Automation of Fence-Line Air Monitoring Systems:

NEMC 2021

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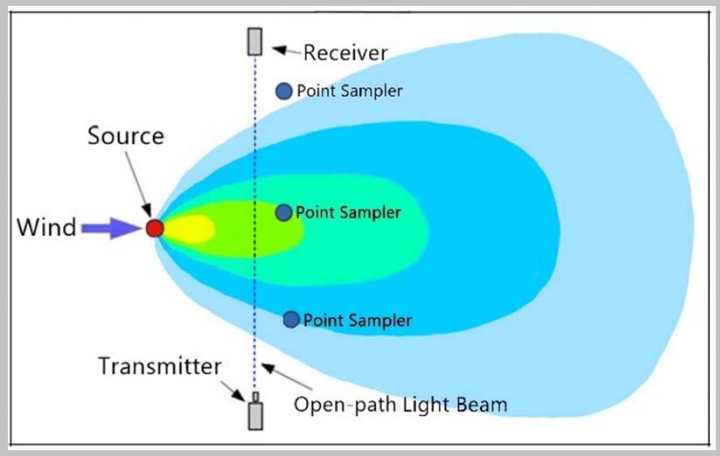
Objective of this Presentation

Describe	Describe how automation of fence-line air monitoring systems enhance their data quality and operational performance.
Present	Present elements of the monitoring systems that can be automated.
Highlight	Highlight examples of automation used in real-world applications.
Summarize	Path forward for continued work in this area

How do the systems work?

- Open-path air monitoring systems use beams to light to detect gases.
- Light is generated using either a light bulb or a laser.
- Light is projected out into the air.
- At the other end of the path an analyzer examines the light to determine which gases were present in the light beam.



The Goal of the Measurement Program:

Ensure the real-time results from the fence-line air monitoring system are as accurate as possible.

Maintain maximum operational performance.

Anticipate situations that could result in system downtime.

Open-Path Fence-Line Monitors

Open-path air monitors are set up at the boundary of an industrial facility with light beams running parallel to communities downwind of the pollution source. The beam path is typically 100-1,000 meters.

Beams can be different types of light sources including broadband infrared, broadband ultraviolet, or lasers.

Advantages of broadband systems are that you can look for more than one gas with the same system.

Open-path FTIR, Open-path UV, Tunable Diode Lasers.

Open-Path UV Air Monitoring Overview

Key Advantages of Open-Path Air Monitoring Systems

- Real-time results for single gases or mixtures.
- Low detection limits – below health impact standards.
- The non-contact test method does not compromise the sample.
- There are no analytic costs associated with the data.
- The raw data can be stored and reviewed at a later date for unknown gases in the air.
- The presence of gases can easily be verified and presented to end-users.

Sound Simple?

It isn't… There are all sorts of things that make the measurement process difficult.

- Cross interference of gases
- Temperature sensitivity of the analyzers
- Variation in the light signal
- Gases not included in the analytic software
- Improper maintenance

How we achieve these goals:

Integrate Data Quality Checks published by the EPA with performance checks based on real-world experience.

Work with manufactures to identify specific operational performance boundaries for their technologies.

Embed real-time system checks into the measurement process to track operational performance.

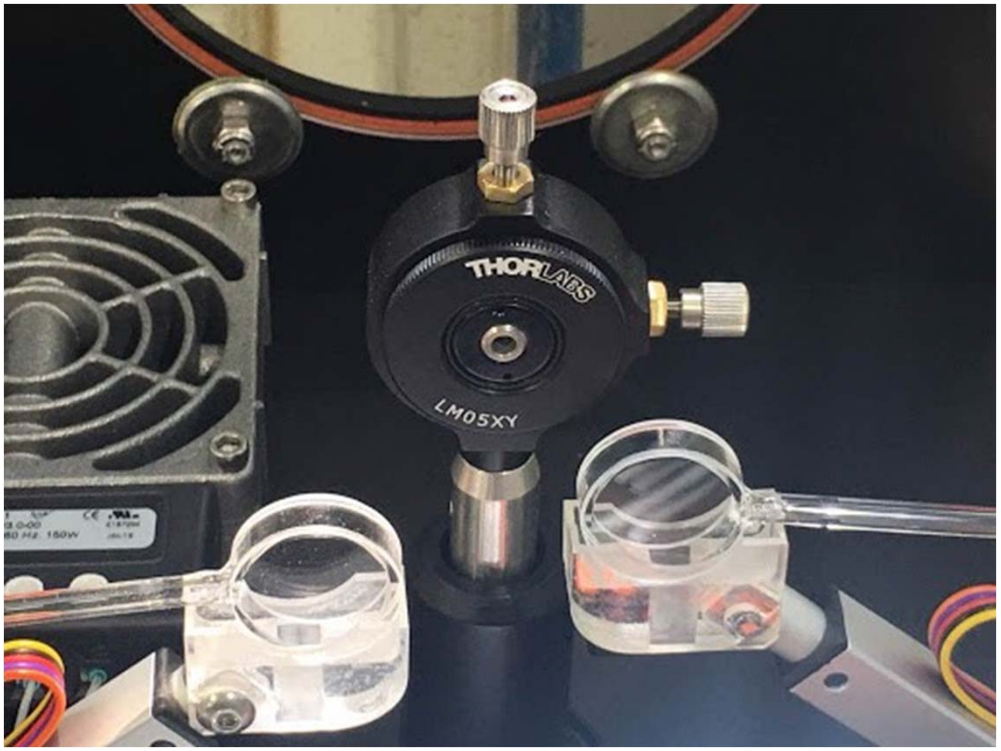
Perform a graduated system review of system performance, data quantification. Checks occur in real-time, daily, weekly, monthly, quarterly and annually. Each set builds on prior checks.

Focus Areas

- Calibration
- Alignment
- Operational Checks

Remote Calibration System

Using robotics, open-path systems can be remotely challenged using sealed gas cells that can be directly inserted into the beam-path.



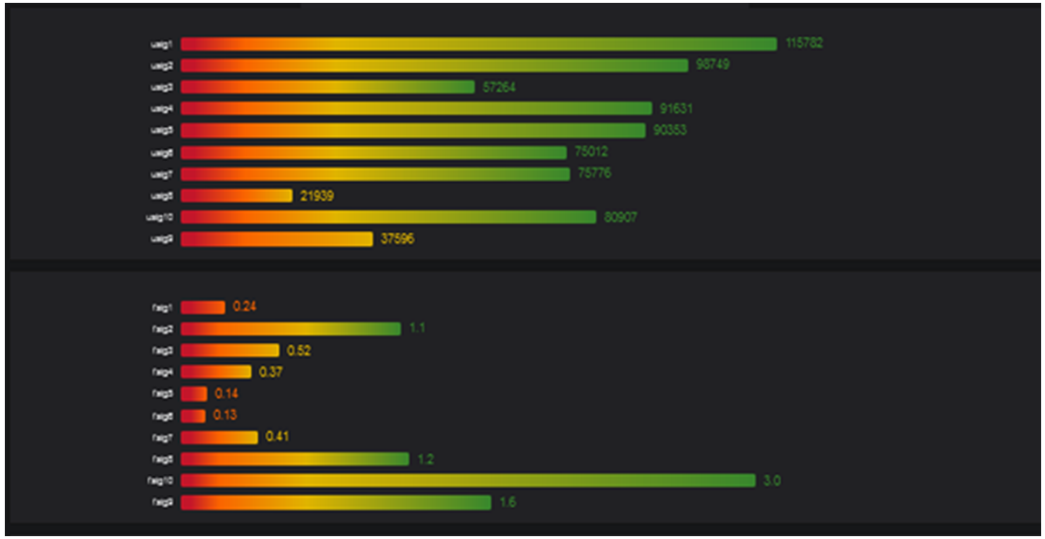
Automated QA/QC

Daily Calibration Checks

Sample Date	Time	Site Name	File Number	Path Length (meters)	Benzene (ppb)	Benzene (R^2)
7/31/2020	15:58	UV5-QA	42	900	0.86	0.01
7/31/2020	15:59	UV5-QA	43	900	0.81	0.16
7/31/2020	16:00	UV5-QA	44	900	0.77	0.18
7/31/2020	16:01	UV5-QA	45	900	48.37	0.99
7/31/2020	16:02	UV5-QA	46	900	47.21	0.99
7/31/2020	16:03	UV5-QA	47	900	47.59	0.97
7/31/2020	16:04	UV5-QA	48	900	0.89	0.21
7/31/2020	16:05	UV5-QA	49	900	0.92	0.04
7/31/2020	16:06	UV5-QA	50	900	0.68	0.13

Real-time Optical Alignment

Open-path fence line air monitoring systems can become optically misaligned while collecting data in the field. This results in decreased data quality or even complete loss of data.



Remote/Automated Alignment

Automated Positioning

Sample Date	Site Name	File Number	Path Length (m)	Light Signal	Light Level
7/24/2018 12:44	Fenceline 1	11180	900	18,634	Low
7/24/2018 12:45	Fenceline 1	11181	900	18,730	Low
7/24/2018 12:48	Fenceline 1	11182	900	88,785	OK
7/24/2018 12:49	Fenceline 1	11183	900	88,321	OK
7/24/2018 12:50	Fenceline 1	11184	900	85,551	OK
7/24/2018 12:51	Fenceline 1	11185	900	88,482	OK
7/24/2018 12:53	Fenceline 1	11186	900	86,949	OK
7/24/2018 12:54	Fenceline 1	11187	900	86,284	OK

Real-time Date Validity Checks

Fence-line monitoring programs often collect data from instruments and report results on a real-time basis to the public. It is vitally important to make sure the results of the data are screened to ensure information is as accurate as possible.

Real-time Data Validity

Real-time data validity can be enhanced by processing the data using two independent analytic methods. If both methods produce similar results, then the results are considered valid.

Sample Date	Site Name	File Number	Path Length (meters)	Ben R2 (PLS)	Ben-PPB (PLS)	Detect
7/31/2018 15:58	UV5- QA	42	900	0.01	1.06	No
7/31/2018 16:06	UV5- QA	43	900	0.16	1.18	No
7/31/2018 16:11	UV5- QA	44	900	0.99	36.74	Detect
7/31/2018 16:16	UV5- QA	45	900	0.99	48.37	Detect
7/31/2018 16:21	UV5- QA	46	900	0.99	48.36	Detect
7/31/2018 16:26	UV5- QA	47	900	0.98	14.65	Detect
7/31/2018 16:31	UV5- QA	48	900	0.18	1.51	No

Real-time Checks

Goal – Ensure data sent to real-time website is valid.

Check Type	Check	Frenquency
Instrumentation	Light Signal from Optical Remote Sensors	Real-time
Instrumentation	Instrument Error Codes	Real-time
Instrumentation	Environmental Checks for UV	Real-time
Data	Quantitative/Qualitive Data Check	Real-time
Data	FTIR - Methane and N2O	Real-time
Data	UV - Oxygen and Ozone	Real-time
Program	Analyzer has low signal	Real-time
Program	Analyzer off-line	Real-time
Program	Workstation fails	Real-time
Program	Internet communication failure	Real-time
Program	Gas detected above alarm value	Real-time

Key Points

- The intent of the automation is to ensure the monitoring goals are met.
- The majority of the automation enhancements can be performed remotely using embedded hardware and software.
- Typical system performance goal is 99% + operational efficiency.