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Automated hyperspectral imaging from afar: Identifying gas leaks early and at the source

Allison L Sawyer
Rebellion Photonics, USA

Explosions due to hydrocarbon gas leaks at refineries and offshore sites have claimed hundreds of lives and cost billions of dollars in repair and retribution. Early detection of gas leaks can help to avoid such events, thereby protecting workers and preventing destruction of equipment. Currently, the standard technology for hydrocarbon leak detection is a mesh network of point monitoring sensors. While point sensors are sensitive and can provide a reading of the concentration at a single point, they do not provide a picture of the leak source and plume direction. Furthermore, they require the gas plume to reach the sensor which is often long after the leak has started. Because of these issues, infrared cameras have started to gain popularity as they allow a user to see a gas cloud. However, these cameras pose some issues to gas cloud detection. For instance, they require an operator to view all video and interpret the results. This introduces operator error into the equation, especially since it is hard to distinguish between gas and steam in the infrared spectrum, increasing the chances of incorrectly categorizing the results. Rebellion Photonics' Gas Cloud Imaging is a hyperspectral system that is completely autonomous, allowing 24/7 monitoring with no need for an operator to watch the feed. GCI technology detects gas leaks at the source, providing an earlier, more reliable alarm. With the ability to identify 25 different hydrocarbons, including methane, GCI technology employs advanced algorithms to determine gas type, leak rate, leak location and total volume of the leak automatically, without the need for user interpretation. The snapshot GCI relays real-time visible range video simultaneously with co-located infrared video, providing spatial and temporal information about the plume while quantifying the gas leak using long-wave infrared spectroscopy. In this study, the novel technique of snapshot hyperspectral GCI was applied to detect and quantify gas leaks in real time with high specificity. The detection range of the snapshot GCI camera was tested at 1500 m with ambient temperature of 23 °C and wind gusts of 10 MPH (16 km/h). The snapshot GCI camera detected a gas release with a cross section of approximately 1 m2 and accurately identified the gas as propylene. The snapshot GCI camera has been optimized for outdoor operation and has explosion-proof housing for operation in hazardous environments. The camera operates reliably at temperatures of -40 °C to 55 °C and in adverse weather events such as rain, snow and sandstorms. This technology can catch leaks early, help prevent employees from walking into a hazardous cloud and allows the operator to make process safety decisions to avoid leak escalation that can lead to 'low-frequency, high-consequence' events such as fires and explosions.

allison@rebellionphotonics.com