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Deploying drones for Gas Detection and Monitoring

ARPAS-UK The UK Drone Association

Catapult Connected Places

Detect gas to enable actionable insight to be obtained for use in planning repairs, upgrades, retrofits, and working policies and procedures on complex industrial facilities.

Benefits

- Detect leaks enabling repairs, upgrades and retrofits to be actioned in a timely manner
- Reduce fugitive emissions supporting the business or organisation to satisfy their permit requirements
- Provide monitoring in areas beyond the reach of ground equipment and satellite imagery.
- Provide evidence to the wider public that gas leaks are being monitored in line with the organisations corporate responsibility and commitments to Net Zero 50.
- Provide quantification for leak rates

Impact

Economic £ £ £ Social

Why does this matter?

The UK has recently signed up to a 30% reduction on 2020 methane levels by 2030. This will require increasing government involvement to support industry to account for site fugitive emissions. The regulator will seek as many tools as it can to ensure these targets are achieved. Drone gas detection, monitoring, and quantification, will play an ever-increasing TDLAS laser role in their emission reduction strategies.

Why drones?

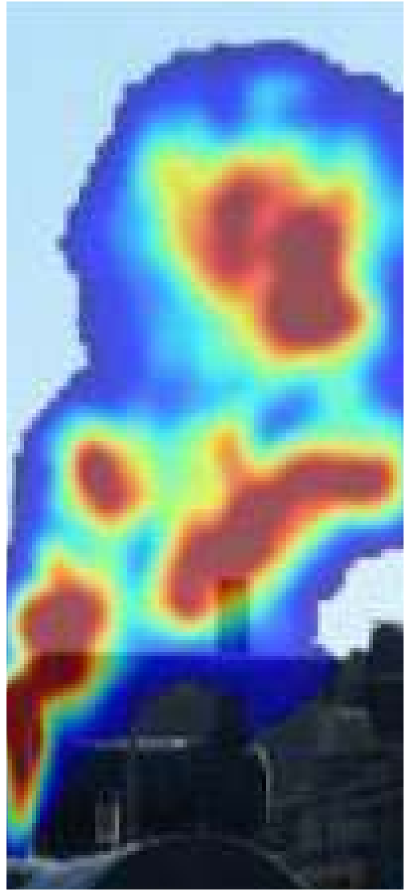
Gas sensors for the detection and monitoring of harmful substances within the environment such as carbon monoxide, carbon dioxide and methane are essential elements of environmental risk assessment. Used in a wide range of industries, processes and applications they touch our everyday lives monitoring toxins found in landfill and agriculture right down to modified atmosphere packaging. Applications range from UK landfill operators deploying drones to monitor methane emissions to detection of methane gas leaks which are common and a challenge in the oil and gas industry. Usually, the methane gas leaks present risks to the community, users, workers and the environment. The oil and gas companies have the responsibility of preventing and addressing any leaks in the upstream, midstream or downstream components of production and distribution systems.

While traditional methods have been used for a long time, they are slow, risky and costly. Further, inspection workers accessing contaminated areas face a wide range of risks when exposed for long periods. To overcome some of these and other challenges, companies can deploy drones, which provide faster, cost-effective, and safe unmanned aerial methane detection solution. A typical application involves attaching a gas sensor to the drone integrated with image, video and location and other sensors or technologies that support the identification of leaking sections of the infrastructure.

Requirements

About gas detection sensors

Gas imaging can significantly enhance functional safety by early detection of hazardous gas leaks. Optical gas imaging technologies can be used to identify possible gas leakages and to investigate the amount of gas emission in industrial sites, which is essential, in the context of increased regulation-backed requirements to decrease greenhouse gas emissions. In the case of methane detection, drones detect the leaks using light reflection and absorption sensors. The sensors emit eye-safe lasers which are reflected back in specific ways upon hitting certain matter such as gases. Analysing the reflected beam enables the drones to pinpoint leaks, including the very small ones.



Action Plan

What needs to be done to make this happen?

Technology → → → → → Industry

There are several kinds of drone-based equipment that can be used for gas detection and monitoring, though the most common utilise laser TDLAS (Tunable diode laser absorption spectroscopy) systems, sniffers, and actively cooled thermal imaging cameras. TDLAS systems are ideal for open sources of fugitive emissions where a wide area must be monitored e.g. landfill sites. These systems do not require huge investment though do require the user to develop their own flight methodologies and GIS approaches (especially for quantification), to get maximum benefit.

Sniffers literally suck air into a module that analyses the gas content. These systems are used extensively in city air quality control and emergency response. They can provide quantification inertly without external calculations.

Thermal imaging cameras on the other hand, are ideal for complex networks of process pipework, require more investment to acquire but are set up at manufacture to detect certain gases making them ideal for industrial applications.

Automation → → → Operators and Industry

In the first half of this decade, most drone surveys will be conducted semi-autonomously under current safety cases. In effect, a pilot flying a drone and a payload within visual line of sight, using automated mission planning software. In most cases, this will involve an in-house pilot travelling site to site or perhaps an external drone service company doing the same (drone spares kept on site). However, in the second half of this decade, Beyond Visual Line of Sight (BVLOS) applications will be more common where the drone and payload will be permanently stationed on site. This will be activated to fly autonomously and monitored by a pilot from an office either onsite or offsite. The natural progression of this approach is to have the drone and payload out of a box where a pilot has oversight as required but in the main, there is no human involvement with data being downloaded on landing while the drone batteries get replenished.

Regulation → Government, Regulator and Industry

Many industrial sites are owned by organisations that have pledged to cut their fugitive emissions in accordance with their commitments to achieving Net Zero 2050. Also, with the UK chairing COP26 and signing up to several protocols including the methane 2030 pledge (now law), it is expected that more emphasis will be placed on operating permits to force operators to prove they are reducing all fugitive emissions. Gas detection regulations will need to be updated in line with developing drone technologies.

Related use cases

Similar drones can be used to detect, test, and model water pollution. New Zealand city Auckland has adopted drone technology for water quality monitoring with estimates suggesting it could save 30 percent in operating costs. A methodology was developed to carry out the sampling process, whereby previously boats and even helicopters were used to collect samples for pollution. The switch has seen the unmanned aerial vehicle (UAV) technology collecting water samples, as part of the city's Safeswim initiative to provide real-time monitoring to the public. The drone collects samples at various intervals up to 1km offshore by lowering a sample bag into the waters. After being sent for lab analysis, results are then fed into the council's water quality monitoring system. One of the aims behind using drone technology is to improve the accuracy of water quality predictions, as well as reducing manpower needed to physically go out and collect samples.

Future use cases

As automated drones become more widespread, there could be a multitude of opportunities for the real-time monitoring of gas and other fluids. Swarms of drones could be used to obtain vast open-source data sets simultaneously. Additional scenarios could include monitoring of green hydrogen and other gases through drones not only on static sites but also across bulk maritime carriers.

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The UK Drone Association

More information

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