Practical Course: Vision-based Navigation Winter Term 2015/2016

Projects

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1. Launching MAV from Arbitrary Initial Condition

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- Control UAV to achieve stable hovering from any initial condition with onboard sensors

- Possible approach:
  - Nanocopters
  - Test control with Motion Capture
  - Use IMU to stabilize orientation
  - Use Camera/Mocap to stabilize position

2. MAV Formation Flight

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- Follow a leading MAV at a fixed relative pose

- Possible approach:
  - Do all computations on a base station PC
  - Detect visual markers to track current robot pose
  - Apply EKF filtering of relative leader MAV pose from
    - Controls of both MAVs
    - Visual Marker Pose
  - Control other UAVs to maintain a fixed relative pose to the leader
  - Joystick Control of Leader
  - Optional: Add some Choreography

3. MAV Ball Manipulation

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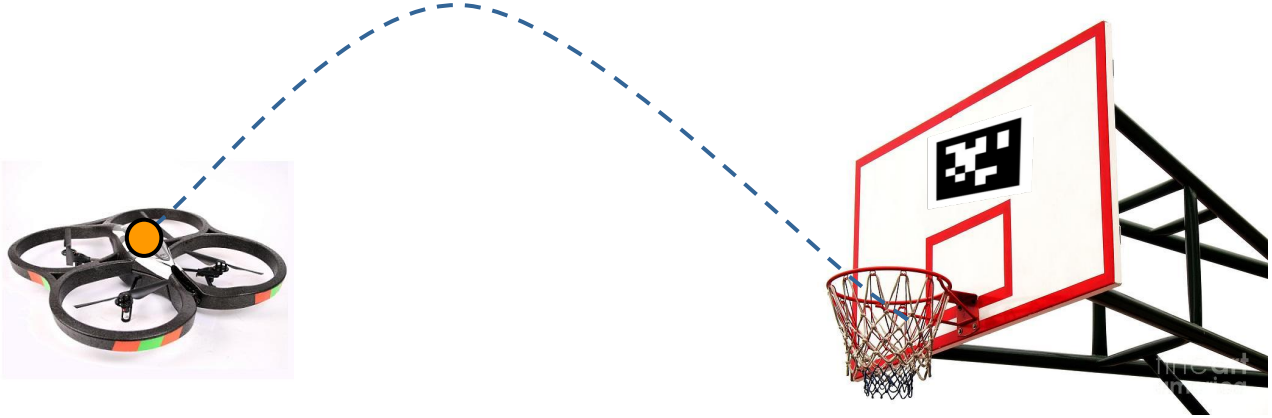

- Throw a ping-pong ball mounted on the top of the drone into the basket.
- Localize and track robot pose using a marker placed on the basket
- Compute a drone trajectory that will provide a proper initial velocity for the ball
- Optionally: track the ball flight using onboard camera
- Optionally: use machine learning to improve results

4. Person following

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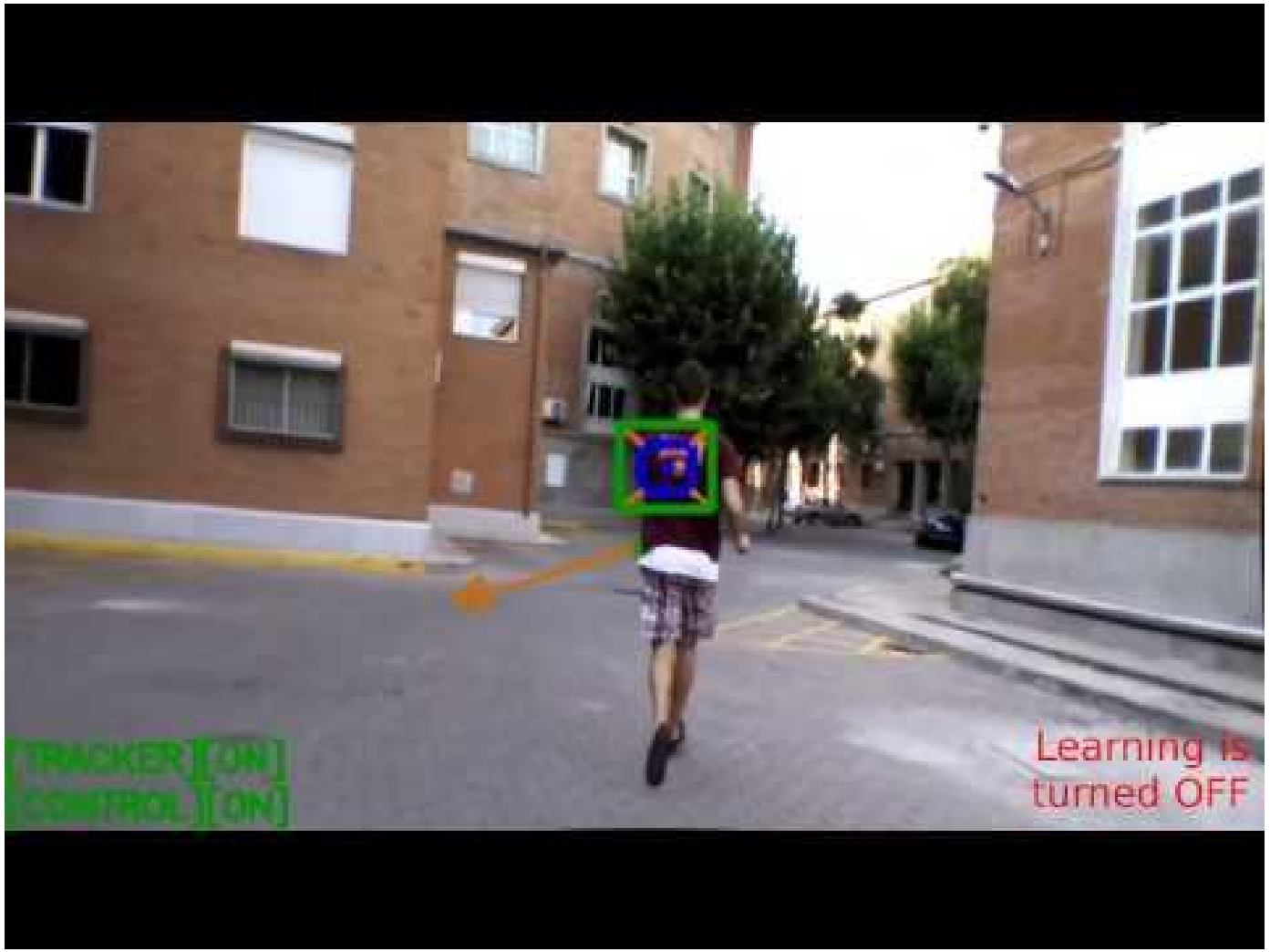

4. Person following

- Follow a person with a quadcopter with onboard camera
- Try different options for human detection:
  - Track bright color T-shirt with blob-detector
  - Track T-shirt with markers
  - Track high texture T-shirt with keypoints detection
- Evaluate the stability of tracking
- Implement several flight modes.

5. Inspection with MAV

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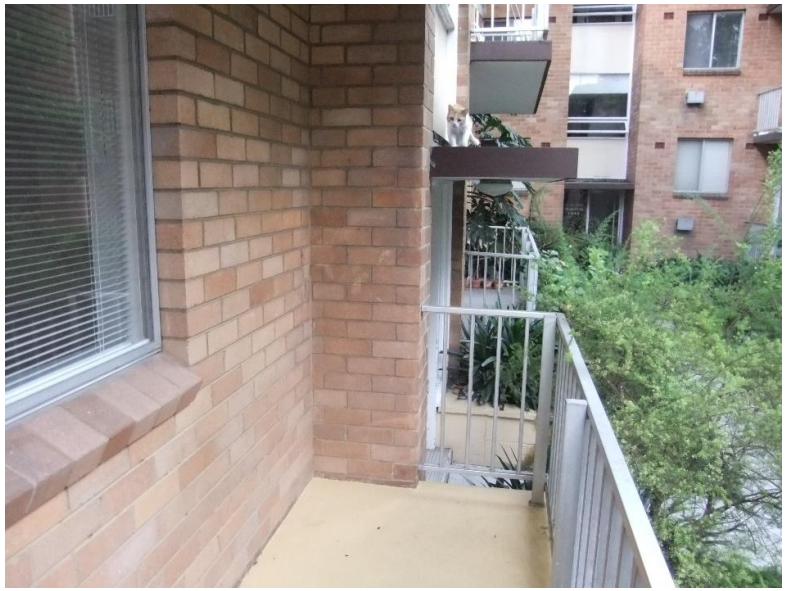
- Idea:
  Assuming state estimation of the MAV is good enough design an interface for inspection tasks.

- Possible approach (Indoors):
  - Interface to visualize information from the drone
  - Tools to make the control easier (stick to surface, ...)
  - Inspection path planning, revisiting teached poses

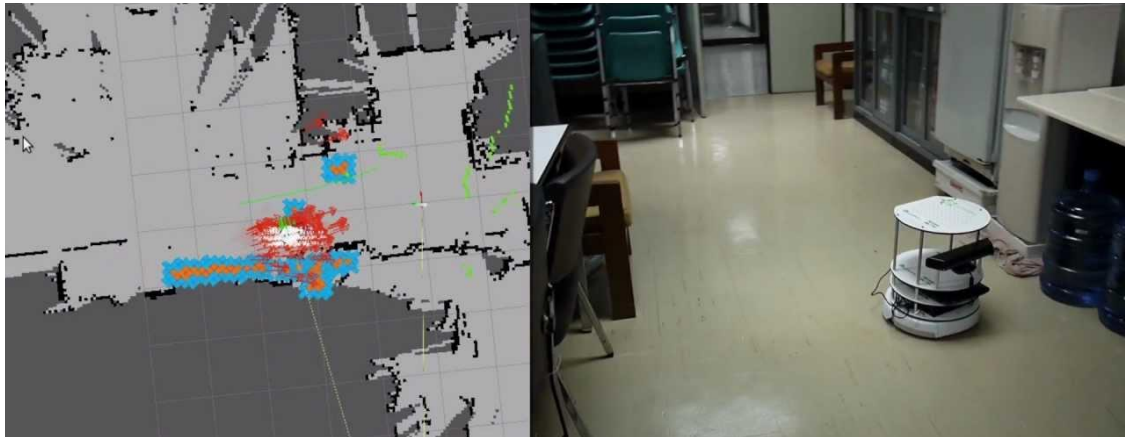
6. MAV Navigation to Photo-Goal

- Idea:
  Direct where your ordered packet should be delivered to by taking a photo of the goal location..



- Possible approach (Indoors!):
  - Direct image alignment for tracking
  - Simplifications to start with:
    - Take a RGB-D photo at goal pose
    - Start from a nearby view
    - Control MAV to align with photo
  - Make gradually more difficult
    - Take RGB-D photos of a whole path to follow

7. Turtlebot Mapping using Omnidirectional Cameras



- Drive to a predefined goal pose relative to the start location, but avoid obstacles

- Possible approach:
  - Use RGBD-SLAM for localization
  - Potential field based control to drive towards goal
  - Avoid closest obstacle in the dense depth map

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Questions ?