Remote Sensing Technologies for Detecting, Visualizing and Quantifying Gas Leaks

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Abstract

Remote sensing technologies can be applied for a wide range of gas leak flowrates and in three main cases: (1) major leaks in crisis management; (2) medium size leaks in safety monitoring; (3) small leaks in environmental monitoring.

A gas test campaign, conducted by Total, the ONERA – the French Aerospace Lab – and ADCIS in September 2015 using three hyperspectral infrared cameras from Telops, confirmed our capacity to visualize in 3D and quantify in real time plumes of methane in the range of 1 g/s to 50g/s. The R&D project on gas remote quantification continued with a second gas test campaign in 2017.

The second gas test campaign was organized on Total's Lacq Pilot Platform in France and involved several gas spectral imaging systems: (1) mobile hyperspectral cameras in the Long-Wavelength InfraRed (LWIR) band (7.7-12µm); (2) a multispectral camera in the LWIR band (7-9µm); (3) a multigas lidar (LIght Detection And Ranging) system coupled with a wind lidar system; (4) five other international teams (US, Spain, Norway and France) were also invited to assess the capacity of their remote-sensing systems to quantify methane and carbon dioxide releases.

The two-week test demonstrated that methane leak emissions ranging from 0.7 g/s to 140 g/s could be visualized and quantified in real time using a mobile Telops Hyper-Cam. This campaign also served to validate the performance of several remote sensing technologies.

Total's Lacq Pilot Platform is a test area for qualifying cost-effective systems designed to complement the gas detection system of a plant and provide valuable information should a gas leak incident occur. New methodologies for the early detection of anomalies using remote observation systems including drones, robots and artificial intelligence data processing systems are currently being investigated there.

Introduction

As part of the NAOMI (New Advanced Observation Method Integration) project, Total and the ONERA have been working in partnership for several years on a project to remotely detect and quantify gas leaks. The objective is to develop systems which can detect and quantify accidental gas releases on Total's operational sites. The systems should also be able to quantify fugitive emissions for application in the context of environmental protection. The infrared cameras currently available on the market detect the presence of gas, but do not provide any hard data such as the methane concentration at a given point.

The main objective of the gas test campaign carried out in June 2017 was to develop systems which can detect, identify, quantify (in ppm) and be used to view a gas cloud in the atmosphere in 3D and 4D (real time), and estimate the gas leak flowrate and the concentration of the gas cloud.

Total is on the lookout for partners, and several industrialists were invited to take part in this gas test campaign to demonstrate the performance of their remote sensing technologies. The goal was to find out more about the different gas detection technologies (benefits and weaknesses) in order to develop a supervision software using the advantages of each one, and improve safety on industrial sites.

The 2017 gas test campaign followed on from the one held in September 2015 [1] [2]. It took place on an industrial platform located in an area of Total's former Exploration & Production France (TEPF) site in Lacq (figures 1 and 2). A third campaign is planned for October 2018 to validate functional solutions of remote detection methodologies and to continue to build up partnerships with researchers and industrialists.

Figure 1—Pilot Platfom in Lacq

Figure 2—operations room

From June 13 to 23, 2017, 51 controlled gas releases to the atmosphere were carried out (45 of methane and six of carbon dioxide). Each release lasted around 10 minutes and consisted of a horizontal or vertical emission of gas. Different amounts of methane and carbon dioxide were released, from 0.7 to 140 g/s.

48 QRAE II compact portable combustible-gas detectors were positioned on posts at different heights to provide reference values of the spot concentrations of methane for each test, in addition to the reference values of the release flowrates. All the operations were prepared and organized in compliance with the applicable safety rules. The gas release point installation is shown in figure 3.

Figure 3—gas release point

The remote gas detection systems were positioned at different distances from the gas release point (50, 100 or 300 meters) as shown in figure 4.

Figure 4—layout of the remote gas detection systems located at points 1, 2, 3, 4, 5, 7 or 8; the gas release point is located at point 6

Main results of the 2017 gas detection and quantification test campaign

Initial testing in 2015 had shown the potential of remote sensing technologies when three hyperspectral infrared cameras developed by the defense and aerospace sectors allowed us to estimate the gas flowrate as well as gas concentrations in the plume and at the point of release [1] [2]. This second test program sought to progress toward more economical and light-weight solutions, easier to mobilize in the event of an emergency, using a single mobile hyperspectral infrared camera capable of moving around the gas release point, rather than three stationary cameras. The revised protocol proved more realistic.

A multispectral camera and a multigas lidar system, both resulting from the NAOMI project between Total and the ONERA, were tested. The multispectral solution, based on four bands (instead of one hundred as in hyperspectral technology), resolved the problems of weight, volume and high cost. The ultimate objective is to equip drones with multispectral camera. The multigas lidar telemetry technique will prove very valuable provided it is limited to methane and carbon dioxide so that it does not exceed one cubic meter and can be easily transported by helicopter.

The test program was also an opportunity to test systems developed by three of Total R&D's project teams. The Argonauts' autonomous surface robot, winner of the ARGOS challenge [5], completed its first gas detection assignment. For environmental monitoring, a tethered balloon fitted with a diode laser spectrometer (under the AUSEA project, or Airborne Ultra-light Spectrometer for Environmental Application) flew over the gas release to detect trace concentrations at several different altitudes. The third R&D project demonstrated the effectiveness of nanotechnologies (APIX project) in surface sensing applications.

Several world's leading suppliers of remote gas sensing solutions – Bertin, Harris, Gas Optics, Sensia, and Fluke – accepted R&D's invitation to use the Lacq test facility. They took advantage of the gas releases to test their products and enhance their expertise with applications relating to safety and environmental protection. Sim Engineering successfully tested their acoustic sensors. Future partnerships were discussed with the different companies present in order to prepare for the third test program due to take place in October 2018.

Quantification and 3D reconstruction using the Telops Hyper-Cam

The Telops Hyper-Cam is a commercial hyperspectral imager producing high-resolution radiometrically calibrated data in real time. It has been widely used in many applications including remote gas detection. Thanks to its high spectral resolution, combined with a good radiometric accuracy, the Hyper-Cam can be used to identify gases and quantify the detected concentration. The Hyper-Cam technology has been presented in several papers [3] [4].

The spectral bands of these cameras are in the LWIR (Long Wavelength InfraRed) or band III (between 7.7 and 12 µm), which enables them to detect methane. The field of view of the instruments is 25° horizontal on 320 pixels and 10° vertical on 160 pixels. The average distance from the source is 100 meters, which is equivalent to a spatial resolution of around 14 cm in the plume. For the tests, the Hyper-Cam was placed on the bed of a pick-up so that it could be rapidly moved around during the gas releases (figure 5).

Figure 5—Telops Hyper-Cam installed on the bed of a pick-up

The main advantage of the Hyper-Cam is that it can be used to quantify a very wide range of concentrations, from 100 ppm to 10% of methane. What's more, the quantification results obtained are very reliable thanks to the large number of spectral bands.

Hyperspectral processing software for quantifying the gas plume, developed as part of the NAOMI project, was also validated, as the quantification results of linear concentrations produced by fixed hyperspectral cameras are highly satisfactory. The different flowrates can be directly identified on the quantification images (figure 6).

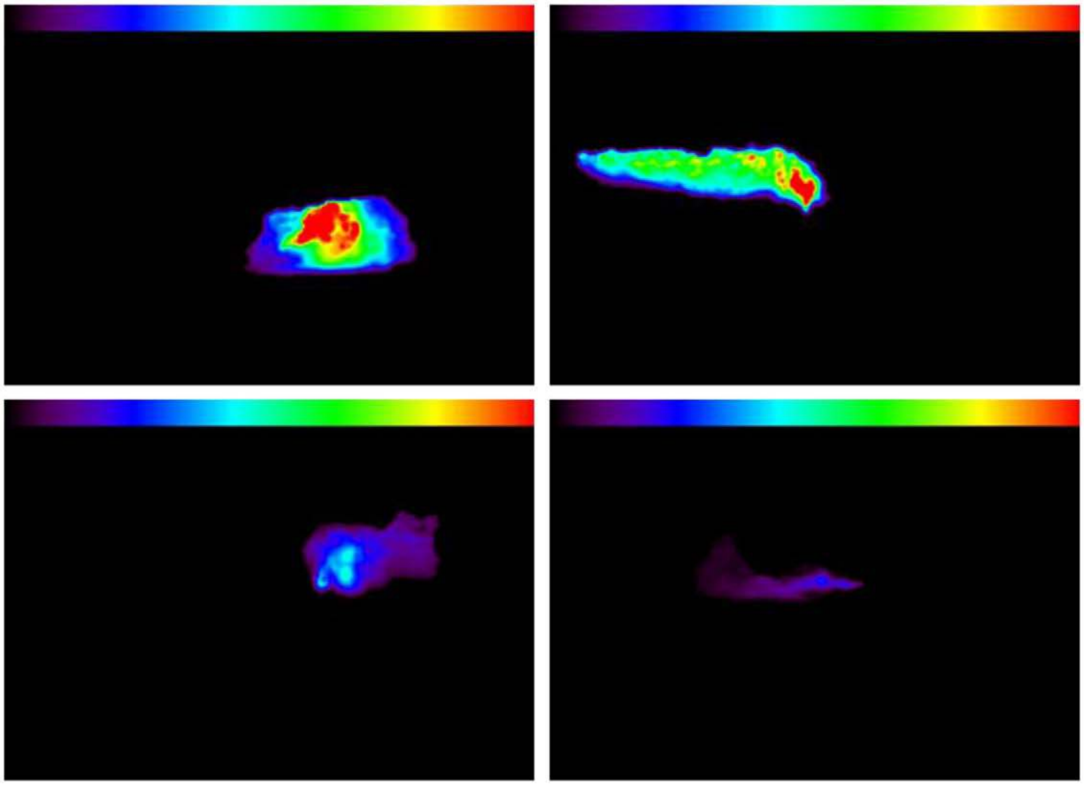

Figure 6—methane quantification map obtained from a hyperspectral camera on a linear color scale of 5,000 ppm.m (red) to 0 ppm.m (black) Gas release rate of 100 g/s (top left) - 50 g/s (top right) – 10 g/s (bottom left) – 1 g/s (bottom right)

The flowrate analysis, based on the linear concentration values recovered and the wind data extracted from a wind lidar system by ZephIR, produced mean flowrate values very close to real ones. Table 1 presents the results obtained from the two Telops cameras, the VLW (Very Long Wave) Hyper-Cam and the Methane Hyper-Cam.

Table 1—Comparison of quantification results for each of the two hyperspectral cameras

	Masse rate (g/s)				Masse rate (g/s)		
Test /	real /	VLW results /	Methane results	Test /	real /	VLW results /	Methane results
S1-05	0,6			S1-01	10	9,2	12,7
S1-14	0,7	1,8	1,4	S1-02	10		9,3
S1-15	0,7		0,7	S1-07	10		
S2-05	0,7		0,8	S1-08	10		
S2-06	0,7	0,5	1,3	S1-11	10		6,9
S1-03	1	1,3	1,4	S1-12	10	11,4	9,3
S1-04	1	1,4	2,0	S1-18	10		
S1-06	1	1,1	1,2	S1-19	10	10,2	11,3
S1-13	1		2,2	S2-01	10	9,4	
S1-16	1		3,1	S2-02	10	7,3	
S2-03	1	0,7		S2-17	10	10,0	
S2-04	1	0,8		S1-21	20	15,8	
S2-19	1	1,8		S2-09	20	17,5	
				S2-10	20	19,3	

For higher flowrates (greater than 50g/s) in applicable cases (i.e. wind direction at a right angle to the line of sight of the camera), an under-estimation was observed: the sources of error are currently being studied (under-estimated velocity, part of the plume not observed, etc.).

The real-time 3D reconstruction carried out by ADCIS using a single mobile hyperspectral camera (figure 7) was more challenging than the 3D reconstruction performed using three fixed cameras during the campaign of September 2015. Because of the time needed to move the camera from the first observation point to the second, acquisitions were made at the two locations at different times and were affected by the wind changing the gas cloud between each image capture. Applying a mean to a moving plume is no guarantee that the mean will correspond to a spot view. At this scale of leak, the wind often changes faster than the time needed to change points of view.

Figure 7—3D reconstruction of the gas plume from software images during a gas release

These tests confirmed that a more perpendicular view is needed (from above) and/or that the system has to be constrained in order to obtain a solution that more closely reflects the geographical and geometrical reality of the plume. Modifications to the present model to integrate the experimental constraints have been suggested, either starting with the algorithm currently used or using a different reconstruction method based on an *a priori* model of a gas cloud.

Multispectral camera developed as part of the NAOMI project

A cryogenic multispectral camera prototype was created as part of the NAOMI project. This camera called SIM-ONE has four filters allowing the simultaneous acquisition of four images and is specifically dedicated to methane (figure 8). The use of a cooled detector means that relatively narrow bandpass filters can be used. With this camera, the number of false alarms is reduced and automatic detection could be possible.

Figure 8—multispectral system with a cooled detector (left) and multispectral system with an uncooled detector (right)

SIM-ONE produced very good results in terms of detection and quantification compared to the linear concentrations found with the hyperspectral Hyper-Cam (figure 9). The high frequency of image capture (1 image/5 ms) is highly promising for estimating the travel speed of the plume.

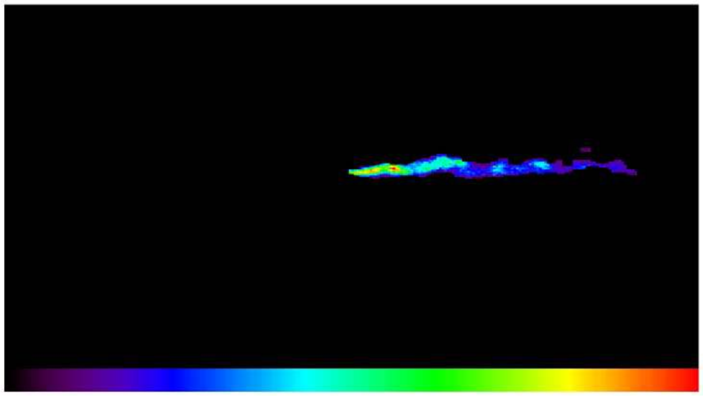

Figure 9—methane quantification map obtained using the SIM-ONE multispectral camera. Color scale from 5,000 ppm.m (red) to 0 ppm.m (black) for a release at 10 g/s

A multispectral system with an uncooled microbolometer-based detector was also tested during the campaign (figure 8). The results produced by this camera were processed after the campaign: detection of methane using an uncooled detector is possible, but quantification of gas leaks is not possible.

Lidar system developed as part of the NAOMI project

A prototype of a multigas flow Differential Absorption Lidar (DIAL) system was also developed under the NAOMI project (figure 10). This system had already been tested on atmospheric methane in the spring of 2017 on the ONERA site near Toulouse (France). Integrated measurements performed over one kilometer showed good recovery of atmospheric methane data.

Figure 10—multigas lidar

The lidar system was not ready to be fully operational during the Lacq campaign. Modifications of the lidar prototype will be implemented. For example a metal plate of the optical flat will be replaced by a carbon fiber plate to face any large temperature fluctuations of the working environment and prevent heat deformation of the mechanisms of the emissions bench. A campaign to validate this robustification will be conducted before the next test campaign of October 2018.

The multigas DIAL system will be coupled with a wind lidar device to measure the transverse wind component. The wind lidar system was also deployed during the Lacq campaign (figure 11) and proved its robustness (high temperature constraints), as well as its capacity to operate autonomously and be deployed in just a few minutes. It provided useful data for quantifying the emission flowrate using a hyperspectral camera. A comparative analysis is being conducted using data from an off-the-shelf wind lidar system by ZephIR and from the weather stations deployed during the test campaign. The scanning capacity of the wind lidar system makes it possible to aim on the plume area, unlike the ZephIR device which measures wind on a vertical line.

Figure 11—wind lidar

Infrared Optical gas imaging used by Modis

Within the framework of a R&D collaboration with Total, Modis had the opportunity to deploy during the two weeks of testing, one of its infrared cameras FLIR GF320 (figure 12) used regularly to carry out gas leak detection campaigns on O&G installations. This camera, whose optical part is rather suitable for leak detection at a distance of less than 10 m, has responded favourably to the operational constraints imposed. In fact, it was possible to reliably detect less than 10 g/s of methane from a position located at a distance of 100 m and 11.5 m high from the source (figure 13). The minimum flow rate detected by the camera during these tests was between 1 and 10 g/sec.

Figure 12—FLIR GF320

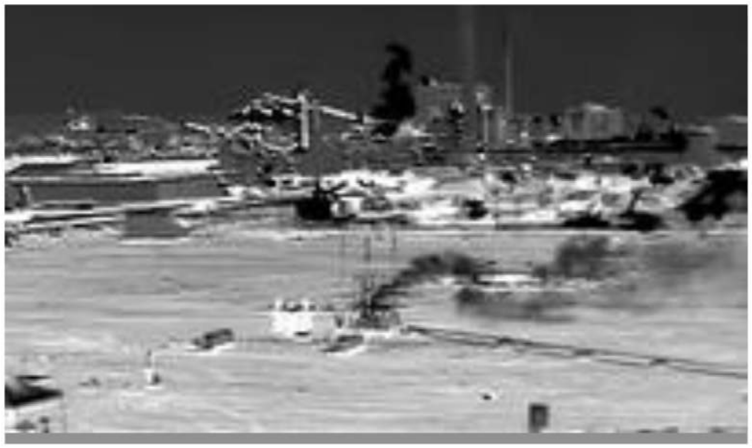

Figure 13—images obtained from the FLIR GF320 during a gas release

Considering that the camera was not used in optimal conditions: no data processing, optics to be adjusted to the source-camera distance and focusing not always optimal because realized remotely via the Ethernet network, the technology used by Modis (FLIR GF320) can be considered as complementary to the quantification methods developed in the framework of the NAOMI project.

Total R&D Argonauts project involving *in situ* gas measurements

On June 16, 2017, Taurob took part in the gas release test campaign with the ATEX-certified demonstrator robot called Argonauts (figure 14), the winner of the ARGOS challenge organized by Total [5]. The robot was driven by remote control (via a Wi-Fi connection) to the gas release site.

Figure 14—the Argonauts robot

A Dräger PIR 7000 detector mounted on the arm of the robot was used to measure the gas. The output signal of the Dräger PIR 7000 was recorded by the robot's onboard computer and also displayed to the operator in real time.

These tests had a very positive outcome: the robot was able to detect the released gas, the rough ground did not hinder its ability to maneuver.

Total R&D AUSEA project involving *in situ* gas measurements

The objective of the Total R&D AUSEA (Airborne Ultra Light Spectrometer for Environmental Applications & Exploitation) project is to develop a system that can be fitted onboard a drone for measuring methane and carbon dioxide concentrations and estimating emissions using weather data and inverse modeling.

To achieve this, Total and the GSMA (molecular and atmospheric spectroscopy group), a mixed research unit comprising the CNRS (French national scientific research center) and the URCA (University of Reims Champagne-Ardenne), formed a partnership to create a drone-embedded version of AMULSE (Atmospheric Measurements Ultra Light SpEctrometer) under development since 2014 (figure 15).

Figure 15—AMULSE system (Atmospheric Measurements Ultra Light SpEctrometer)

During the test campaign of June 2017, the spectrometer was mounted under a tethered balloon and was adapted to integrate a methane measuring channel at 2 ppm, a carbon dioxide measuring channel at 400 ppm and a water vapor measuring channel at 1%. The device used was highly sensitive and able to detect the smallest leaks, of the order of 0.7 g/s. In scenarios with a greater release rate, however, (greater than 10 g/s) saturation was observed.

Measurements were acquired in real time on the ground by Wi-Fi. The balloon was operated manually and moved horizontally and vertically to be positioned in the plume in order to acquire data. The use of a drone appears all the more necessary in that manually positioning a low-reactivity system such as a balloon or a similar device in a moving plume proves very difficult.

Total R&D Nanotechnologies project involving *in situ* gas measurements

One of the objectives of the Total R&D Nanotechnologies project is to develop multi-gas sensors and gas analyzers for safety and environmental applications in collaboration with APIX Analytics. This system is based on a NEMS (Nano Electro Mechanical Systems) resonator technology.

The ChromPix-4d (figure 16) is compact and flexible. It enables rapid analysis by gas chromatography of gas-phase mixtures across a wide operating range (from 75 ppm to 100 % CH_4) and of gas species to be treated.

During the tests, the measurements made with this apparatus were compared with those made by QRAE II detectors positioned near the emission zone. Modifications realized on the Chrompix for this campaign allowed to improve the sensibility in 33 % and reduce the response time to the half (i.e. to 12s). The wide range of operation and the absence of saturation of the sensor are the key points of the technology. This progress was significant and very positive. Future development will focus in the implementation of a compact system.

Figure 16—APIX ChromPix-4d system

Bertin Instruments Second Sight cameras

Bertin Instruments deployed two uncooled multispectral infrared cameras, called Second Sight, to monitor the leaks (figure 17). With the help of supervision software called Vapor Cloud Tracking System (VCTS) both cameras could be monitored at the same time. The infrared images are displayed side by side. The gas clouds are displayed on the screen in real time and their location can be followed on the plant map (figure 18). This software is also suited to systems using more than two cameras.

Figure 17—Bertin Instruments' Second Sight camera

Figure 18—images of the Vapor Cloud Tracking System (VCTS) monitoring software

This trial campaign showed the ability of the Second Sight cameras to detect and identify methane, and also demonstrated the added value of the VCTS software for monitoring several cameras on the same interface, displaying and tracking the gas cloud over the petrochemical plant and identifying the leak to take the appropriate measures. This system ensures the safety of the industrial site by raising the alarm in the case of a gas leak or gas accumulation creating a cloud, estimating the source point and showing the contaminated area.

Harris/AER GreenLITE™ system

The GreenLITE™ system, developed by Harris Corporation and Atmospheric and Environmental Research, Inc. (AER), was deployed in the gas test campaign. The current GreenLITE™ system provides 2-D maps of trace gas (either methane or carbon dioxide) concentrations and estimated emissions as well as other custom analytics, in an autonomous fashion via standard secure web-based services.

GreenLITE™ is designed to provide near real-time actionable information to the user 24 hours per day, 365 days per year, over areas from 0.04 to 25 km2. The trace gas of interest, either methane or carbon dioxide, is selected via interchangeable laser sources.

The Harris/AER GreenLITE™ system combines laser-based differential absorption spectroscopy measurements obtained along predetermined paths (chords) defined by the straight-line path between one of M active transceivers and N passive reflective surfaces, with a suite of computation approaches for computing integrated trace gas concentration along each chord and estimating the 2-D distribution of concentrations/emissions over the field of interest at a nominal height above the installation surface. The GreenLITE™ layout for the 2017 gas test campaign is illustrated in figures 19 and 20.

Figure 19—On left: Harris/AER GreenLITE™ Transceiver with Optical Head mounted on tripod and Electronics Box (2 per site) On right: Retroreflector mounted on tripod (30 per site)

The GreenLITE™ system comprises two primary sub-systems, the onsite data collection sub-system and the cloud-based data processing and analytics sub-system. The hardware-oriented data collection sub-system consists of the transceivers and retroreflectors, which provide the measurements of differential optical depth. The data processing/analytics sub-system converts observed differential optical depth values into column XCH_4 or XCO_2, constructs 2-D views of trace gas distributions for a horizontal plane over the area of interest, and estimates emission rates.

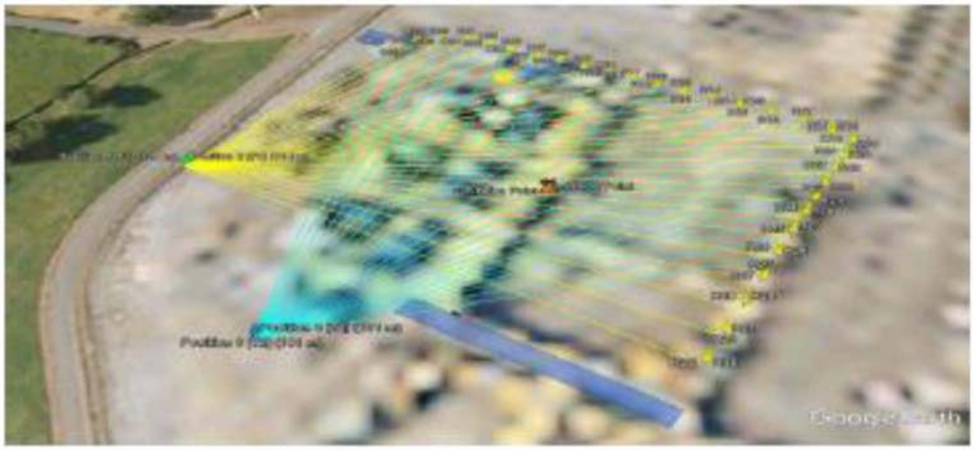

Figure 20—Two Transceivers (on the left: green and blue) and 30 reflectors (yellow on the right) locations, the chords are defined by the unobstructed paths between transceivers and reflectors. The blue lines represent the chords associated with one transceiver, and the yellow lines represent those for a second transceiver. The number of transceivers must be at least 2, if 2-D reconstructions are desired.

The examples in figures 21 and 22 illustrate the data collection, retrieval, reconstruction, and emission estimation process using data acquired from a single methane release during the gas test campaign. The plot on the left-hand side of figure 21 shows the average individual chord concentration values acquired over a 2-minute time interval, and the image on the right illustrates the resulting 2-D concentration reconstruction. Figure 22 shows the estimated flux map corresponding to figure 21 from which a leak rate is calculated. The raw transmission data used to generate these plots, along with companion instrument information, were transmitted via secure network protocols to a cloud-based set of servers. At the remote server site, the data were ingested and converted to ppb/ppm chord concentration values using the site-specific information and ancillary weather information and the methods described in [6].

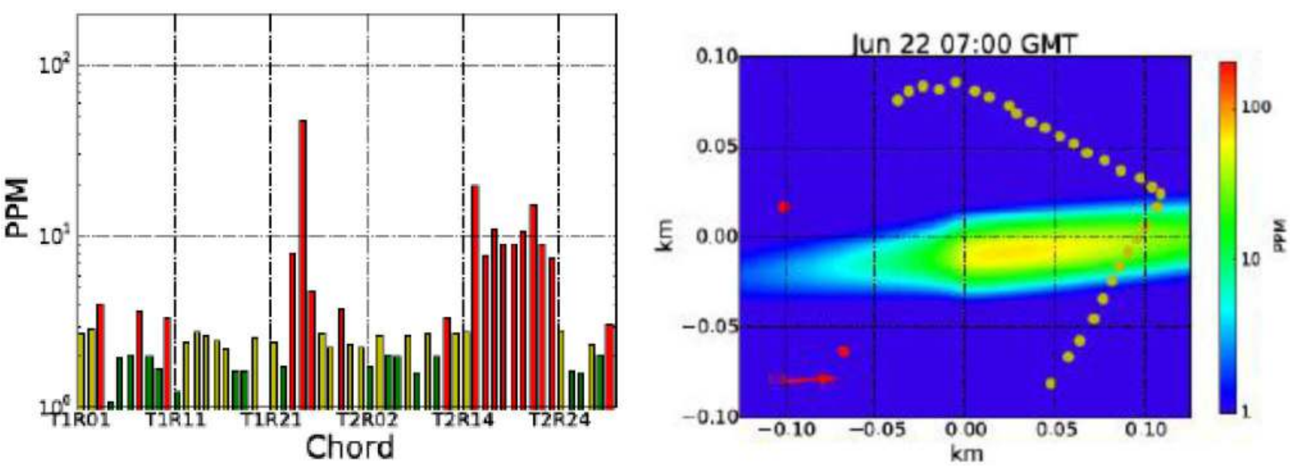

Figure 21—Retrieved CH_4 chord values (left) and resulting 2-D field concentration reconstruction (right)

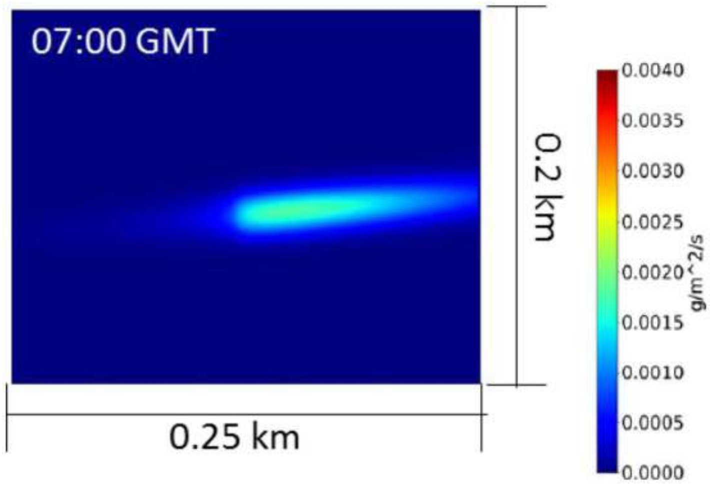

Figure 22—Estimated 2-D CH_4 flux map corresponding to figure 21

GreenLITE™ successfully demonstrated the ability to quantify and map the location of controlled methane and carbon dioxide releases during the tests. In addition, the Harris/AER team successfully implemented estimates of methane emission rates which were generally within a factor of two of the known release rates and can be improved upon for future deployments. Comparable results were also demonstrated by GreenLITE™ for the carbon dioxide releases.

GAS OPTICS Gas Vision System (GVS®)

The GAS OPTICS Gas Vision System (GVS®) uses IR and gas correlation to visualize, identify and quantify gas concentration of the monitored gas cloud. Using the desired reference gas as filter, the GVS® is capable of visualizing and quantifying gas leaks in real time. This enables both automatic alarm decisions, and provides valuable information for better and faster decision making when a gas leakage occurs.

In the 2017 gas tests, the GAS OPTICS teams mounted the GVS® in a van, for quick commissioning and flexible remote surveillance (figure 23).

The GVS® performed well and in according to expectations during the tests. All sizes of gas leaks were detected and videos of leaks automatically recorded. Gas was identified as methane, gas concentration quantified and automatic alarms went off when concentration surpassed the given limit (0.5 LELm).

Figure 23—Gas Optics GVS® installed in a van

The GVS® both localizes source, identifies the gas and quantifies concentration, all visual and intuitively framed, in real time and from remote (see figure 24).

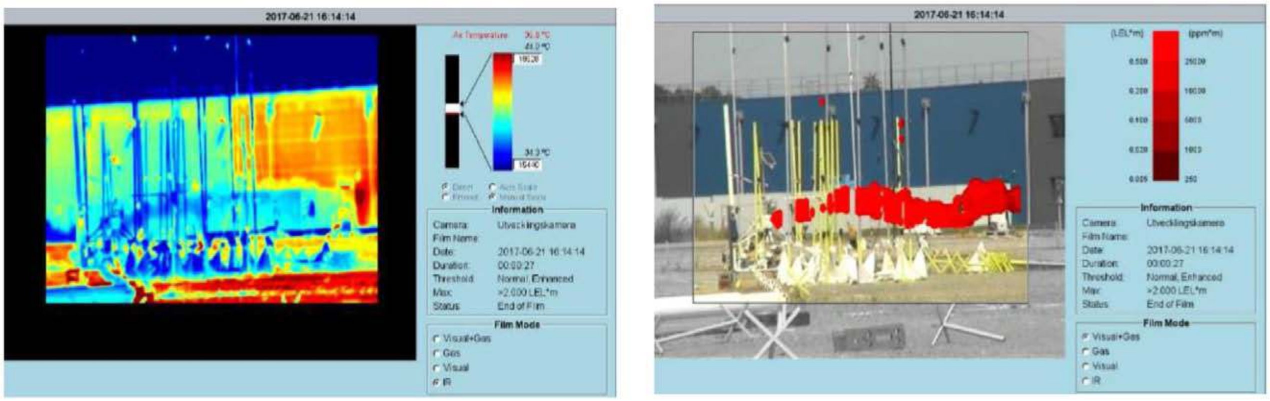

Figure 24—the pictures show the same methane leak in infrared/thermal mode (left) and in Gas Vision Mode (right). In Gas Vision Mode, the GVS® identifies the gas as methane and quantifies density (LELm)

Sensia Gas Sensing System (GSS)

Two different cameras, based on uncooled detectors, were used by the Sensia team during the 2017 test campaign: the Sensia infrared camera, used as a reference, and the Gas Sensing System (GSS), specifically used in methane Leak, Detection and Repair (LDAR) campaigns. Both are based on a hand-held system but were used as fixed equipment in this case (figure 25).

Figure 25—Sensia operator focusing and aiming the camera

All the releases were successfully observed with the GSS hand-held camera from 50 and 100 meters with 20- and 50-mm optical systems. The GSS is able to automatically detect the gas release. Figure 26 shows images of the gas release obtained using the 20-mm lens from a height of 10 meters, 100 meters away from the gas release point.

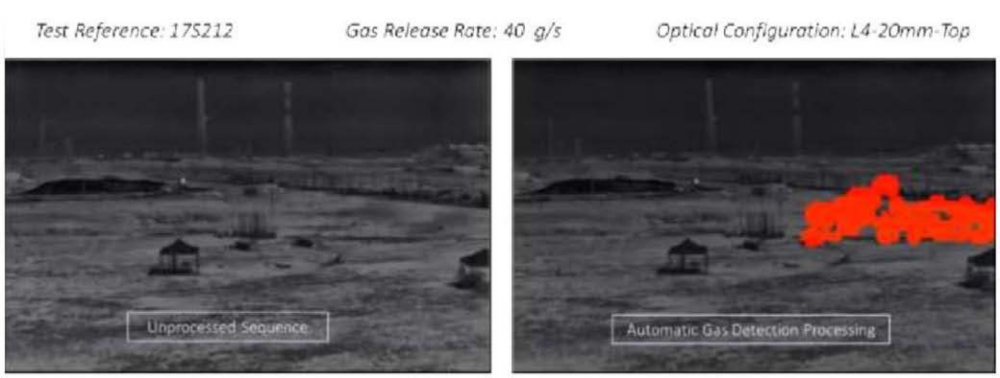

Figure 26—images obtained from the GSS during a gas release. The figures show the unprocessed image on the left and the image obtained when Automatic Gas Detection Processing is activated on the right

Fluke Gas Imaging Camera (GIC)

Fluke Gas Imaging Cameras (GIC) are based on uncooled detector technology.

In the 2017 gas tests, the GIC were located 50 meters from the gas release point (figure 27). The prototype cameras functioned as the Fluke team expected. Sun-heated ground provided the best thermal contrast for viewing the gas.

Figure 27—Fluke Gas Imaging Camera (GIC)

Sim Engineering and Wavely Acoustic Sensors

In the June 2017 test campaign, the Sim Engineering and Wavely team was the only participant to use acoustics to detect gas leaks as part of Total's R&D project on major accident prevention, which aims to improve gas leak detection by combining several methods including acoustics.

State-of-the-art research shows that gas leaks generate an acoustic signal created by turbulence at the orifice outlet. Among the different technologies used to detect gas leaks, acoustics has been used for many years now. However, these tools are mainly mobile and manual and require the presence of an operator. Some industrialists offer fixed acoustic sensors for gas leak detection [7] [8] mainly based on acoustic signal intensity measurements to determine whether gas is present. It appears that some fixed ultrasonic sensors are gradually tending towards more complex acoustic signal analyses. The acoustic signal generated by a gas leak is effectively complex and varies according to many parameters including internal pressure, gas type and geometry of the hole. It appears that a network of wireless acoustic sensors incorporating a detailed analysis of the signal generated by the gas leak would be particularly suitable for detecting, locating and quantifying gas leaks on industrial sites.

In the June 2017 test campaign, dosimeters in the band of 0-6 kHz were positioned near the emission point on the posts used for the fixed RAE sensors (figure 28). The gas releases produced an acoustic signal measured by the dosimeters. In parallel high-quality recordings in the band of 0-100 kHz have taken outside the ATEX zone. In some cases, the signal produced could also be heard in the control center located 100 meters from the emission point.

Figure 28—audible sonometers from SVANTEK on the left, ultrasonic microphone on the right

A calibration function between the sound level measurement for the third-octave band centered on 5,000 Hz and the theoretical flowrate of the gas releases was determined and served to estimate the flowrate of three blind tests.

A campaign dedicated to acoustic measurements is due to take place in June 2018 on the Lacq Pilot Platform. Several companies specialized in acoustics have been invited.

Conclusions

The June 2017 test campaign was an opportunity to test several technologies: quantification of methane and carbon dioxide leaks using hyperspectral and multispectral cameras, and lidar systems. Future partnerships were discussed with some of the main players in the remote gas quantification sector.

The choice of technologies depends on many parameters and has to be assessed on a case by case basis (emergency situation, safety surveillance, site specificities,…). The purpose of the campaign was to show complementary of the different technologies and not to compare performances between different suppliers for example as during a challenge. The exchanges between the participants were very productive.

Drawing on the data acquired during the campaign, the aim now is to define the best and most complete and robust set-up possible: optimization of the most suitable technology and associated software, implementation of logistics to deploy the technology selected, training courses for users, time required before handover to operations, gas leak diagnosis, etc.

The test infrastructure in Lacq offers the possibility of performing gas releases in operating conditions, while defining the best strategies (instruments, processing solutions, data fusion, decisions) for the different scenarios (releases between 0.5 and 300 g/s of methane).

The aim of the campaign due to take place in October 2018 on the Lacq Pilot Platform is to test the entire chain and to provide training to operators on the technologies selected for the two main scenarios: emergency situations and safety surveillance. The main players in terms of optical and acoustic gas detection technologies will once again be invited. The data acquired will be processed and combined to deliver an understandable gas leak diagnosis in real time.

Acknowledgments

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