

**„SpecDrone“ -
Präzisionsgesteuerte Drohnen
im Paarflug zur mobilen
spektroskopischen
Methandetektion im offenen
Pfad**

Program:

FFG Take Off - Klimaneutrale Urban
Air Mobility Ausschreibung 2022

Duration: 11/2023 - 10/2025



NEW MEASUREMENT APPLICATIONS FOR DRONES THROUGH PRECISION PAIR FLIGHT

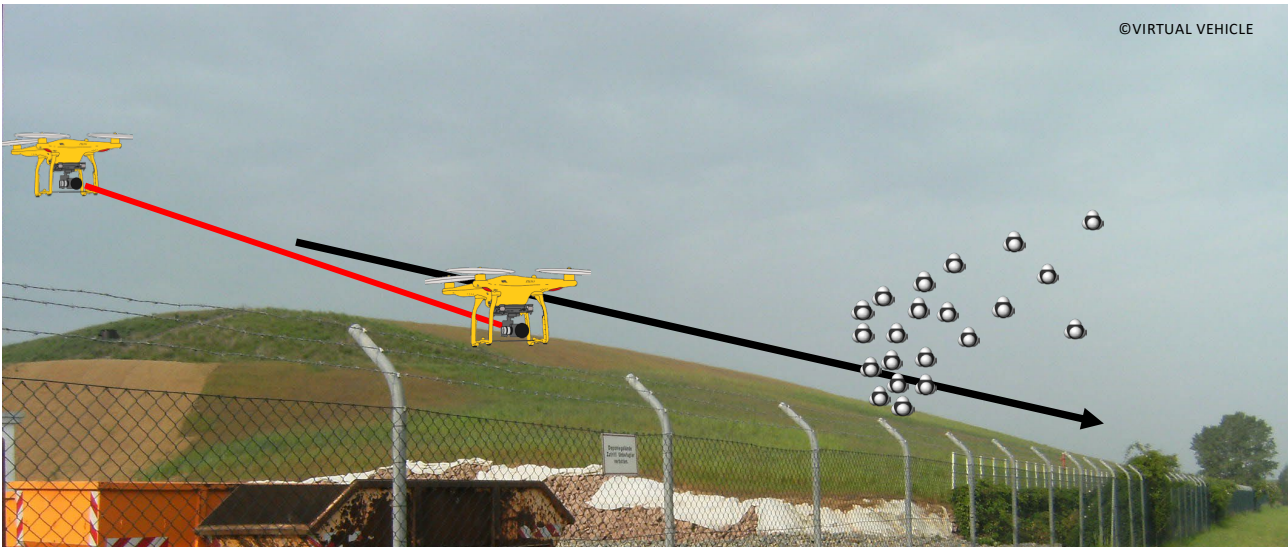
THE COMBINATION OF A PRECISLY OPERATED PAIR OF DRONES AND OPEN PATH SPECTROSCOPY ENABLES A NEW APPLICATION FIELDS FOR ENVIRONMENTAL GAS SENSING

The development of unmanned aerial systems (drones) has progressed rapidly in recent years and is one of the fastest growing technology sectors of the decade. Drones as mobile sensor platforms have revolutionized the application fields for measurement tasks. In addition to camera-based systems for inspection and surveillance, optical sensor technologies are frequently used for environmental monitoring.

Using spectroscopic methods, harmful gases can be detected with a single drone instrumented with a point sensor and manually or automatically searching for emission sources. One of the most investigated gas components worldwide is methane, which is the second largest contributor to the greenhouse effect

next to CO₂. Methane emissions have versatile sources, with the largest contributions coming from the oil and gas industry and landfills. Identifying and assessing the sources requires the study of large areas, which is very inefficient to accomplish with point sensors. By using open path spectroscopy, where a beam of light is stretched over longer distances (~50m) between the light source and detector, the gases of interest can be detected along the path. This technology is commonly used for fixed installation systems.

The project goal is to expand the applications of drones by improving flight precision and



implementing swarm algorithms for cooperative control and orientation of drones.

Impacts and Effects

These developments enable the use of gas sensors based on open-path spectroscopy to effectively scan large areas like landfills for methane emission sources.

The fusion of precise pair flight of two drones and open-path spectroscopy expands the range of applications, e.g. fire gas detection, the investigation of industrial emissions, or the detection of landmines through the detection of chemical outgassing.

1. Flight precision and stabilization

The drone platform twinFOLD KAT from the project partner twins GmbH is the basis for the integration of the sensor system. The UAV has been adapted to integrate a Gimbal stabilization system, the sensor system as well as all communication interfaces and electronics. FH Kufstein implemented the pair flight algorithm based on a leader – follower principle with a continuous communication interface between the drones for smooth position updates. The path planning of the drone pair for efficient scanning of large areas has been proved in a simulation environment by applying self-optimizing planning

algorithms. Hiwitronics fused the pair flight and individual drone maneuver position with the orientation of the Gimbal stabilization platform in a custom control algorithm for maximizing the aiming precision of the optical sensor and hence improving the active line-of-sight signal of the light path between the drones.

2. Sensor Technology

VIRTUAL VEHICLE (project coordinator) developed the mobile methane detector embedded in the drone platform. The open path optical sensor system is based on tunable diode laser absorption spectroscopy (TDLAS) in the near infrared spectral region. The biggest challenges within the development process were the miniaturization and lightweight design of the system as well as the ambitious signal processing due to vibrations on the drones. The detector is designed for a path distance of 50m with a detection limit of 10 ppm*m.

3. Results

The project objectives were successfully demonstrated in a real-world measurement demonstration in which a predefined methane leakage was identified.



The TDLAS technology developed as part of the project has important strategic impact for VIRTUAL VEHICLE. It is significant because it opens up various new applications for mobile drone measurement tasks and can be transferred to other areas such as battery safety for the rapid in-situ gas measurement of harmful combustion gases in the

event of thermal runaway failure. In addition, the technology can be adapted for contactless high-speed gas temperature measurement.

SpecDrone initiated a successful collaboration within the drone community and new partnerships with twins GmbH, FH Kufstein and Hiwitronics.

Project Coordination (Story)

Bernhard Fischbacher, Dr.
Lead Researcher
Virtual Vehicle Research GmbH
T +43 (0) 316 873 9815
bernhard.fischbacher@v2c2.at

Virtual Vehicle Research GmbH

Inffeldgasse 21A
8010 Graz
T +43 316 873 9001
office@v2c2.at
www.virtual-vehicle.at

Project Partners

- twins GmbH
- Hiwitronics
- FH Kufstein

This success story was provided by the center management/consortium management and by the mentioned project partners for the purpose of being published on the FFG website. Virtual Vehicle Research GmbH is funded within the COMET K2 Competence Centers for Excellent Technologies by the Austrian Federal Ministry for Innovation, Mobility and Infrastructure (BMIMI), Austrian Federal Ministry for Economy, Energy and Tourism (BMWET), the Province of Styria (Dept. 12) and the Styrian Business Promotion Agency (SFG). The Austrian Research Promotion Agency (FFG) has been authorised for the programme management. The COMET Programme is managed by FFG. Further information on COMET: www.ffg.at/comet

Virtual Vehicle Research GmbH would also like to thank the supporting industrial partner Siemens Mobility Austria GmbH and the scientific partner Graz University of Technology - Institute of Railway Engineering and Transport Economy.