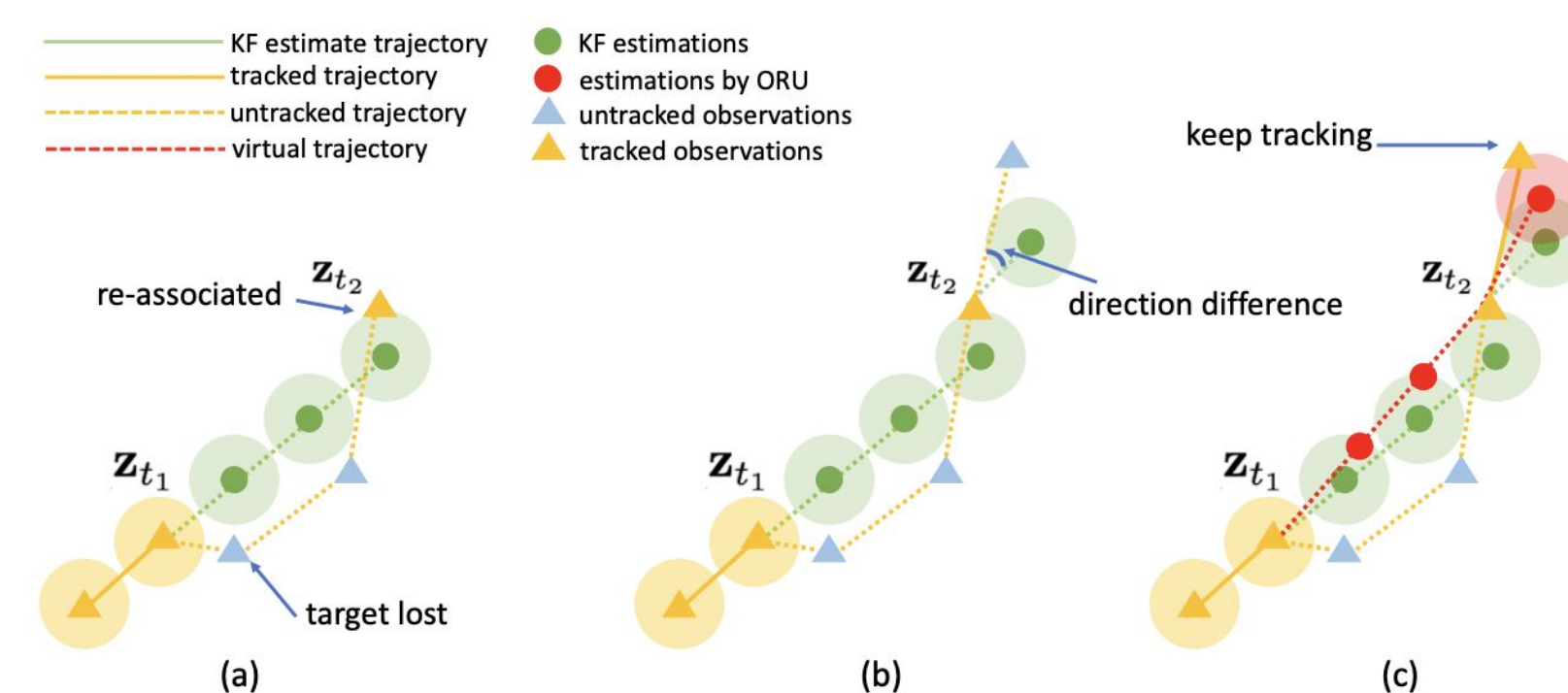


## Goal I: Real-time multi-target tracking



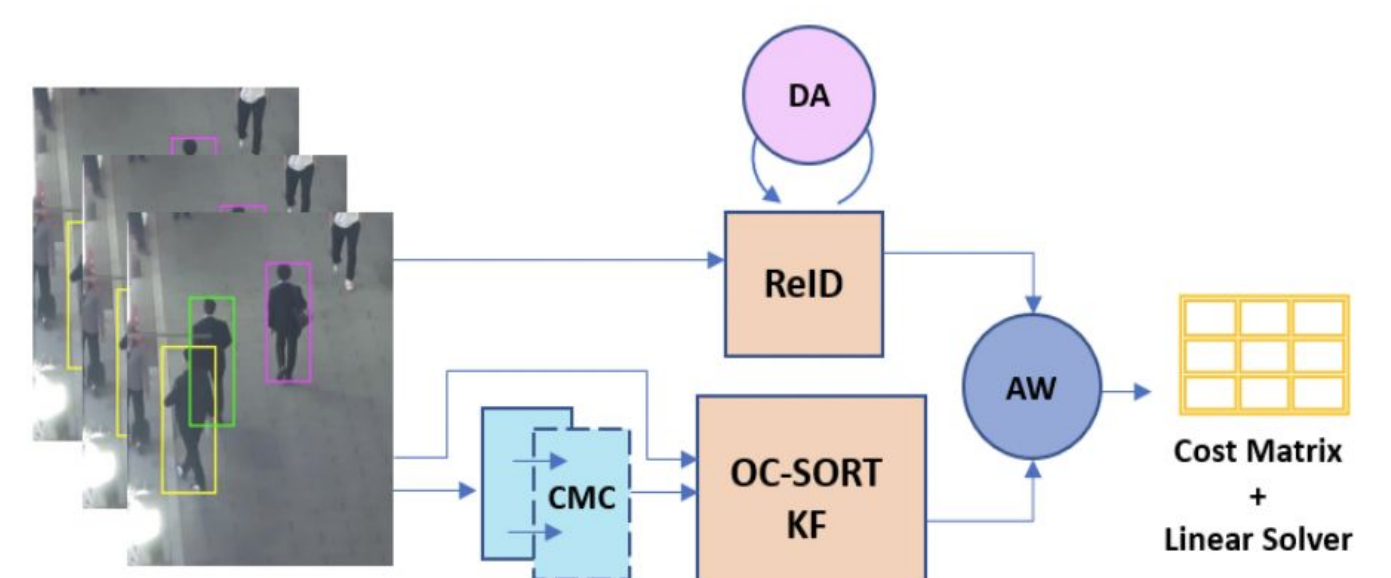
Multi-target tracking in drone's view

- **Robust to Occlusion:** Optimize robustness by fixing limitations of Kalman filter.
- **Two-stage Tracking:** Detection and association stages are separated, flexible to different detection frontends.
- **Real-time:** No deep model is used at the association stage, fast even on edge devices.
- Compatible with tracking from different view perspectives: *bird-eye view, drone's view, and third-person view.*
- An optional appearance matching module further improves performance.



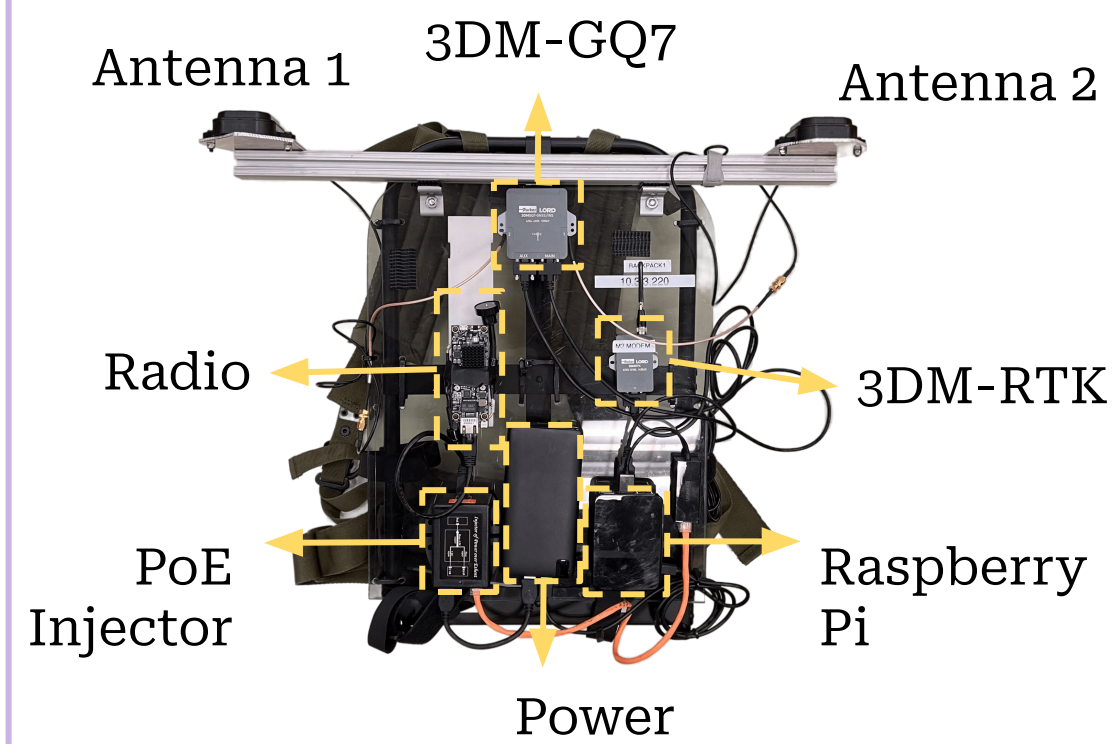
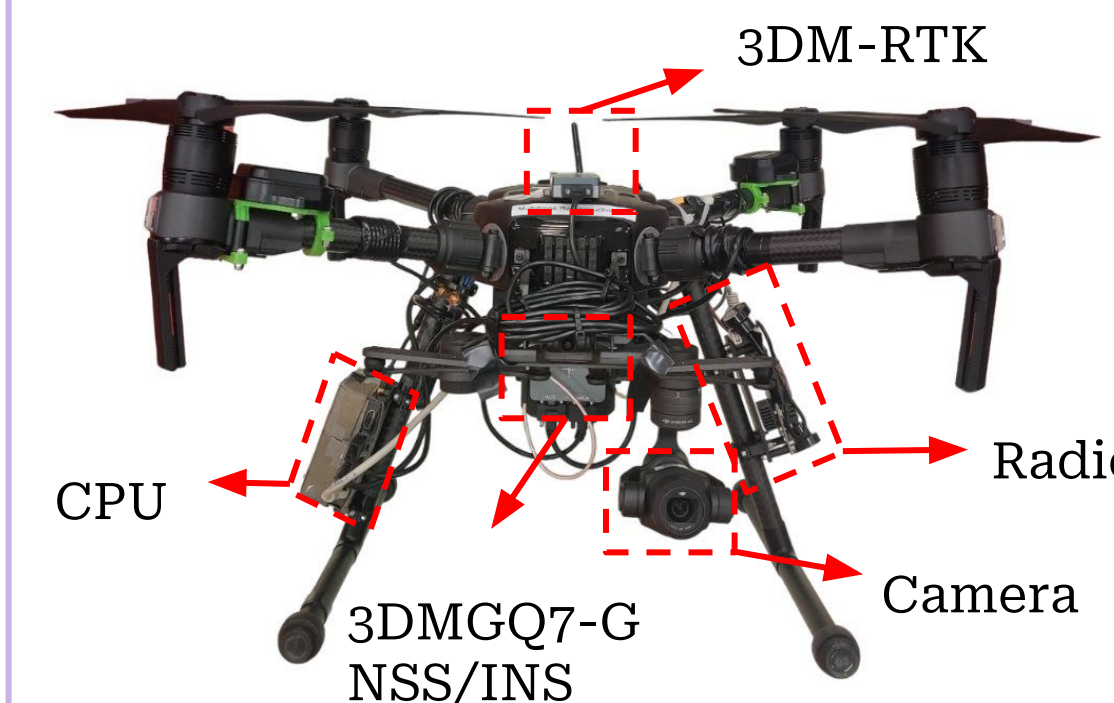
**OC-SORT:** Improves robustness to occlusion during tracking

Cao, Jinkun, et al. "Observation-centric sort: Rethinking sort for robust multi-object tracking." *Conference of Computer Vision and Pattern Recognition (2023)*.  
Maggiolino, Gerard, et al. "Deep OC-SORT: Multi-Pedestrian Tracking by Adaptive Re-Identification." *arXiv preprint arXiv:2302.11813 (2023)*.

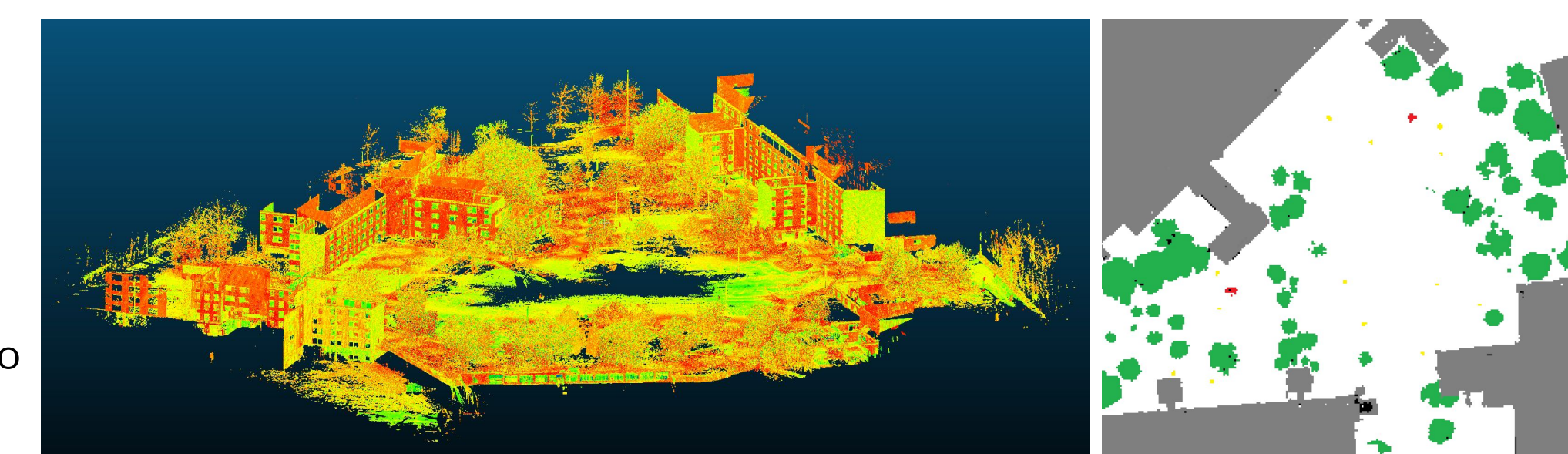


**Deep OC-SORT:** Integrates OC-SORT and visual appearance-based re-identification.

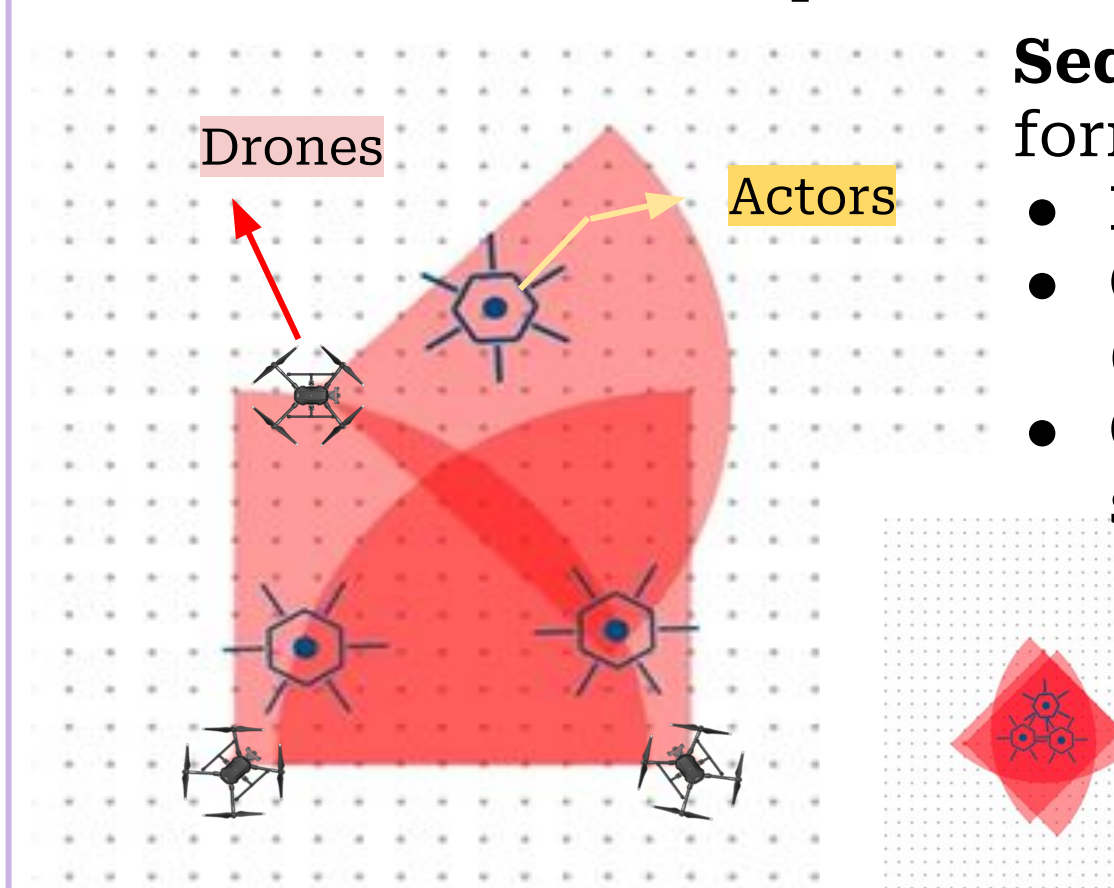
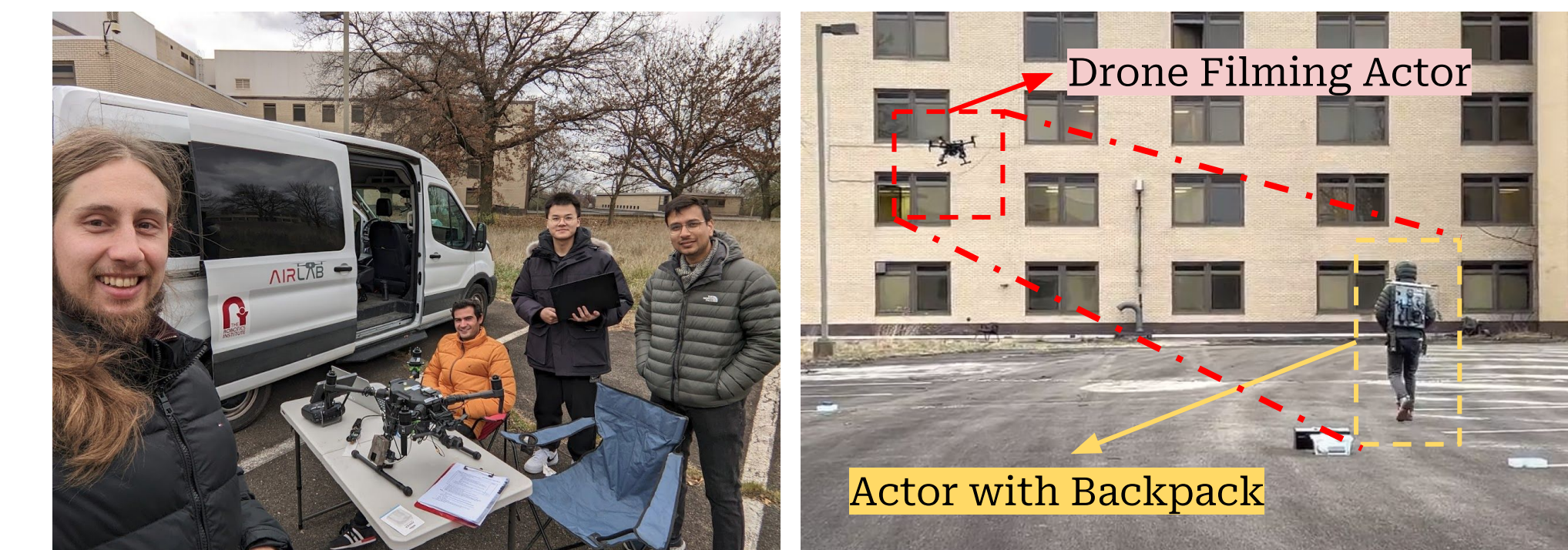
## Goal II: Coordinated filming for reconstruction



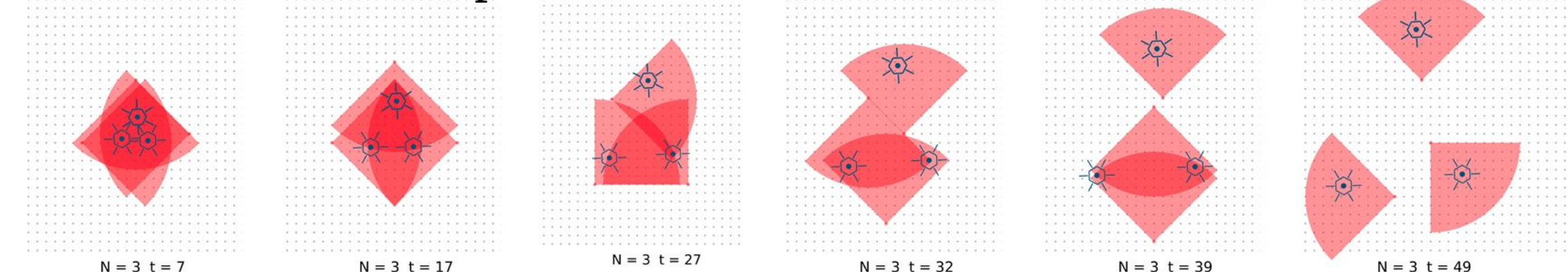
**Field Test System:** Robots track and film actors via a GPS backpack with communication over a mesh network. This setup will enable in-field coordination of 3-4 drones filming up to 3 people.



**Environment Map:** Pre-existing map will enable GPS-based navigation and filming in cluttered test environment



- Sequential planning:** Optimizes view quality with changing formations.
- **Diverse views:** Maximize sum square-root pixel density (PPA).
  - **Optimized trajectories:** Individual planning via value iteration (single pass).
  - **Coordinated robots:** Jointly optimize views & trajectories via submodular optimization methods.



Corah, M. and Scherer, S. "On Performance Impacts of Coordination via Submodular Maximization for Multi-Robot Perception Planning and the Dynamics of Target Coverage and Cinematography." *RSS Workshop on Envisioning an Infrastructure for Multi-Robot and Collaborative Autonomy Testing and Evaluation (2022)*.  
C. Ho, A. Jong, H. Freeman, R. Rao, R. Bonatti and S. Scherer, "3D Human Reconstruction in the Wild with Collaborative Aerial Cameras." *International Conference on Intelligent Robots and Systems (2021)*.

## Impact



**Biomechanics**  
Accurate and actionable biomechanical data



**Animal Studies**  
Large-scale tool for understanding group behaviors



**Entertainment/Cultural Preservation/VR** – infinite views of unscripted scenes



**Robotics/AI** – massive high-quality data for learning-based models