Detection of Natural Gas Pipeline Leaks and their Health Consequences using Airborne Lidar

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Presentation

• Health Hazard Issue
• Current Detection Methodologies
• The Challenge to Detect Leakages
• Lidar Detection Methodologies
• Advantages for Lidar Detection
• Summary
Health Hazard Issue

- Natural gas (Methane) poses a risk to human health, public safety, and the environment
- Colorless, odorless
- Difficult to locate emissions accurately and quantify the risk
- 2.3 million miles of natural gas pipeline in the US (60,000 miles of primary lines)
US Primary NG Pipelines
Health Hazard Issue

- Nearly all pipelines leak: old age, aged welds, construction defects, corrosion, third party ruptures, natural/environmental causes
- Government standards mandate “leak surveys” up to 4 times per year which is economically impossible.
Challenge to Detect Leakages

• Most pipelines are 2 to 4 feet underground
• Minor leaks are difficult to locate with traditional methods:
  – Visual Observation along corridors to locate secondary indicators (stressed vegetation)
  – Walking the corridor with a “sniffer”
• Inspection Frequency: 3 to 10 years
• A small leak undetected can result in enormous damage.
Challenge to Detect Leakages

**Flame Ionization Spectroscopy**
- Hand-held device
- Slow – 1 mph
- Need to come in contact with the plume
- Difficult terrain and property issues
- Industry standard equipment

**Pass-through Optical Sensors**
- Truck mounted sensor
- Slow – 5 mph
- Need to come in contact with the plume
- Difficult terrain and property issues
- Easily damaged
Lidar Detection Methodologies

- Possible to use remote sensing technologies: lidar + imagery
- Cover long distances in one day
- Detect, georeference, and quantify leaks
- Provide rapid turnaround time
- Evaluate the health risks in a GIS with current data
**Differential Absorption Lidar (DIAL)**

- Utilize two lasers at different wavelengths
- Calibrated to fit the same footprint
- Measure the difference between the return signals to ‘map’ and detect the concentration of the gas leak
- Lidar pulses at 3,000 pulses per second
- 1 meter pulse spacing at 500 m AGL
- Fly 1,600 km per day
- Deliver results in GIS in 24 hours
ANGEL System
(Airborne Natural Gas Emission Lidar)

- Developed by ITT Industries Space Systems Division
- Dual Laser System, GPS/IMU, Georeferenced Color Imagery, “Active Pointing”, GIS Workflow
- Final Product: 3D Color-coded Model of Emission, 30 cm resolution Color Digital Orthophoto
ANGEL Operations

ANGEL DIAL Sensor in Cessna 208 B
Operational Characteristics

Elliptical Scan Pattern (Rotating Mirror)
ANGEL Operations

Pipeline Data from Client

Pipeline Position
ANGEL Operations

Pipeline Integrated with Flight Path and Imagery

- Flight Path
- Pipeline Position
ANGEL Operations

DIAL Scan Overlaid on Pipeline

Flight Path

Scan Pattern
ANGEL Operations

“Blue Ribbon” Analytical Layer

Potential Leak

Flight Path >
Emission Identification

Buried Transmission Line Leaking from a 2-in. Crack
Emission Identification in GIS
Summary

• DIAL technology provides accurate leak detection and quantification
• Captures color imagery leading to survey-grade orthophotography of corridors
• Captures wide-angle color video of surrounding areas
• Operates ~100x faster than other methods
• Safe methodology & Less Expensive
• GIS –ready, accurate datasets
Additional Applications

- Inspection of NG Storage facilities
- Detection of Other Leaks (re-calibrate lasers)
  - Oil Spills
  - Propane
  - Gasoline
  - Diesel Fuel
Thank You......

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