History of Optical Gas Imaging
How Does Optical Gas Imaging Work?
How Does Optical Gas Imaging Work?
How Does Optical Gas Imaging Work?
The Science Behind Optical Gas Imaging
Electromagnetic Spectrum

Gamma Ray    X-Ray    Ultraviolet    Visible    Infrared    Microwave    Radio

shorter wavelength      higher frequency    higher energy

longer wavelength      lower frequency    lower energy

Visible: 0.4-0.7 µm
Mid wave Infrared: 3-5 µm
Long wave Infrared: 7-14 µm
Understanding Wavelengths

How do you “tune” an OGI camera for specific gases?

IR Spectra of Common Industrial Gases

* Data intentionally skewed to protect proprietary filter location
Filters….Not Just for Coffee
The Science Behind OGI

Midwave OGI Camera with Cooled Detector

We “match” the spectral response of the camera to the “peak” spectral absorption of the gas by filtering!

* Data intentionally skewed to protect proprietary filter location
What about Longwave IR?

* Data intentionally skewed to protect proprietary filter location
OGI Filtering (Cooled Camera)

Infrared Energy

IR Lens

Spectral Filter

Cold Shield

IR Detector

Camera Body

Detector and filter are cryogenically cooled to ensure minimal thermal emissions (Down to -321°F)
OGI Filtering (Uncooled Camera)

- Infrared Energy
- IR Lens
- Spectral Filter added to the IR lens
- Camera Body
- IR Detector
- Uncooled detector does not need additional parts for cooling
Cameras Designed for Many Gases

IR Spectra of Common Industrial Gases

- Methane
- CO₂
- CO
- R-22
- SF6

* Data intentionally skewed to protect proprietary filter location
IR Wavelengths: Functional vs Fingerprint
IR Spectra of Common Hydrocarbon Gases

Propane, Benzene, Methane, Ethylene

Functional Region

Fingerprint Region
Functional Region Filter (3.1µ – 3.6µ)

Propane, Benzene, Methane, Ethylene

Assuming a filtered region of ~ 200 nanometers

* Data intentionally skewed to protect proprietary filter location
Fingerprint Region Filter (7µ – 12µ)

Transmission (7.000 – 12.000)

**Propane, Benzene, Methane, Ethylene**

Assuming a filtered region of ~ 200 nanometers

* Data intentionally skewed to protect proprietary filter location
Choosing a Filter

…a Delicate Balance with Uncooled OGI
Sensitivity of OGI Cameras

Uncooled

Cooled
Why is Camera Sensitivity Important for OGI?

Uncooled camera: 7-14µm
NETD ~ 100 mK

GF320: 3.2-3.4µm
NETD ~ 15 mK

ΔT = 22°, Methane flow = 10 liter/min, Wind 5-10 m/s, Rel. humidity = 23%

NECL = 1000 ppmxm
ε = 0.67

Methane

NECL = 13 ppmxm
ε = 0.78
Uncooled OGI: Filter for a Single Gas?

Propane, Benzene, Methane, Ethylene

Assuming a filtered region of ~ 200 nanometers

* Data intentionally skewed to protect proprietary filter location
Thermal Sensitivity Effects with Filters

Applied to Uncooled OGI Cameras

And image from a camera with a wider filter would have high sensitivity

With a narrow filter bandpass in an uncooled imager the image quality would deteriorate
**Uncooled OGI: Just Make a Bigger Filter?**

**Propane, Benzene, Methane, Ethylene**

*Data intentionally skewed to protect proprietary filter location*
Gas Contrast with Uncooled OGI

Uncooled camera with no filter:

NECL = 1000 ppm*m

Uncooled camera w/ filter ~7 – 8.5 µm:

NECL = 100 ppm*m
Finding the Right Filter

Propane, Benzene, Methane, Ethylene

Assuming a filtered region of ~ 200 nanometers

* Data intentionally skewed to protect proprietary filter location
The “Cooled vs Uncooled” Question

The Advantages of an Uncooled OGI Solution
- Lower in cost
- Requires less maintenance with no cooler
- Some gases can only be seen in the fingerprint (LWIR) region (Sulfur Dioxide, Nitrous Oxide)
- **Challenge**: Must get the filter right with sensitivity and gas contrast balance

So Why Pay More for a Cooled OGI Solution
- Cooled solutions still provide unmatched results, more resolution and better sensitivity
- Many regulatory standards require a cooled OGI camera (OOOOa, M21 – AWP)
- Many features are only available with the cooled solutions (QOGI, Ex Rating)
- Cooled cameras work in the functional (MWIR) region to visualize all hydrocarbons
Questions

Craig O’Neill
Director of Business Development
FLIR Systems Inc.
+1-800-224-6003
craig.oneill@flir.com