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Indoor Autonomous Navigation of Low-Cost MAVs Using Landmarks and 3D Perception

Ludovic APVRILLE[1], Jean-Luc DUGELAY[2], Benjamin RANFT[3]

1. Institut Mines-Telecom, Telecom ParisTech, CNRS/LTCI - Sophia Antipolis, France
2. EURECOM - Sophia-Antipolis, France
3. FZI Research Center for Information Technology, Karlsruhe, GERMANY

Context

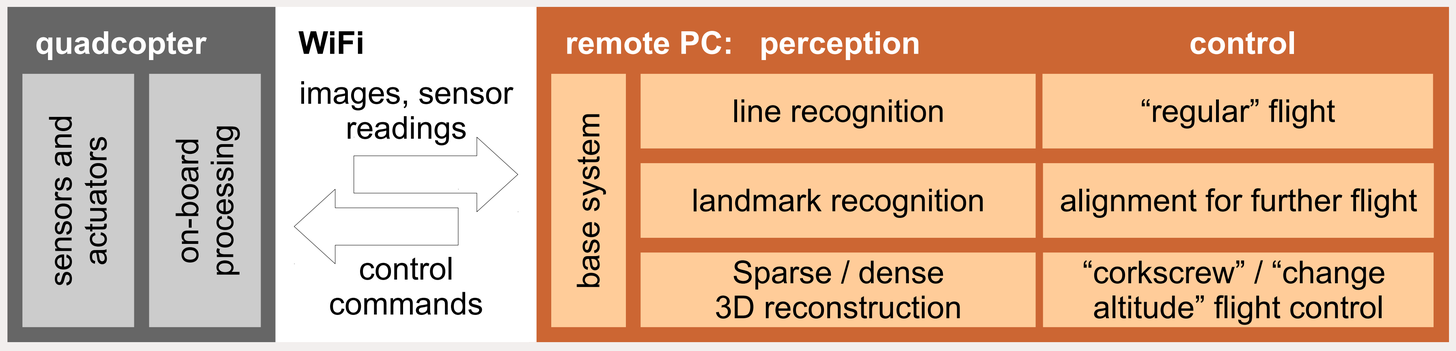
Autonomous navigation of inexpensive drones

- Parrot AR.2 Drone, around 300 euros
- Indoor navigation (NO GPS signal), bottom/front cameras

Navigation techniques:

- Following a colored line places on the floor
- Identifying landmarks located at crossings
- Capture the environment in 3D, with no 3D sensor

System Architecture = Mini Drone + Remote Computer



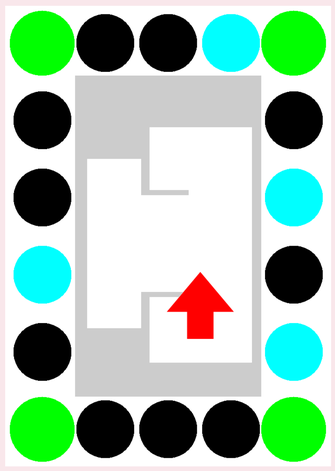
Contact

Video

Following a Line

- Use of the bottom camera
- Line following is used in "difficult" environments, typically in a narrow corridor

Landmark Recognition



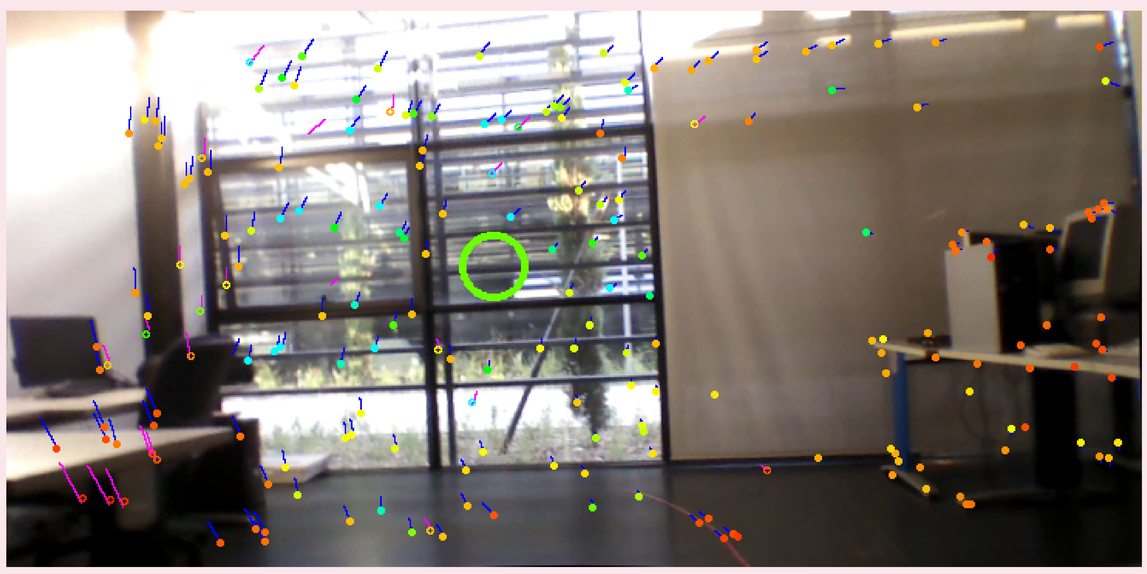
Landmark

Recognized landmark just before re-orientation

Sparse 3D

Spatial locations of a few hundreds of distinct image points whose difference is obtained with a **corkscrew flight**

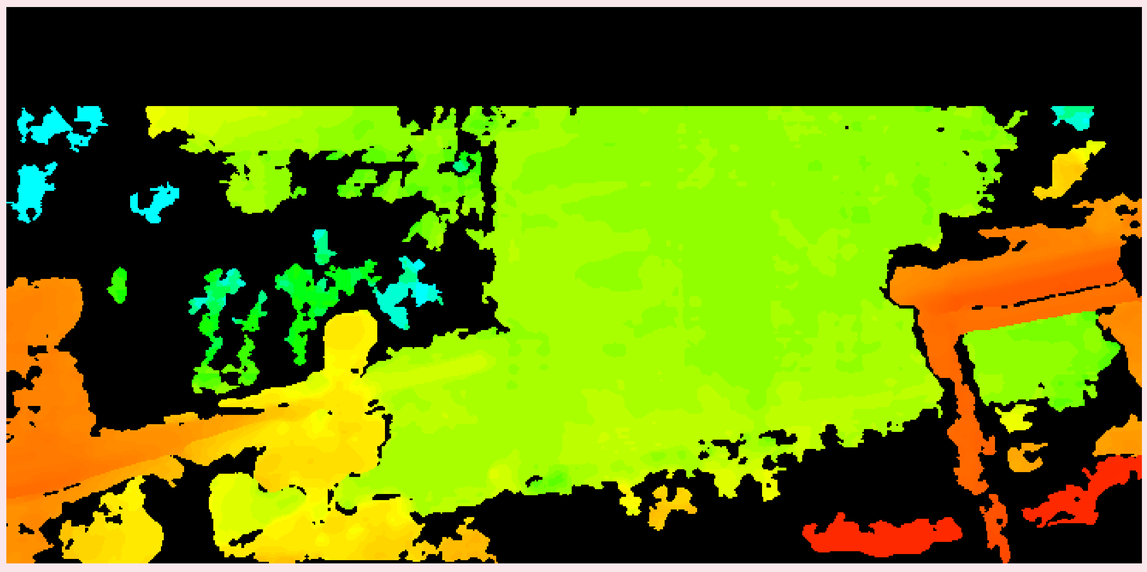
- Blue/purple lines → optical flow vectors consistent/conflicting with the camera's motion
- Points → longitudinal distance (red = 1m, cyan = 10m and above)
- Green circle → target flight direction



Imperfect sparse 3D reconstructions: A path through a window is planned because of too few correspondences

Dense 3D

Estimated distance for most pixels of images ... But: exclusive flight control with **change in altitude to create a 3D vision**



Dense 3D reconstruction results: The overlayed rectified images before and after the height change illustrate the precision of the estimated camera motion (left). Therefore, any standard implementation for distance reconstruction may be used without modification (right).

https://www.youtube.com/watch?v=tamYpmGvzRw Contacts: ludovic.apvrille@telecom-paristech.fr dugelay@eurecom.fr ranft@fzi.de