robotics Swiss National Centre of Competence in Research

News Bulletin

Issue 07

Automatic Re-Initialization and Failure Recovery

With drones becoming more and more popular, safety is a big concern. A critical situation occurs when a drone temporarily loses its GPS position information, which might cause it to crash. This can happen, for instance, when flying close to buildings where GPS signal is lost. In such situations, it is desirable that the drone can rely on fall-back systems and regain stable flight as soon as possible.

A group from the Robotics and Perception Group at UZH and NCCR Robotics have developped a new technology to automatically recover and stabilize a quadrotor from any initial condition. On the one hand, this new technology can allow a quadrotor to be launched by simply tossing it in the air, like a “baseball ball”. On the other hand, it allows a quadrotor to recover back to stable flight after a system failure. Since this technology does not rely on any external infrastructure, such as GPS, it enables the safe use of drones in both indoor and outdoor environments. Thus, our new technology can become relevant for commercial uses of drones, such as parcel delivery.

The quadrotor is equipped with a single camera, an inertial measurement unit, and a distance sensor (Teraranger One). The stabilization system of the quadrotor emulates the visual system and sense of balance within humans. As soon as a toss or a failure situation is detected, the presented computer-vision software analyses the images looking for distinctive landmarks in the environment, which it uses to restore balance.

All the image processing and control runs on a smartphone processor onboard the drone. The onboard sensing and computation renders the drone safe and able to fly unaided. This allows the drone to fulfil its mission without any communication or interaction with the operator.

The recovery procedure consists of multiple stages, in which the quadrotor, first, stabilizes its attitude and altitude, then, re-initializes its visual state-estimation pipeline before stabilizing fully autonomously. To experimentally demonstrate the performance of our system, in the video below we aggressively throw the quadrotor in the air by hand and have it recover and stabilize all by itself. We chose this example as it simulates conditions similar to failure recovery during aggressive flight. Our system was able to recover successfully in several hundred throws in both indoor and outdoor environments.

Video showing the technology at work

References:

M. Faessler, F. Fontana, C. Forster and D. Scaramuzza, "Automatic Re-Initialization and Failure Recovery for Aggressive Flight with a Monocular Vision-Based Quadrotor," In IEEE International Conference on Robotics and Automation (ICRA), Seattle, 2015.

M. Faessler, F. Fontana, C. Forster, E. Mueggler, M. Pizzoli and D. Scaramuzza, "Autonomous, Vision-based Flight and Live Dense 3D Mapping with a Quadrotor Micro Aerial Vehicle," Journal of Field Robotics, 2015.

For further information please refer to:

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A full press pack containing high definition photos and videos is available.

NCCR Robotics

The Swiss National Center of Competence in Robotics (NCCR Robotics) is a federally funded programme bringing together robotics laboratories from EPFL, ETH Zurich, University of Zurich and IDSIA to work on wearable, rescue and educational robots.

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