Overview

The key research area Flying Robots covers several domains of the Robotics and Mechatronics Center – Aeronautics, Space, Robotics, and Optical Information Systems – in order to exploit synergies in the development of robotic technologies for autonomous flying platforms. The spectrum of our work ranges from low-level control and sensor data processing to mission planning and execution. We have been working on general problems for autonomous systems taking into account special issues related to flying platforms and their applications.

In adition to traditional applications focused on aerial sensor data acquisition (photo, film, infrared and multispectral cameras) we intensively work on applications where the flying robots have to interact with the environment physically, for example installation of sensor nodes, taking samples of soil or water in inaccessible areas, and even the assembly of structures. We also work on multi-robot systems, on technologies for a safe landing of flying robots on mobile platforms as well as on HAPS (high altitude pseudo satellites) and solar electrical platforms for long term missions in the stratosphere.

PLANET

www.ec-safemobil-project.eu

www.arcas-projects.eu

www.aeroarms-projects.eu

DLR_Flying_Robots_GB_06/16

DLR at a glance

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. In addition to its own research, as Germany's space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation's largest project management agency.

DLR has approximately 8000 employees at 16 locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Goettingen, Hamburg, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stade, Stuttgart, Trauen, and Weilheim. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

Institute of Robotics and Mechatronics

Konstantin Kondak
Muenchener Strasse 20
82234 Wessling, Germany

Konstantin.Kondak@dlr.de
Phone: +49 815328-1127
Fax: +49 815328-1134

DLR.de/rmc/rm/en

DLR.de/rmc/rm/en

DLR Flying Robots

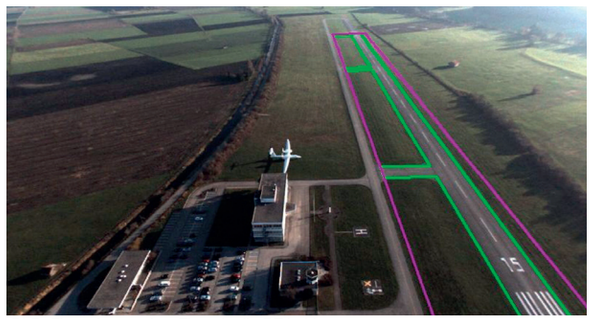
Exploiting robotic technologies for aerial applications

Aerial manipulation

Researchers within the DLR Flying Robots group have integrated an industrial robot arm with seven degrees of freedom into an autonomous double-rotor helicopter platform. The system is intended for automatic deployment and maintenance of mobile service robots with magnetic wheels, which are used for pipeline inspection. Forces acting on the aircraft caused by motion of the arm or gripping contact have to be balanced by flight control. This requires closely coupled control loops of robot arm and helicopter. Similar systems could also be used for inspection and maintenance tasks in areas which are hazardous or otherwise inaccessible for humans.

Vision guided operations

The Flying Robots group is working on vision and sensor fusion algorithms for robust and highly accurate state estimation as well as for autonomous navigation. These methods are applied for instance to runway detection for automatic landing of fixed-wing UAVs and to object detection for aerial manipulation.

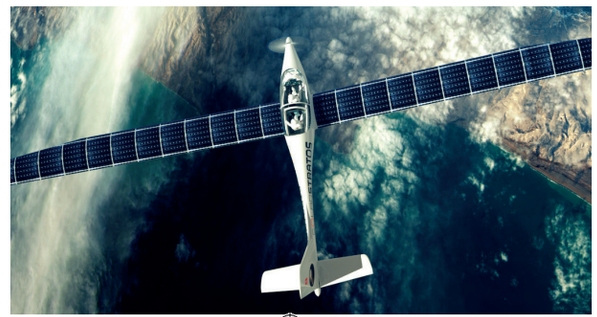


High-altitude platforms

In the near future, high-altitude platforms could extend application fields presently covered by satellites and are therefore often named HAPS, which stands for high-altitude pseudo satellites. Possible applications range from establishing communication networks to long-term recording of weather and environmental data.

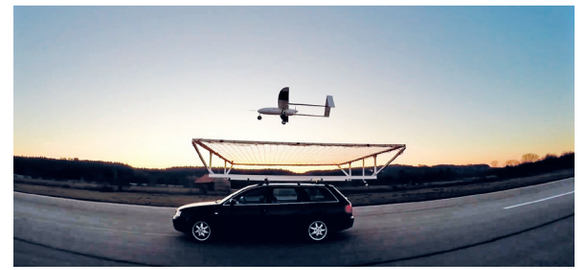
A novel system for transporting scientific payloads to high altitudes was developed and successfully tested by the DLR Flying Robots group. Using a balloon, the High Altitude Balloon Launched Experimental Glider (HABLEG) was brought up to a height of 20 kilometers. After release from the balloon, the aircraft managed to perform the critical transition from free fall to gliding flight. The glider covered a distance of 70 kilometers and autonomously returned to the launch site. In this experiment, all system components could be tested intensively under real world conditions. It marked the first successful experiment of this kind in Europe.

The Flying Robots group is now working in close cooperation with Elektra UAS GmbH and SolarXplorers SA (Solarstratos project) on highly efficient drives, avionics components, as well as payloads and autonomy functionalities for autonomous and optionally piloted solar high-altitude platforms and missions.



Landing on moving platforms

Weight is crucial for long-duration flights of high-altitude platforms. Without the need for a landing gear, the weight of an aerial vehicle can be significantly reduced, which results in extended range and enhanced performance. The DLR Flying Robots group has developed a system that enables a fixed-wing aircraft to land autonomously on a moving ground vehicle and therefore allows for omitting the landing gear. For the first time, this system has been demonstrated using an electrically powered fixed-wing UAV with a take-off weight of 25 kilograms, which performed a gentle landing on the roof of a car travelling at 75 kilometers per hour.



A related research field, which is also investigated within the Flying Robots group, is autonomous landing of UAV helicopters on ship decks, which is a crucial part of marine missions, like ice monitoring, inspection of wind farms, or search for castaways.

Lighter than air UAVs

Due to static lift and low energy consumption, lighter than air UAVs offer great potential for long-endurance missions. Members of the DLR Flying Robots group are working on modeling and control of airships used for establishing long-range communication relays as well as for public and environmental monitoring.