MR-i

Hyperspectral Imaging FT-Spectroradiometers Radiometric Accuracy for Infrared Signature Measurements

Power and productivity
for a better world™

FT-IR Spectroradiometry Applications

Spectroradiometry applications

From scientific research to deployable operational solutions, Fourier Transform Infrared (FT-IR) spectroradiometry has been established as an ideal technology to develop and enhance various military applications. For the defense industry, FT-IR spectroradiometry is used for:

– camouflage system development and thermal signature optimization;
– characterization of thermal emission signatures of aircraft engines;
– development, analysis and improvement of IR decoy emission spectra and advanced counter-measure systems;
– classifying fugitive emissions for developing infrared signature databases;
– classifying battlespace detonations, including bomb-hit detonation, muzzle flash, and missile launches;
– remote sensing of battlefield conditions for developing various deployable reconnaissance solutions.

This powerful and innovative technique extends engineering modeling applications. It is also used to improve various types of IR emitting sources. FT-IR imaging spectroradiometers provide key information for modeling IR emitted source of energy and mapping the spatial evolution of the radiance.

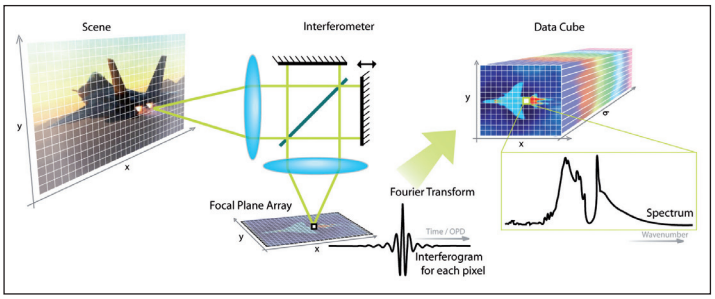
Combining the imaging spectroradiometer radiance measurement with retrieval algorithms enables the mapping of various atmospheric applications such as:

– meteorological turbulence sounding;
– atmospheric composition analysis;
– Stand-off detection and monitoring of a chemical cloud.

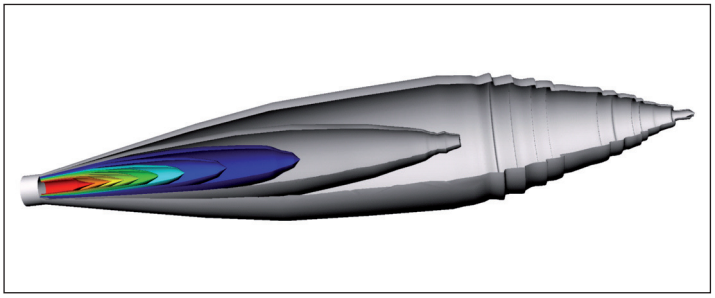
Technology

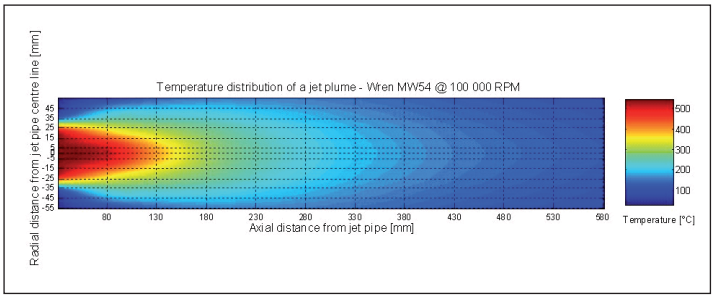
While conventional mono-pixel FT-IR spectroradiometers offer unique performance such as higher spectral resolution and enhanced sensitivity over the instrument field of view (FOV), multi-pixel FT-IR hyperspectral imagers now extend possibilities in infrared characterization. They provide accurate spatial characterization of a target's signature by spatially resolving the essential characteristics over the observed scene.

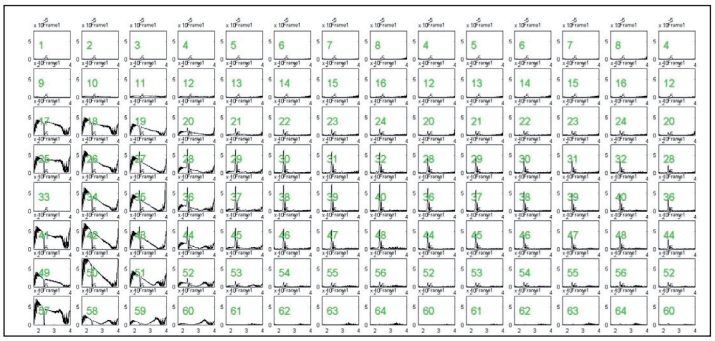
The captured data is further exploited by combining the spectral and spatial information of the scene. As a result, an FT-IR imaging spectroradiometer has the unique capability of generating 3D images (2D images with spectral bands in the Z axis) providing a spectrum with every pixel of the mapped scene.



Schematized imaging Fourier transform spectroradiometer







IR characterization and modeling of a rocket plume

The Forefront of Imaging Spectroscopy

With over 35 years of innovation and being recognized as a world leader in spectroscopy, ABB is expanding its line of remote sensing products with a newly developed FT-IR hyperspectral imaging spectroradiometer. The MR-i features include the following.

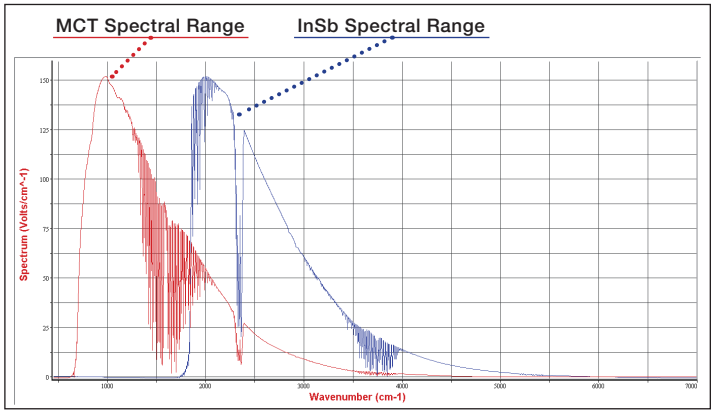
Proven robust design

The MR-i is a commercial FT-IR imaging spectroradiometer. Its design is based on the ABB Bomem MR-Series spectroradiometers. It operates using the same MR304 / MR170 frictionless and rugged 4-port interferometer architecture.

Dual-camera configuration

The MR-i is the first commercially available FT-IR hyperspectral imaging spectoradiometer capable of dual-camera operation, simultaneously covering the MWIR and LWIR of the electromagnetic spectrum. The MR-i 4-port interferometer can accommodate a combination of two different types of camera modules (MWIR/LWIR), extending the instrument spectral range coverage or a combination of two identical camera modules (MWIR/MWIR), extending the instrument dynamic range. With this unique feature, the MR-i is capable of simultaneously acquiring and perfectly synchronizing the data of two interchangeable camera modules, making the instrument adaptable to multiple measurement scenarios.

Configuring the MR-i with two detection modules is like combining the functions of two imaging spectroradiometers in a single instrument, providing the following advantages:
– perfect synchronization of both cameras;
– ease of operation using one user interface;
– lower acquisition cost;
– lower maintenance costs.

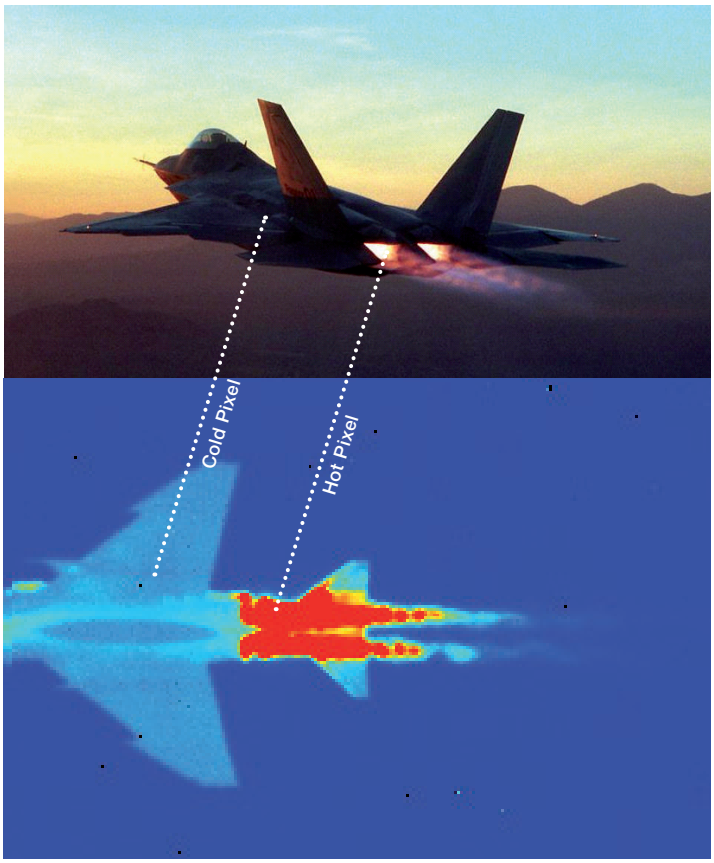


The MR-i dual detector broad spectral range

Sensitivity / extended dynamic range

Some applications such as targeting an infrared signature often require simultaneous measurements of low and high intensity emission sources randomly dispersed over the mapped scene. The signal-to-noise performance of each individual detection module is affected by the integration time of the camera. Setting the integration time in respect to the energy level of the hot pixels will negatively impact the signal-to-noise performance of the cold pixels in the scene. On the other hand, having the integration time pre-set for maximum signal-to-noise performance of the cold pixels will cause saturation on the hot pixels.

The MR-i offers an unmatched sensitivity for the characterization of a target's IR signature. With both ports equipped with detector modules covering the same spectral range (MWIR-MWIR or LWIR-LWIR), they can be individually set to different gains or integration time to extend the dynamic range of the instrument. This greatly enhances the brightest and faintest areas of the observed scene.



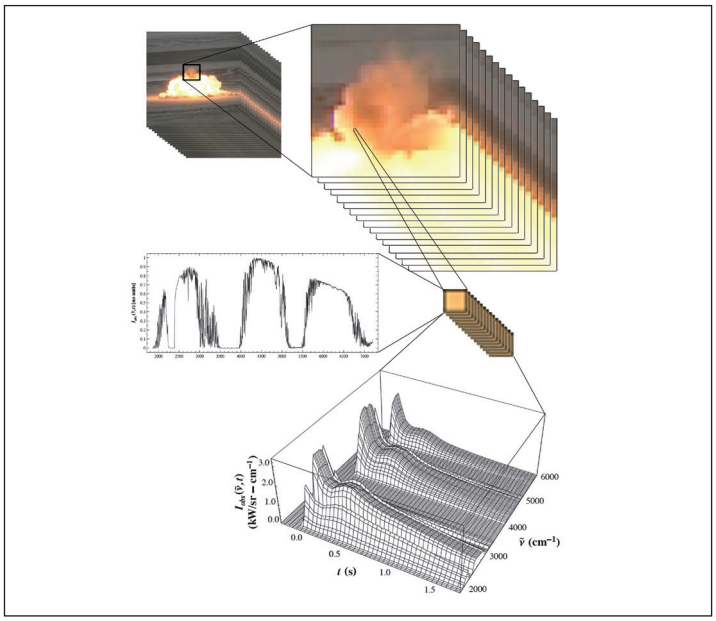
Dynamic Range of an Observed Scene

Fast scanning data acquisition rate

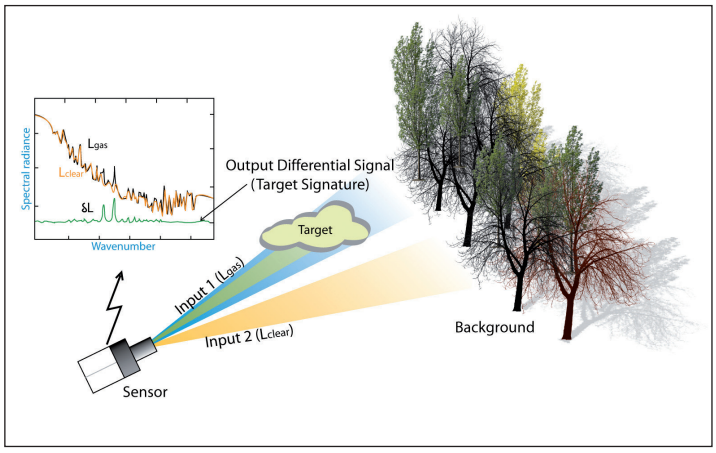
The MR-i is the fastest commercially available FT-IR imaging spectroradiometer ever built. It generates the highest datacube measurement rate on the market. The MR-i is equipped with state-of-the-art cameras modules capable of the highest frame measurement rate available and is perfectly suited for the characterization of fast moving and rapidly evolving targets. The combination of both camera modules in a single instrument generates an unprecedented measurement rate and provides the best combination of spectral coverage, dynamic range, time resolution and spatial resolution performance ever seen on a COTS FT-IR imaging spectroradiometer instrument.

Differential optical subtraction

The MR-i can be configured with a linear array multi-pixel sensor optimised for differential acquisition in the VLWIR (cut off near 14µm). For this configuration, the instrument is equipped with a dual-input telescope capable of optical background subtraction. The resulting signal is the differential between the spectral radiance entering each input port, eliminating the clutter impact of the background. This specific configuration has been designed to support scientific research related to stand-off detection and identification of chemical agent threats.



The MR-i Spatial, Spectral and Time Resolution



Differential optical subtraction

Modular / self-configurable instrument

The MR-i can easily adapt to multiple applications. It is designed with user-configurable modular architecture, providing the user with the flexibility to adapt the instrument to the characteristics of a specific measurement scenario. The MR-i can be reconfigured by the user without the need for re-calibration or factory reworks by simply interchanging or combining various detection modules or input telescopes.

MR-i Modules

1 MR-i Spectroradiometer
2 Camera/detector module A
3 Camera/detector module B
4 Input telescope
5 Radiometric calibration sources

The MR-i Modular Design

MR-Series Heritage

ABB designed multiple passive FT-IR radiometers based on high-resolution Fourier-Transform spectrometry for spaceborne applications. Today, ABB technology is used in various satellites for remote sensing applications such as:
– earth observation;
– climatology;
– atmospheric sounding.

In spacecraft, ABB FT-IR radiometers are used to detect, identify and quantify each distinct species of gas in our atmosphere, based on the characteristics of their respective IR signatures.

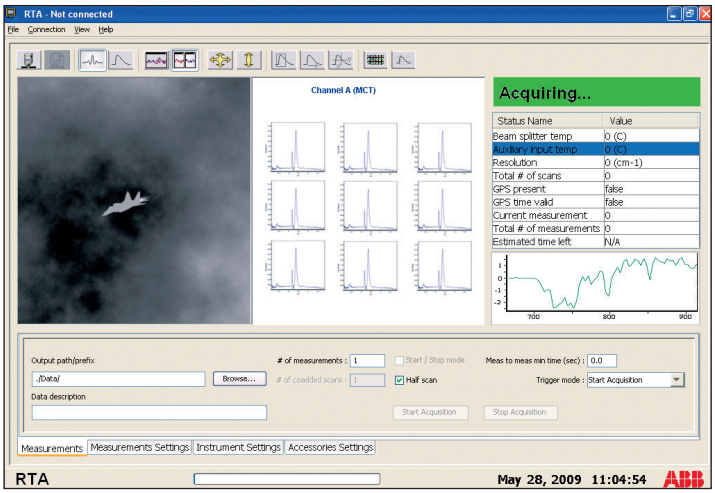
For over three decades, ABB has dominated the market by offering a comprehensive portfolio of highly reliable, rugged and field-proven FT-IR spectroradiometers used for various remote sensing applications.

15 years ago, ABB introduced the MR-Series FT-IR spectroradiometer for defense and atmospheric research organizations. There are now over 150 instruments routinely used throughout the world.

MR-Series spectroradiometers have earned an excellent reputation based on:
– exceptionally high radiometric reproducibility;
– wavelength accuracy;
– high sensitivity;
– high spectral resolution;
– field operation reliability.

The new MR-i

The MR-i is built from the same proven technology and 4-port FT-IR configuration as used in the MR-Series spectroradiometers. ABB incorporated all the lessons learned and experience gained from the MR series when developing the new MR-i hyperspectral imaging spectroradiometer. This new spectroradiometer includes:
– newly developed acquisition and post-processing software modules;
– state-of-the-art IR cameras;
– improved optical configuration adapted for best imaging performances;
– our latest digitalization algorithms (time sampling).



The MR-i is the solution in hyperspectral imaging spectroradiometry.

The MR-i is the only imaging spectroradiometer solution on the market offering:

– wide spectral range coverage;
– high dynamic range and signal-to-noise ratio;
– high time resolution;
– high spectral resolution;
– high spatial resolution;
– high accuracy;
– high reliability.

Contact us

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About ABB

ABB Analytical Measurement continues to set the standards for FT-IR Spectroradiometry used in military, meteorological, and environmental applications. Building on more than 35 years of experience in Fourier spectrometers and optical instrumentation ABB's engineering department has the expertise and capabilities to efficiently serve customers interested in remote sensing aerospace applications. Its dedicated team of engineers offers the best solutions with reliable airborne and spaceborne instruments, infrared calibration systems, hyperspectral imagers, and software for ground segments and simulation.

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