NEW ERA TECHNOLOGY, INC.

The Complete Aerial Surveying, Remote Sensing, and Reporting Solution for the Oil, Gas, and Product Energy Sector

Volume 1, Issue 4 **March 2020**

From the Desk of the President

Future of Leak Indication Technology

I never thought at any time that our nation and our industry would be facing the type of turmoil and unsettling situation that we are dealing with currently. As we go press with this newsletter there is no end in sight to the problems that we will be facing and certainly no clear answers to what needs to be done in light of the medical emergency and the economic problems that will certainly be coming to everyone in industry in the United States. We do know that we must stay the course and keep moving forward if we are to come out of this in the future.

To that end we at New Era Technology, Inc. are continuing with our development programs for both the new navigation systems and the GEN V3 sensor.

The sensor program, although not where we had hoped it would be at this time is moving forward and some excellent progress can be reported. Many of the components for the assembly are now arriving and the preparations for assembly and testing are being completed. The first of the subassemblies will be completed by the end of March which will allow preliminary testing to begin. Over the next two months each of the unit subassemblies will be thoroughly tested prior to the final assembly being completed. It is anticipated that the final assembly will be completed and installed in the fixed wing aircraft for the initial live testing in mid to late June. We will expect that in the June newsletter that will be able to give more concrete timelines on completion and final testing.

This newsletter and the next issue will continue with technical presentations on remote sensing.

Inside This Issue

Notes from the Scientific Laboratory

Remote Sensing Technology-Past and Present

Forward Looking Infrared (FLIR)

One of the most common technology for the indication of gas leaks is Forward Looking Infrared (FLIR). FLIR consists of a thermal camera taking images or video in infrared and commonly used in commercial and military application to measure the temperature of objects. Note that the main manufacturer of FLIR cameras is a company called FLIR Systems Inc.

In this document, FLIR refers to the technology, not the company.

To detect pipeline leaks, the FLIR camera is tuned to a passband of 3.2 to 3.4 µm. This range is where most hydrocarbon gases have strong emission/absorption bands. ***Figure 1*** shows the infrared absorption bands of methane, with the strongest band at 3.3 µm. When gas leaks from a pipeline, it cools rapidly as the pressure changes. This results in the leaked gas being cold relative to the background. Therefore, any background radiance that passes through the gas will be absorbed, resulting in a reduction of transmitted radiance.

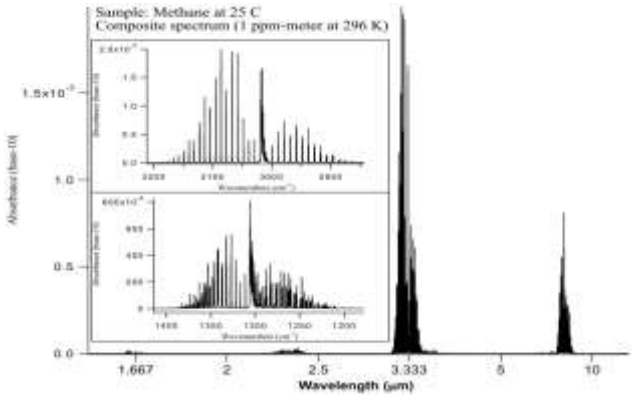

Figure 1: *Absorbance of methane in the infrared* (Pacific Northwest National Laboratory)

The picture on the next page shows a FLIR image of a gas leak. The dark cloud is the gas. The gas looks "black" because it has absorbed the background radiation, similar to how smoke absorbs visible light.

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Update from the Customer Solutions Desk

My name is Paul Marcum and I am the Operations and Account Manager for New Era Technology, Inc. I have been with the New Era Technology for more than four years in my current position. Beginning April 1, 2020 I will be assuming the role of Business Development/Sales Manager.

As many of you know Randy Burkham is no longer with New Era Technology, Inc. as of March 31, 2020. Randy has been a great asset to the company and we wish him the very best in his new endeavors.

New Era Technology, Inc. has some very exciting advances this year with a new camera and navigational system utilizing the latest technology. Additionally, version 3 of our gas filtered radiometric fugitive emissions sensor, which can be mounted on a helicopter or utilized in a fixed-wing aircraft, should be completed this year as well.

Services that New Era Technology. Inc. can provide include:

1) Aerial Patrol Flights (both visual patrol and visual patrol with video)
2) Leak Indication Survey
3) Canopy Studies
4) Disaster Recovery Program
5) GIS Services

I would like to discuss the opportunities that New Era Technology, Inc. can provide your company. Knowing that the next few months are going to be very trying for everyone in the industry I will be adopting a position of being a resource for any information or needs that you have where we can assist. I will continue to keep you updated on what is going on at New Era through this News Letter and email.

My contact information is:

Address: 755 Boardman-Canfield Road
Suite F6 West
Boardman, Ohio 44512

Office Phone (330) 758-1955
Cell Phone (330) 360-3815

Email at pmarcum@neweratechinc.com.

Notes from the Laboratory

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FLIR is rarely used for aerial remote sensing of pipeline leaks.

The main reason is that identifying leak plumes requires an operator to "see" the plume in real time during flight. When looking downward at the ground and traveling at high speeds, an operator would only momentarily see a much less distinctive plume against a highly varying surface background, which makes the system less reliable for aerial leak indication.

Figure 1: *FLIR image of a gas leak.*
http://www.alternet.org/environment/hold-your-breath-nearly-200-infrared-videos-expose-methane-pollution-all-across-united

Advantages:

- Provides images of the plume
- Relatively inexpensive
- Can identify the source of the leak

Disadvantages:

- Not ideal for airborne platforms
- Not easily automated
- Requires a large temperature difference between the gas and the environment
- Not very tunable to different gases
- Not very sensitive
- Does not provide information about the magnitude of the gas plume/leak

Gas-Filter Correlation Radiometry (GFCR)

New Era Technologies Inc. (NETI) is the only aerial pipeline leak indication company that employs a technology known as Gas-Filter Correlation Radiometry (GFCR). GFCR is a well-established remote sensing technology, first employed in satellite remote sensing in 1970, on the Nimbus 4 satellite.

A GFCR consists of a dual channel radiometer. For a nadir viewing remote sensing GFCR, the first channel measures the total upwelling radiance in a spectral passband. The signal from this channel is known as the reference signal (REF). The second channel contains an identical optical chain, except with a gas cell filled with the gas of interest in the optical chain.

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Notes from the Laboratory

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This channel measures the total upwelling radiance in the spectral band, except at those wavelengths at which the gas of interest absorbs. This signal in known as the correlation signal (COR), and is always lower than REF.

To measure the amount of gas of interest that the incoming radiance has passed through, the REF and COR signals are compared. Typically, a proxy signal known as the difference to average ratio (D2A) is calculated from the REF and COR signals. This signal equals the difference between REF and COR divided by the average:

$$D2A = \frac{2(REF - COR)}{(REF + COR)}$$

D2A is convenient as it is unitless and, to first order, independent of changes in the incoming radiance (e.g. due to changes in surface reflectivity).

For nadir-viewing airborne remote sensing, NETI designed a new type of GFCR known as a Simultaneous View Correlation Radiometer (SVCR). In this configuration, the incoming radiance is split into two identical optical paths and the REF and COR channels are measured at the same time (***Figure 7***). To achieve this split and keep the optical chain as simple as possible, a single biaxially split optical chain was developed. Also, to achieve a separation in the FOVs of the REF and COR channels at the detector, two biaxial wedges were placed in the optical path. This configuration allows the simultaneous measurement of REF and COR signals over the same FOV, thus correlating the noise in the detected REF and COR signals induced by surface variations. Therefore, to first order, surface noise is removed from the D2A signals.

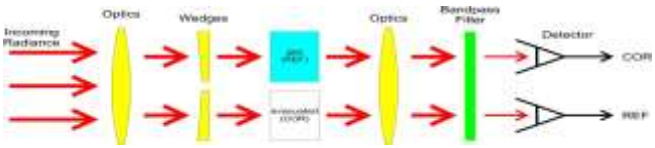

Figure 1: *Schematic of a Simultaneous View Correlation Radiometer (SVCR).*

These REF and COR signals of a SVCR are similar in concept to the λ_{off} and λ_{on} signals of DIAL measurements, in that one signal is sensitive to the gas of interest and the other is not. However, the main difference between SVCR and DIAL is that the two SVCR signals are measured simultaneously (temporal and spatial) and DIAL is not.

Another big difference between the SVCR leak indication service provided by NETI (marketed under the name Sentinel™) and DIAL is that the passband of Sentinel™ is tuned to the 3.3 µm band of methane (or ethane), compared to the 1.65 µm band of DIAL. As seen in ***Figure 1***, the absorption bands at 3.3 µm is orders of magnitude stronger than at 1.65 µm.

Sentinel™ was designed to provide true images of the plume of leaked gas. An example image of a leak is shown in ***Figure 1***.

Sentinel™ is a pushbroom type imager, which means the detector consists of a linear array of pixels oriented perpendicular to the direction of travel. This means that as the aircraft moves forward, an image along the surface is created. Sentinel™ has a 32×1 pixel detector array with an on-ground pixel FOV of ≈2 m (from a nominal flight altitude of ≈1000 ft, 300 m). Sentinel™ provides the widest of all commercial airborne pipeline remote sensing technologies of 64 m (210 ft).

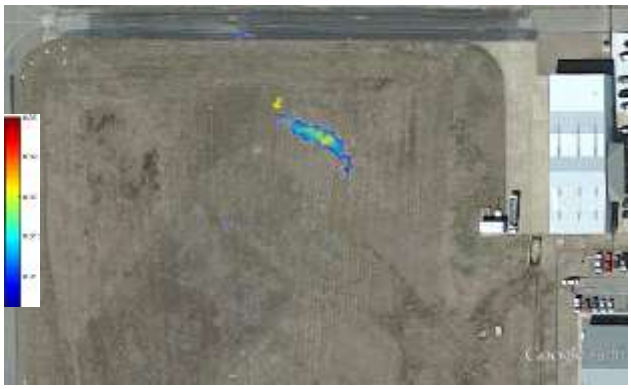

Figure 1: *Sentinel™ leak anomaly detected during a leak test on April 31, 2016. Flow rate was 400 litres per minute.*

One final consideration is the operational requirements of the Sentinel™ system. Sentinel™ was designed to often fly at an altitude of ≈1000 ft. This allows Sentinel™ to be operated in residential areas without requiring special flight permits. This altitude is much higher and significantly safer than most other remote sensing technologies.

Advantages:

- Provides images of the plume
- Can identify the source of the leak
- Good Sensitivity
- Operates at a high, safe altitude (300 m, 1000 ft)
- Provides a wide across-track image swath (64 m, 210 ft)
- Detects in 3.3 µm range, the strongest absorption band for hydrocarbons

Disadvantages:

- Requires sunlight for measurement
- Poor performance over water+

New Era Aircraft

The current fleet of aircraft for New Era consists of Cessna 206, Cessna 182, Cessna 172 and Symphony 160. The company is looking to add two more Symphony 160 aircraft to the fleet later this year.

Cessna 206

Symphony 160

With the expected success of the new sensor in 2020 New Era will be adding aviation partners to accommodate the expected growth and demand for the leak indication that will come in the United States and Canada.

Helicopter option where it is most economical for the client.

NEW ERA TECHNOLOGY, INC.

Contacts

Home Office

New Era Technology, Inc.
755 Boardman-Canfield Road
Suite F6 West
Boardman, Ohio 44512

www.NewEraTechInc.com

Aircraft Locations

North Lima, Ohio (4G4)

Salisbury, North Carolina (KRUQ)

Houston, Texas (KTME)

Future Newsletters

Issue Dates:

June 2020
September 2020
December 2020

Future contents:

Progress reports on sensor development
Details on navigation system
Business Updates
Technical Updates
Who's Who at New Era