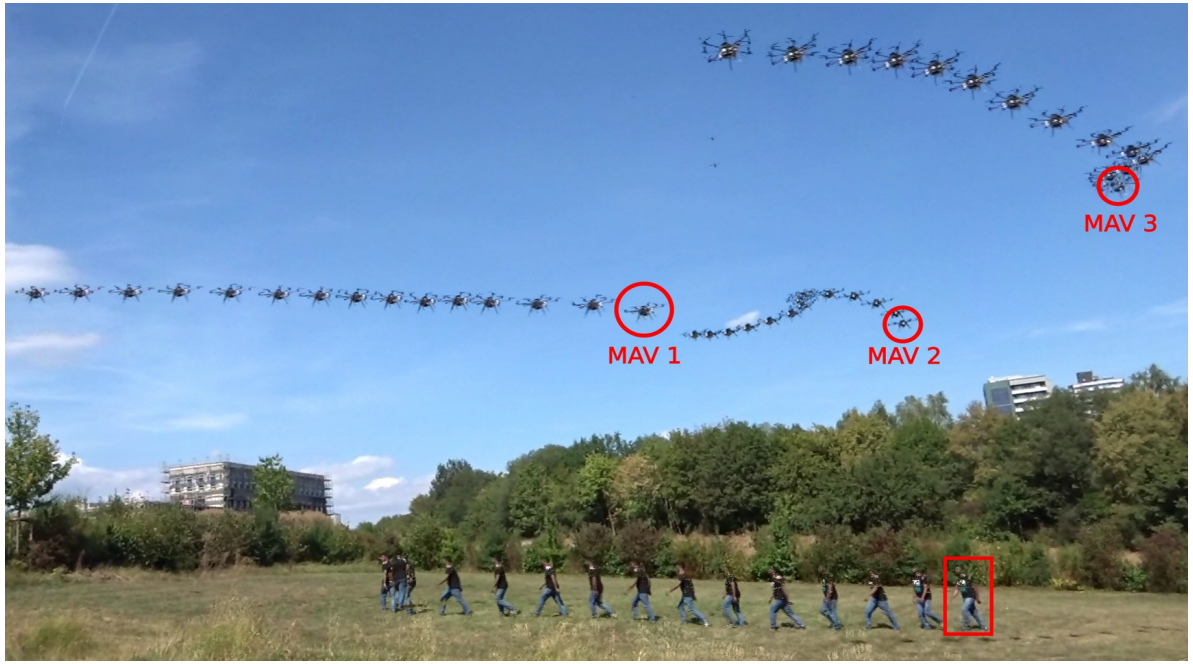
AirCap – Aerial Outdoor Motion Capture



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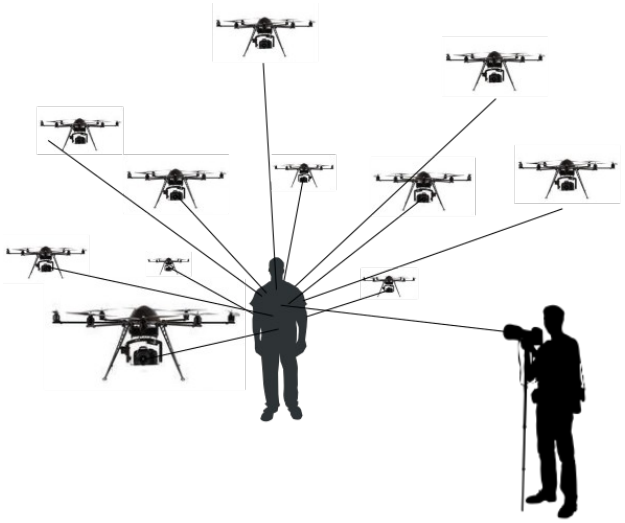
Indoor MoCap: 4D Scanners

- 22 stereo camera pairs
- 22 full color cameras
- pattern projectors

- 60 meshes per second
- 150k points per mesh
- ~(1.5m)² scan platform

Can we do human MoCap in outdoor scenarios?

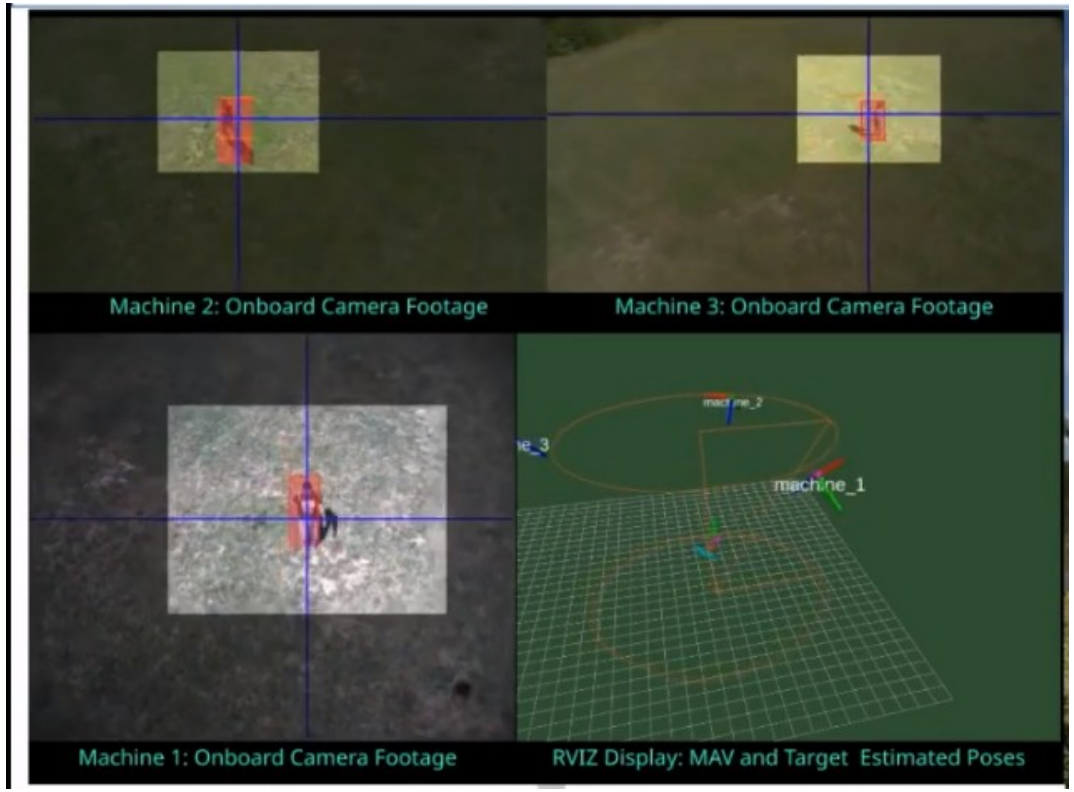


- A team of flying robots.
- Cameras mounted on each robot.
- Robots follow the subject.
- Robot formation covers all important viewpoints.

Goal

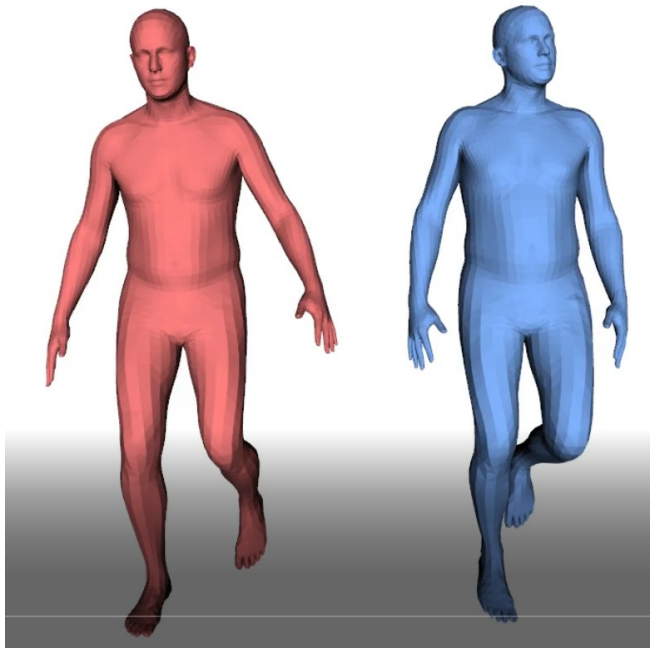
Online and On-board person position estimation and multi-robot formation control

MoCap Front-end



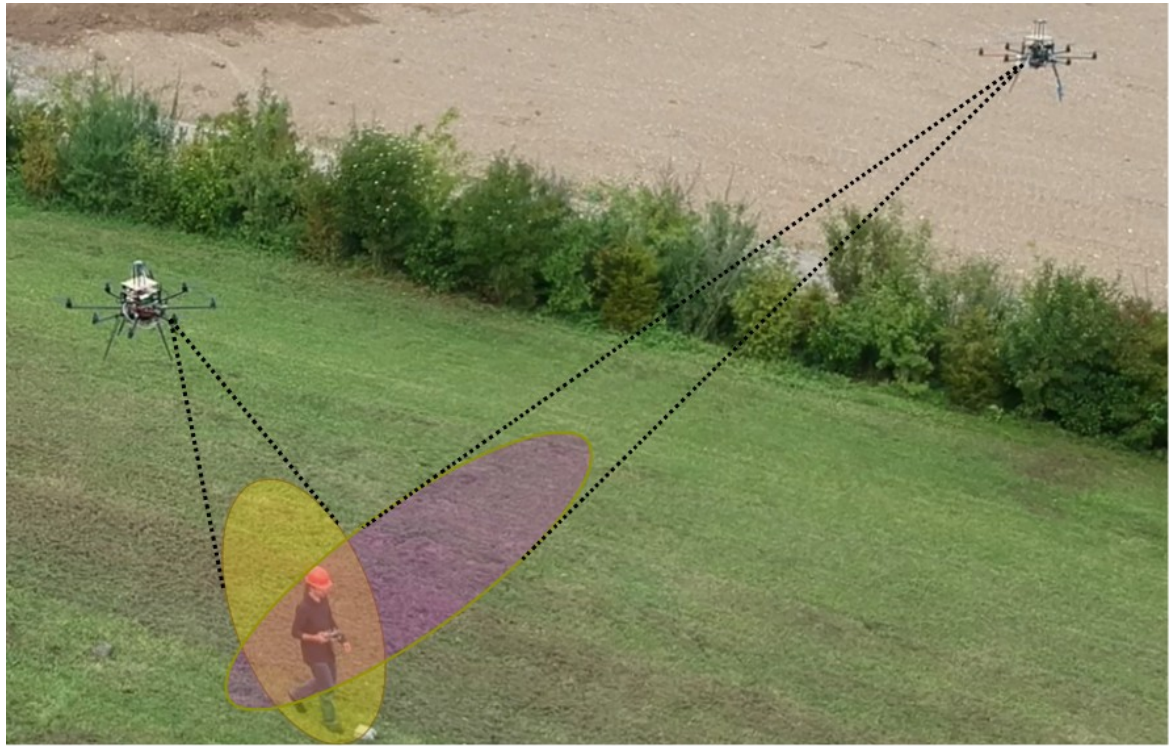
Offline pose and shape estimation from multiple aerial videos

MoCap Back-end



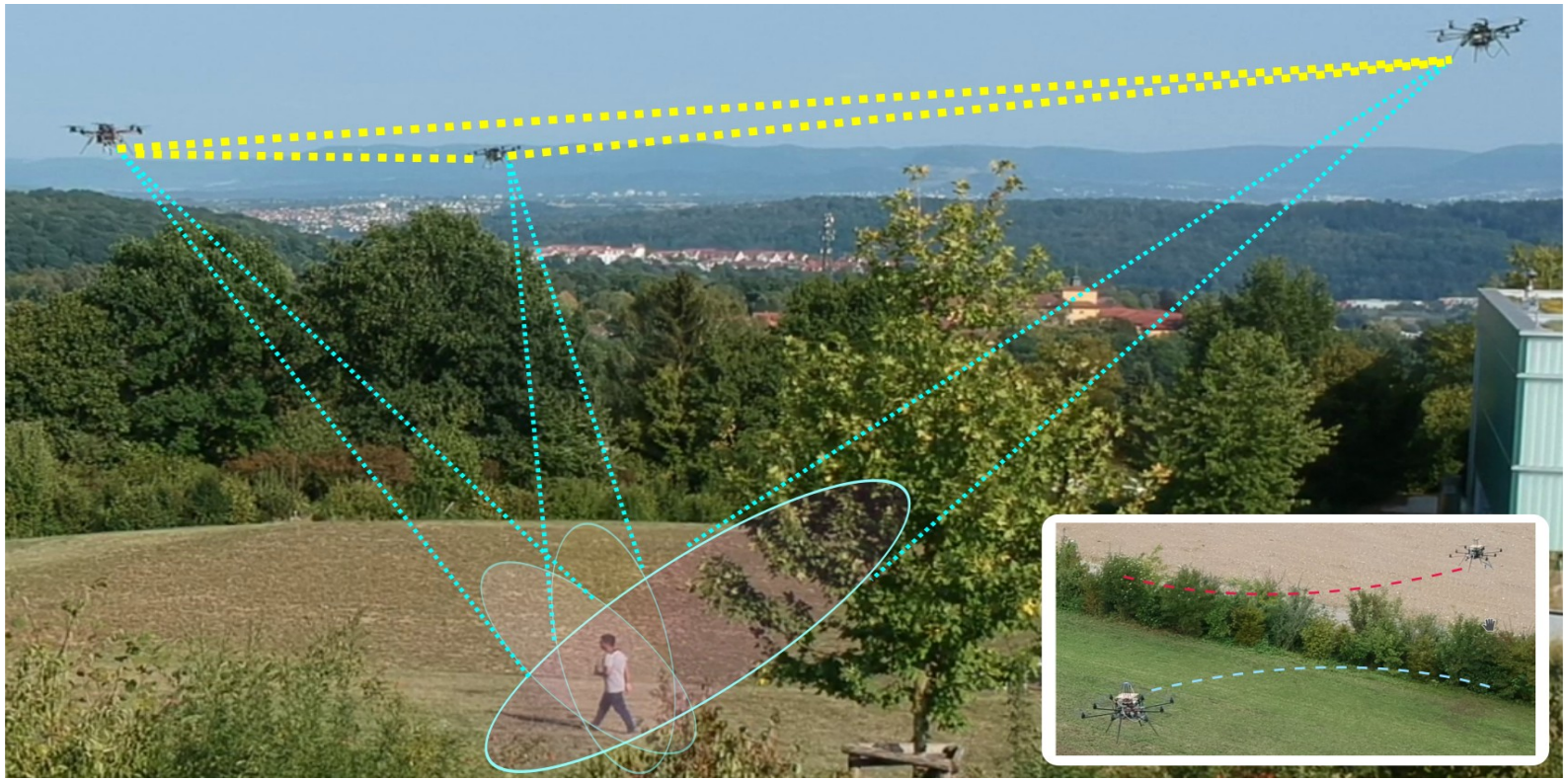
Outdoor MoCap using UAVs – Research Challenges

- Real-time performance
- Detect and track people
- Self-localization
- Multi-robot Information fusion
- Inter-robot collision avoidance
- Obstacle detection and avoidance
- Formation control



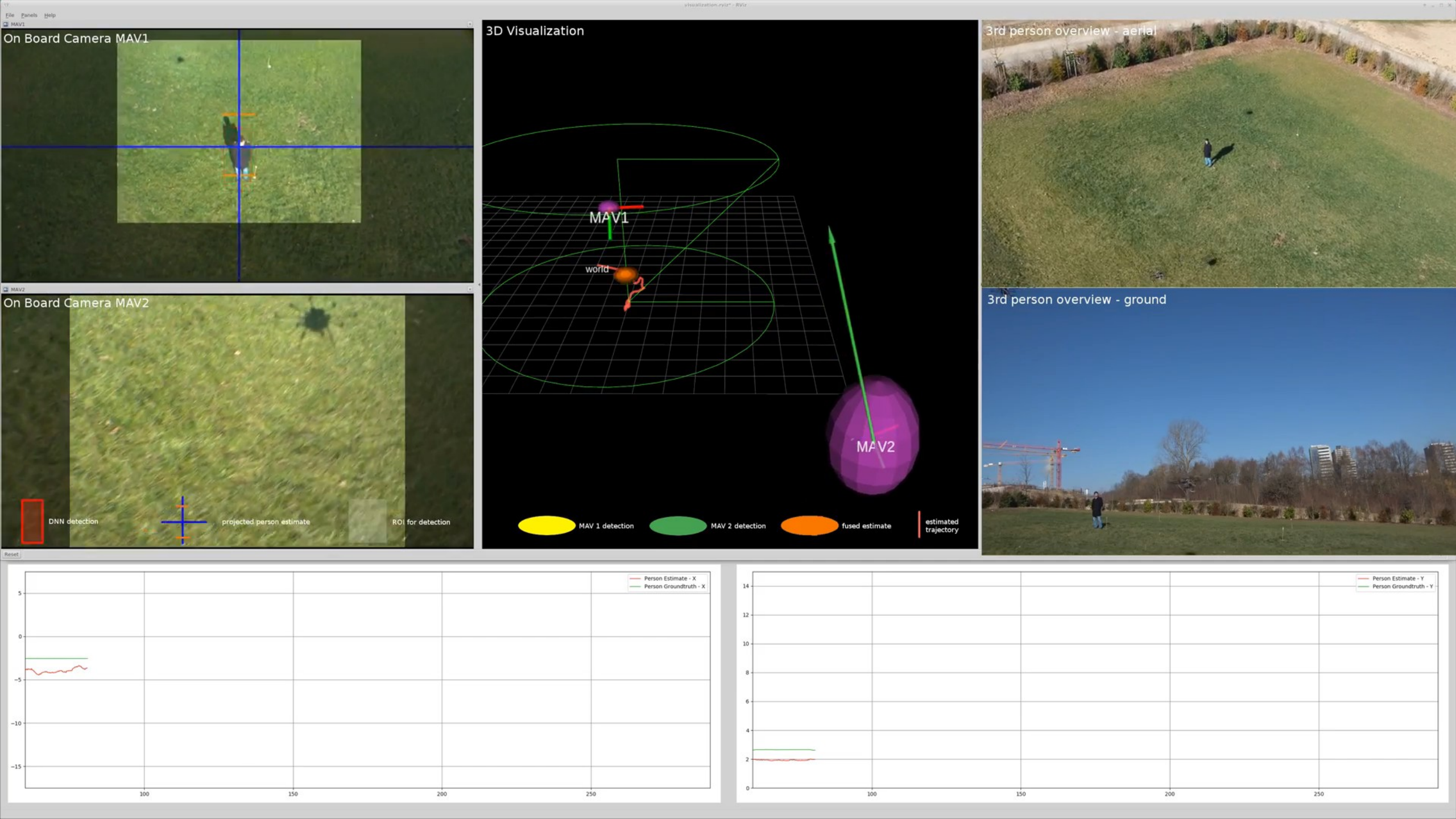
AirCap: Perception-Based Control

- Autonomous cooperative detection, tracking and following.
- Active perception-based formation of MAVs:
  - Minimizes uncertainty in the fused person position estimate.
  - On-board processing, no markers on the human, no pre-specified formation geometry.



[1] R. Tallamraju et al., "Active Perception based Formation Control for Multiple Aerial Vehicles," in IEEE Robotics and Automation Letters. 2019.

[2] E. Price et al., "Deep Neural Network-Based Cooperative Visual Tracking Through Multiple Micro Aerial Vehicles," in IEEE Robotics and Automation Letters (and IROS). 2018.


File Panels Help
MAV1
On Board Camera MAV1
MAV2
On Board Camera MAV2
DNN detection
projected person estimate
ROI for detection
Reset
3D Visualization
MAV1
world
MAV2
MAV 1 detection
MAV 2 detection
fused estimate
estimated trajectory
3rd person overview - aerial
3rd person overview - ground
Person Estimate - X
Person Groundtruth - X
Person Estimate - Y
Person Groundtruth - Y

Simulation Experiments in Gazebo

In the next clip we showcase the results

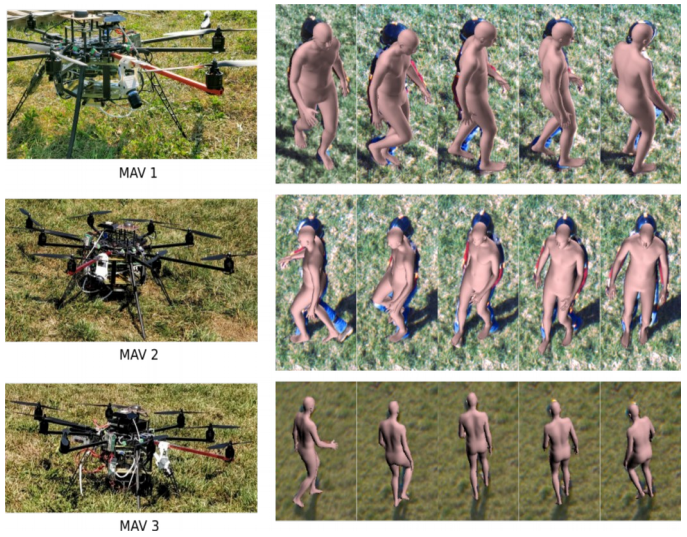
of our proposed approach using

8 simulated AscTec Firefly MAVs

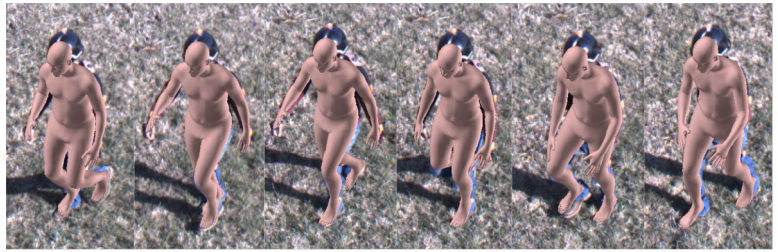
- autonomously maintaining an optimal perception-driven formation,
- avoiding multiple static obstacles (trees) and teammates,
- while cooperatively tracking a person walking on an uneven terrain.

AirCap: 3D Markerless Outdoor Human Motion Capture

3D pose and shape overlaid on an external camera view



3D pose and shape overlaid on MAV camera images



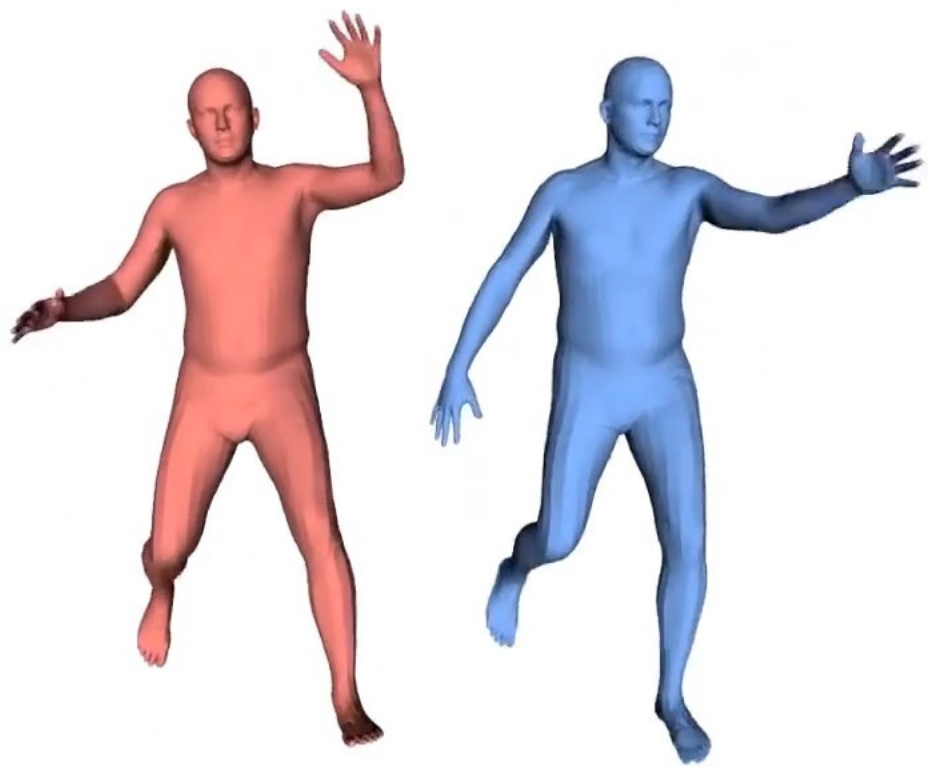
walking sequence

exercise sequence

[3] N. Saini et al., "Markerless Outdoor Human Motion Capture Using Multiple Autonomous Micro Aerial Vehicles," in International Conference on Computer Vision (ICCV), 2019.

Ours

Reference




Manual takeoffs for safety

Thank You