myCopter
newsletter #3

This is the third newsletter for the project myCopter, funded by the European Union under the 7th Framework Program.

Second progress meeting

Project members at the meeting in Lausanne. Image: Felix Schill, EPFL.

The second progress meeting for the project took place on the campus of the École Polytechnique Fédérale Technique de Lausanne (EPFL) in Lausanne, Switzerland. All partners reported on their progress, and we discussed plans for further collaborations. With all partners in a single place we could align goals and interactions for the coming months, but also focus our work towards the final goals of our project. Naturally, the two research labs at EPFL, the Computer-Vision Lab and the Laboratory of Intelligent Systems, gave demonstrations of their work. New computer vision algorithms and several flying robots were showcased to give all partners an impression of the capabilities of these technologies.

Scientific progress

After 18 months into the project, multiple experiments have been performed and several technologies have been implemented. We present some highlights below.

Generic PAV model implemented in simulators

The University of Liverpool has upgraded the generic model for PAV dynamic behaviour to include new and more sophisticated vehicle response types. As each of these response types are best suited to certain types of tasks in certain parts of the flight envelope, a hybrid response type has been developed that automatically provides the optimum response type to the pilot depending on the flight condition.

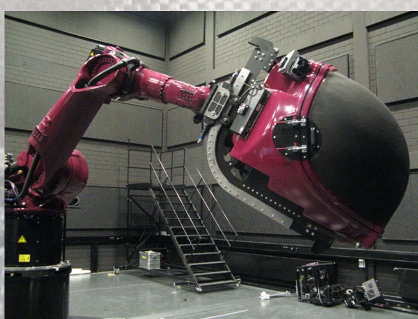
The generic PAV model has been evaluated in various tasks with experienced test pilots on the Heliflight-R simulator at the University of Liverpool (see a video of this work on our website). The hybrid response type indeed provided the best handling qualities, but that these are not yet sufficiently refined to allow non-professional pilots to safely control a PAV. Discussions with the test pilots revealed useful insight into how this may be achieved, and these modifications will be implemented in the next iteration of the model.

The generic PAV model has also been implemented on the research simulators at the Max Planck Institute for Biological Cybernetics and the German Aerospace Center DLR. The model is used for experimental evaluations for novel human-machine interfaces and piloted assessments on the Flying Helicopter Simulator.

Navigation framework for small aerial vehicles

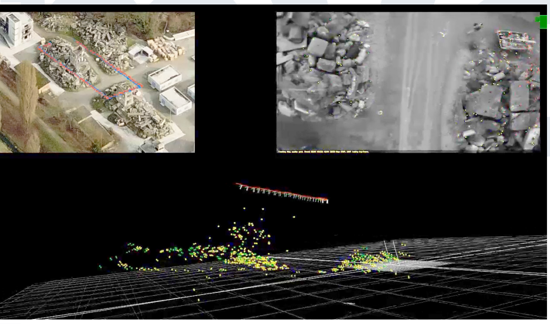
Current out-of-the-box solutions for navigation lack the robustness and flexibility for leaving a controlled laboratory environment and perform navigation with small aerial vehicles. Truly autonomous flight in general environments is not possible without reliance on unrealistic assumptions such as uninterrupted GPS signals, perfect communication links to a ground station for data processing and control, or pose measurements from external motion capture systems. Higher level tasks, such as autonomous exploration, swarm operation and large trajectory planning, can only be tackled after solving such issues.

Computer vision techniques are commonly used in research for real-time tracking and navigation. High-performing stereo-based systems have demonstrated successful operation on ground vehicles. However, stereo setups are unsuitable for navigation with small aerial vehicles as the stereo image essentially reduces to a monocular image when the scene is viewed from a large distance or from close by (e.g., during landing). Hence we focus our study around



The generic PAV model has been implemented on different simulators. Images: University of Liverpool, MPI for Biological Cybernetics, DLR.

monocular based methodologies. We have implemented a high-performance parallel tracking and mapping system to achieve monocular self-localisation and mapping on board of a small aerial vehicle. Due to the long trajectories that are flown, the high dynamics of the motion of the vehicle, and dynamic objects in the scene, we use additional sensors including an Inertial Measurement Unit featuring accelerometers and gyroscopes, a magnetometer, airpressure data, and GPS information where available.



Vision-based flight with an unmanned aerial vehicle. Image: ETHZ

The framework that we have developed is publically available at http://www.asl.ethz.ch/research/software. The packages *ethzasl_ptam*, *ethzasl_sensor_fusion*, and *asctec_mav_framework* have been developed partially in the myCopter project. A video showing a test flight using this framework can be found on our website.

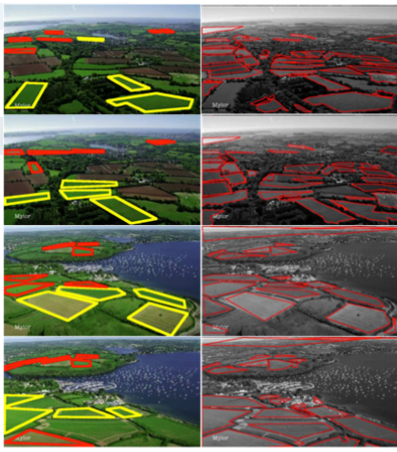
Lightweight and low-cost quadcopter

After a review of sensortechnologies for collision avoidance and flocking strategies, the proposed radar modules will be used in real-world evaluations of these strategies with small unmanned vehicles. A light-weight and low-cost quadrotor has been developed to perform the flocking and collision avoidance experiments. Ten of such platforms are being build, which will be used as flying obstacles that a highly-instrumented vehicle will have to avoid.

Vision-based flight with an unmanned aerial vehicle. Image: Felix Shill, EPFC

Vision algorithms for landing place selection and assessment

Currently, automatic landing systems heavily rely on beacons and systems on the ground to determine the path towards a landing spot. In the myCopter project we are developing vision algorithms that can perform robust and real-time automated landing place assessment in man-made environments. With our approach, landing sites are assessed as featureless, but regularly shaped, areas in the image that typically characterise man-made landing structures. Examples include prepared landing surfaces such as runways and landing pads, as well as unprepared ones, including grass fields, dirt strips and building rooftops. We have developed a novel image segmentation and shape regularity measure that is demonstrated in a video.



(left) Pilot annotations with yellow polygons signifying top 4 areas to land, (right) areas to land as detected by our monocular vision-based approach. Image: EPFL

Conferences

- European Rotorcraft Forum 2012, Amsterdam, Netherlands
- International Conference on Robotics and Automation 2012, St Paul, Minnisota, USA
- International Conference on Intelligent Robotics and Systems 2012, Vilamoura, Portugal
- Robotics Science and Systems 2012, Sydney, Australia
- International Conference on Human-Computer Interaction in Aerospace 2012, Brussels, Belgium
- European Conference on Visual Perception 2012, Alghero, Italy
- HELI World 2012, Frankfurt am Main, Germany

Publications related to these conferences can be found on our website.

In the press

The myCopter project has featured in more than 50 news articles, such as in BBC Future website. An overview is given on our website. And the number of subscribers to our newsletter has surpassed 210 people, ranging from private persons to industry representatives.

Upcoming mid-term review meeting

The myCopter partners are currently preparing for the mid-term review meeting that is to be held at the Karlsruher Institute für Technologie in Karlsruhe, Germany. After two years into the project, we will evaluate developments in all workpackages and start preparations for the implementation of technologies into the Flying Helicopter Simulator (FHS). The FHS will be used to demonstrate selected technologies at the end of our project.

Pictures: DLR, myCopter, The University of Liverpool, MPI for Biological Cybernetics, EPFL, ETHZ

http://www.mycopter.eu
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