Cooperation Concepts for Autonomous Ground and Aircraft Vehicles for Exploration and Surveillance

During the last ten years the research group "Real Time Learning Systems" (EZLS) led by Prof. Kuhnert has been working very successfully in the field of autonomous robotics for unstructured outdoor scenarios. In the last three years the ground based robots with which the research started have been supplemented by aerial vehicles of different sizes.

The intention of this study was to research groups of heterogeneous, autonomous ground and aerial vehicles equipped with sensors of different types. An important topic of the study was to investigate the distributed retrieval, processing and fusion of information. This was done for a military sample application. In a convoy and reconnaissance scenario two unmanned aerial vehicles (UAVs) are providing high resolution images of points or areas of interest. During the mission the group autonomously also coordinates its moves e.g. by following an autonomous ground vehicle(AGV). During the whole flight the UAVs were transmitting live imagery to a ground station and to the AGV.

The base for the UAVs was the MD4-1000 from the company "microdrones". These systems were modified and equipped by EZLS to achieve the necessary autonomous and sensoric functions. An additional embedded computer was integrated which connects to the original flight control systems and the 15 mega pixel camera system. This computer is able to communicate with other UAVs and AGVs via WIFI.
EZLS has provided a software package that allows autonomous coordinated flight operations, implements a collision avoidance technique and is also responsible for camera control and transmission of high resolution images and live videos.
This study was done in cooperation with the University of Hannover (AGV) and Fraunhofer FKIE. The interfaces to the systems of these partners were implemented using the robot operating system ROS.
A successful demonstration at the area of FKIE in March 2012 showed that the solutions developed in this study are fully functional.

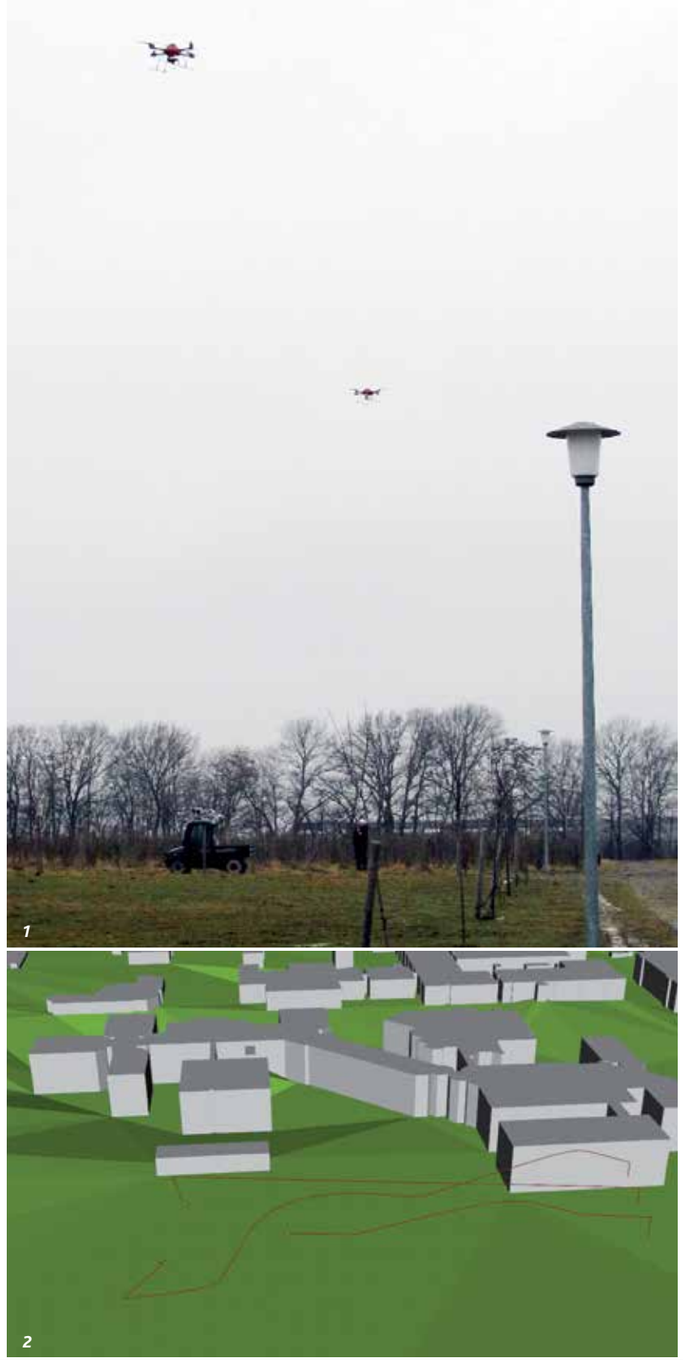

Fig. 1
Fully autonomous surveilance mission of two aerial robots and one ground robot.

Fig. 2
3D Simulation for path planning and execution of a group of 3 aerial robots exploring one spot.

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