Gas Imaging Cameras - Making Invisible Gas Leaks Visible

Steve BEYNON is EMEA Gas Imaging Business Development Manager for FLIR Commercial Systems
2 Kings Hill Avenue , Kings Hill, West Malling, Kent , United Kingdom
Tel: +44 1732 220011 • email: gasimaging@flir.com

Many chemical compounds and gases are invisible to the naked eye. Yet many companies work intensively with these substances before, during and after their production processes. This article discusses how thermal imaging cameras can be adapted to visualise fugitive gas leaks. The GF-Series thermal imaging cameras from FLIR Systems (see figure 1) were developed to produce a full picture of the scanned area and visualise gas leaks as 'smoke like images' on the camera's viewfinder or on an inbuilt LCD, thereby allowing the user to see fugitive gas emissions. The GF-Series imaging technology allows gas leaks to be viewed in real time and images recorded in the camera for easy archiving.

The Gas Imaging Camera – Why is it different?

The construction of a thermal imaging camera is similar to the construction of a digital video camera. There is a lens, a detector, some electronics to process the signal from the detector and a viewfinder or screen for the user to see the image produced by the camera. The detectors used for the Gas Imaging cameras are quantum detectors that require cooling to cryogenic temperatures (around 70K or -203°C). Gas Imaging Cameras operating in the mid-wave infrared region (MWIR) use an Indium Antimonide (InSb) detector, those operating in the long wave infrared region (LWIR) use a quantum well infrared photodetector (QWIP) detector.

Figure 1: A Gas Imaging Camera (in action)

Image Normalization

Each individual detector in a Focal Plane Array (FPA) has a slightly different gain and zero offset. To create a useful thermographic image, the different gains and offsets must be corrected to a normalised value. This multistep calibration process is typically performed by the camera software. The final step in the process is the Non-Uniformity Correction (NUC). In measurement cameras, this calibration is performed automatically by the camera. In the GF Series Gas Imaging Camera, the calibration is a manual process. This is because the camera does not have an internal shutter to present a uniform temperature source to the detector.

The ultimate result of this normalisation process is to produce a thermographic image that accurately portrays relative temperature across a target object or scene. No compensation is made for emissivity or the radiation from other objects that is reflected from the target object back into the camera (reflected apparent temperature). The image is a true illustration of radiation intensity regardless of the source of thermal radiation

Spectral Adaption

The gas imaging camera differs from measurement cameras. In addition to the lens, detector, cooler and image processing electronics there is a filter mounted on the front of the detector. This filter is cooled with the detector to prevent any radiation exchange between the filter and the detector. The filter restricts the wavelengths of radiation allowed to pass through to the detector to a very narrow band called spectral adaption.
The filter band wavelengths for the different gas detection cameras are shown below:

Camera Model	Detector Spectral Range	Filter Waveband
Mid Wave	3-5 μm	Approx. 3.3 μm
Long Wave	10-11 μm	Approx. 10.5 μm

Infrared Gas Absorption Spectra

For many gases, the ability to absorb infrared radiation depends on the wavelengths of the radiation. In other words, their degree of transparency varies with wavelengths. There may be IR wavelengths where they are essentially opaque due to absorption. Physical property databanks exist containing infrared absorption data for many substances. To determine the infrared absorption spectrum for a gas - a sample is placed in an Infrared Spectrometer and the absorption (or transmission) of infrared radiation is measured at different wavelengths. The resultant absorption data are normally published as graphs (or spectra).

Gas Imaging Cameras take advantage of the absorbing nature of certain gas molecules, to visualise them in their native environments. These cameras use a filter that restricts the camera to operating in a narrow spectral range where the gas to be detected has high absorption thereby selectively enhancing the detection (visualisation) of the gas leak.

Conclusion

FLIR gas imaging cameras were developed to provide preventative maintenance solutions that help spot leaks in tanks, pipelines and facilities. They have been proven worldwide to improve safety and profitability and minimise emissions thereby reducing the risk of business interruptions. The FLIR GF-Series are capable of rapidly scanning large areas of piping, monitoring furnaces, heaters and boilers and detecting / visualising gases such as SF_6 (Sulphur Hexafluoride) and 24 other harmful gases quickly, from a safe distance.

To learn more about the visualising gas leaks using thermal imaging technology a free 40-page guide to gas imaging may be downloaded from www.flir.com/thermography/eurasia/en/landingpage/?id=31208.

FLIR Systems is the world leader in the design and manufacturing of thermal imaging cameras for a wide range of applications.