Alberta Methane Field Challenge – November 2019

Final Summary Report

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Project Objectives

The objective of the Alberta Methane Field Challenge (AMFC) was to better understand the real-world utility of emissions measurement systems for helping to reduce methane emissions from the upstream oil and gas sector in Canada. A suite of selected technologies were deployed to operating oil and gas sites and tasked with detecting, measuring, and localizing emissions sources in an intensive fieldwork campaign in November 2019. The University of Calgary Portable Methane Leak Observatory (PoMELO) was selected as a participant. This report summarizes our involvement in the project.

Left: *The University of Calgary Portable Methane Leak Observatory (PoMELO) conducting emissions surveys. The system is mounted on the roof of conventional field truck and is completely computerized.*

The PoMELO system is mounted on the roof of a conventional field truck and driven around emitting equipment. Detections of emissions, an estimate of the location and emissions rate are produced onboard immediately to facilitate follow-up actions such as additional Optical Gas Imaging (OGI) surveys or on-the-spot repairs.

The objectives of the deployment were to participate within the AMFC series of experiments, providing a reliable representation of the role of the PoMELO set of vehicle-based technologies. We also used the data from the deployment to advance the development of our technology.

The University of Calgary is a public research institution in Calgary, Alberta, Canada. The challenge of reducing methane emissions from the upstream oil and gas sector is well suited to the University expertise, mixing a need for deep scientific knowledge of atmospheric dynamics, measurement systems, and complex engineering. The PoMELO set of technologies is a research and development project **-** but is presently undergoing commercialization to enable broader uptake.

Technology Description

The PoMELO system is vehicle-based emissions measurement system. The system consists of a high-performance methane sensor (Li-Cor 7700), GPS positioning sensor (Hemisphere GPS V103), and anemometer (RM Young 86000), mounted on the roof of a conventional field truck. The instruments feed data into a computer that runs customized software for detecting methane emissions, localizing the equipment that is emitting, and providing rapid quantifications of the emissions. We focus on providing immediate information, with no offsite post-processing required: anomalies of interest can be addressed while still onsite.

The basic principle of operation is as follows. As methane is emitted from vents, fugitives, and combustion sources, it is mixed and translated laterally by the ambient wind, forming a plume. We drive through the plume with our instruments and the system creates a detailed picture of the plume and most likely source location. Over several passes through the plume, the information is refined and improved internally by the statistical model. We use a proprietary localization and quantification engine that utilizes proprietary algorithms that have little genetic similarity to existing plume modeling or odor localization methodologies.

The system is designed to provide instructions for OGI follow-up immediately. The data shows what parts of the pad are emitting and what parts are not. If there are no emissions detected, no OGI is required. This accelerates time on each site and focuses OGI effort to only emitting locations, instead of time-consuming surveys of equipment that is not emitting.

The PoMELO system is significantly different from previous incarnations of the instrumented vehicle concept. First, we measure and process data at a significantly faster rate than other systems. Processed data are fed into quantification and localization algorithms at 10 Hz. Second, the system is portable and streamlined with only select instruments to improve reliability. Third, the data are used with context to detect, localize, and quantify sources real-time. For example, an evolving picture of leak source locations is produced live while driving. This software is the primary contribution of the PoMELO system, it enables immediate reporting of information that is actionable by workers while onsite. The goal is to eliminate second, follow-up visits after the initial survey, reducing costs, increasing safety, and reducing emissions.

Data collection methods

We arrived at a site and initiated emissions data collection with our system. Within several minutes we had obtained a picture of the most likely emissions sources at the equipment level. From this, we labeled the sources with the equipment that was present and the system calculated emissions rates on a per-equipment basis. From this, an initial report was auto-generated and anomalous sources could be examined further with the OGI camera.

Results were generally finalized for most sites onsite, or during the drive to next site. We then transcribed our default report into the AMFC-specific reporting spreadsheets. AMFC-specific reporting required additional post-processing following the survey. We also created diagram sketch maps of the infrastructure present at each site to help understand the emissions from different types of equipment and accurately match our equipment-scale results with that of the other teams – whom measure emissions at a variety of other scales.

AMFC Participation Summary

We attended the full project tour from 13-24 November 2019. We conducted 54 experiments at the controlled release facility, and 56 site visits. We encountered no significant down-time due to equipment problems. We were limited in road access during some severe winter weather events. Please note that the experiment did not provide accurate data number of sites possible to survey in a day because site access was limited. Furthermore, sites were much further apart than normal operations under contract to a producer.

Learnings and Areas of Improvement

The AMFC experiment allowed us a valuable opportunity to understand the types of emissions present on oil and gas sites and enhance our algorithms. We better understood the role of vehicle-based systems to address emissions challenges in the upstream oil and gas sector.

Areas for improvement

We generated additional data to help our site suitability modeling efforts. Vehicle-based systems are best suited for sites with good road access and limited venting. With some extreme winter weather, we encountered the limitations of vehicle access. Some sites could not be visited due to unsafe road conditions. These conditions favour aerial systems that do not require road access – but these conditions can generally be predicted. In future surveys we are hoping to better predict when conditions are unsuitable, saving considerable cost in the process, and improving crew safety.

Cost implications

The AMFC fieldwork further emphasized the need for rapid results that are finalized onsite. The ability to generate actionable emissions data while still onsite facilitates follow-up with OGI cameras or immediate repair. This is advantageous as driving to site dominated fieldwork time (and cost). We believe this approach and the sophisticated software that enables it to be a strong advantage as the cost of follow-up visits with OGI crews is often not explicitly accounted for in cost-benefit studies of alternative emissions measurement technologies – yet is a major component of any emissions measurement program.

Additionally, our focus on sophisticated software that produced results immediately also minimized post-processing. This significantly reduces cost as personnel do not require dedicated time blocked post-survey, and clients are not left waiting for results while emissions continue. This study was an exception as it required more post-processing to generate specific data elements that our system does not produce onsite – necessitating some office work after the survey. However, the approach of immediate results was proven to provide tangible and valuable cost savings.

Data product example

The standard data product that is produced onsite is a template report that highlights emissions sources and emissions rates. Note that the user interface on computer in our vehicle can be also used to guide follow up work and can be zoomed to specific sources and queried to produce more detailed data. Our onsite report is designed for those whom wish to see a tangible report immediately. The report generation tool is known as ‘padmapper’.

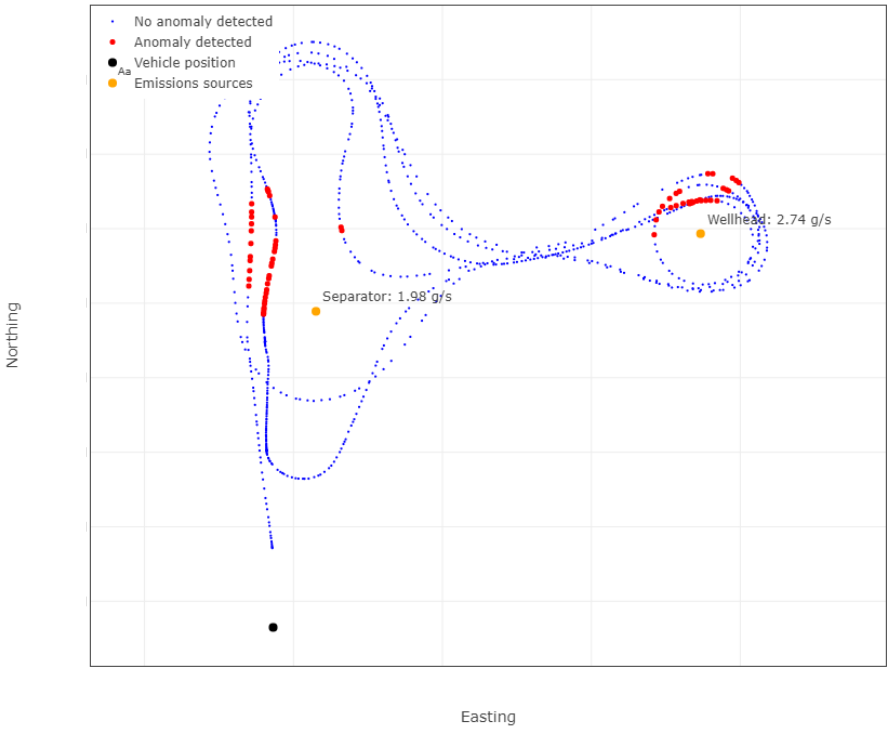
UNIVERSITY OF CALGARY **Padmapper Results**

AMFC Site XX

Visit times: 2019-06-XX XX:XX - 2019-06-XX XX:XX

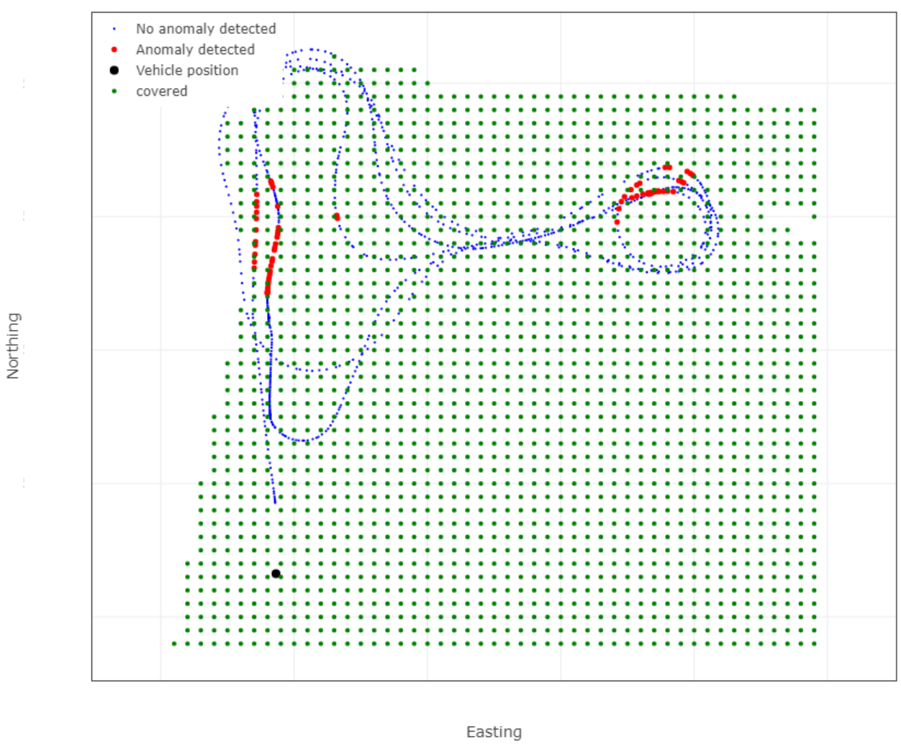
Padmapper Sources

Emissions sources: Map shows emissions sources on the site, with emissions rates in g/s.



Padmapper Coverage

Coverage: Map shows portions of the site that were surveyed with the system. Blue dots show where vehicle traveled, and no anomaly was detected. Red dots show where an anomaly was detected. Green dots show the region which was covered by the Padmapper system.



Source	Leak rate (g/s)	Easting (UTM)	Northing (UTM)

Separator	1.98	XX	XX
Wellhead	2.74	XX	XX

Report generated: 2019-06-XX XX:XX

Performance and Cost Implications

The performance of the system in the AMFC set of experiments was excellent. The set of experiments allowed us to solidify our deployment niche and the effectiveness of the 'one visit model' for guided OGI. The cost implications of the 'one visit' model were further solidified.

First, our system facilitates skipping close range OGI surveys in equipment that is not emitting. This saves considerable time. Further, if an entire site is clean, LDAR workers do not need to get out of their truck and can immediately proceed to the next site.

Second, immediately investigating anomalies is substantially easier (and likely much lower cost) than reporting results, making office decisions, and then sending out OGI crews for follow-up. If an anomaly is detected, that equipment is surveyed and it is immediately apparent if the equipment is venting or leaking, or there is a more serious safety concern. We believe minimizing post-processing, office work, and off-pad communications is essential to reducing emissions cost effectively. The cost implications of on-site reporting and immediate action can be framed in terms of time. Survey times are very low for our system (~5-10 minutes) – if there is 30 minutes of post-processing and office communications required for each pad, the cost advantages of a method can evaporate. AMFC allowed us to further understand the strength of our immediate reporting approach and the cost savings available.

Together, the AMFC set of experiments provided valuable information for us to continue to enhance and improve the system and has given us new confidence about the suitability of both our approach and technology for cost effective, practical, alternative LDAR.