

VSR

VERSATILE SPECTRO-RADIOMETER
FOR INFRARED APPLICATIONS



PERFORMANCE
WITHOUT
COMPROMISE



LR Tech inc.
47 Saint-Joseph street
Lévis, Qc, G6V 1A8
Canada

lrtech.ca

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The extensive FTS experience of LR Tech has helped me and my team overcome many ground-based and air-borne experimental challenges.

- Dr. Tracy Smithson

High spectral resolution

The VSR™ achieves a high spectral resolution for a compact field instrument, while preserving sensitivity and high scan rates (Figure 1, p. 3)

Robust telescope options

The VSR™ field of view is telescope dependent. Changing telescopes is easy; no optical realignment is required thanks to collimated beam interfaces.

Cryogen-free operation

2 cryogen-free high-emissivity cold reference sources are available, offering rock-solid stability without the need for cryogenes.

User-friendly software

The EDGAR™ and the Anneth™ softwares provide radiance, irradiance and brightness temperature in real-time to simplify data validation in the field. (p. 5)

Flexible operation

Change the spectral resolution and speed of the VSR™ by using a hardware interface or remotely, using the Edgar™ or the Anneth™ softwares.

THE ADVANTAGES

High sensitivity

More photons are captured by a Fourier transform interferometer in the infrared region (FT-IR) than either filter-based or dispersive instruments.

High-speed, robust operation

The VSR™ scanning mechanism is designed for reliable field operation even in adverse environments including vibration. (Figure 6, p. 6)

Ultra-wide bandwidth

With its unique 3 detectors configuration, the VSR™ can cover the MWIR, LWIR and SWIR range. (Figure 1, p. 3)

Instrument longevity

To support robust field operation and the ultra-wide spectral range, non-hygroscopic materials are used for the high-efficiency beamsplitter/combiner optics.

Unmatched usability and field support

The VSR™ provides extensive housekeeping data recording of temperature and voltages, as well as remote control software suites. Just connect the VSR™ to the internet and an LR Tech expert can perform health monitoring and obtain an accurate diagnostic in minutes.

THE VSR

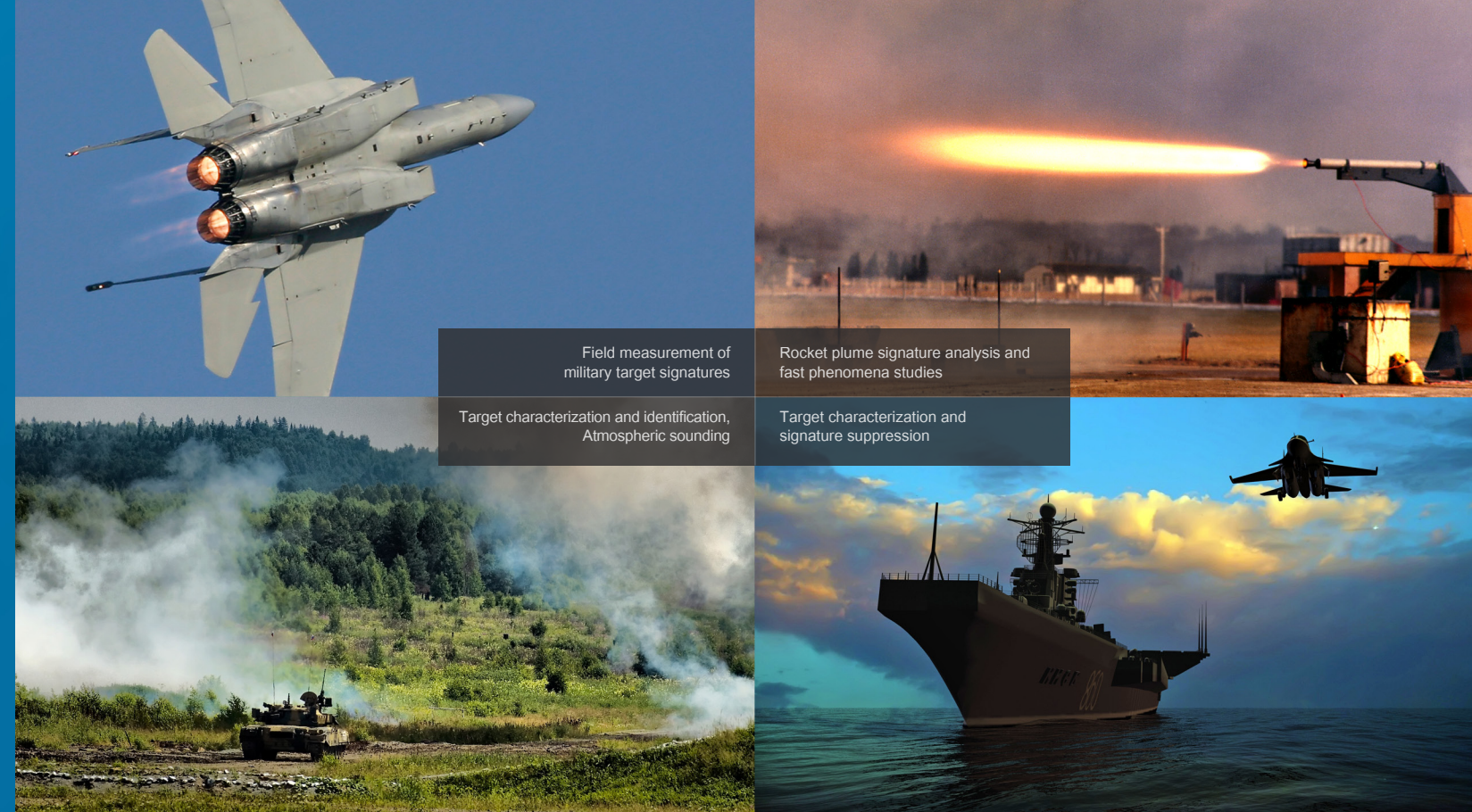
The most advanced fast-scanning infrared emission spectroradiometer

The Versatile Spectroradiometer (VSR™) is a compact high sensitivity spectroradiometer which uses Fourier Transform Infrared (FT-IR) technology. Its high speed, robust operation is ideal for multi-scenario operation, from the laboratory to airborne applications even those with heavy vibrational constraints. The VSR™ can provide real-time high resolution spectral information on slow and fast occurring phenomenon, as well as perform material and target signature analysis.



	Specification	Value	Units	Comment
Optical	Spectral range	500 to 11 111	cm ⁻¹	Using HgCdTe (MCT), InSb detectors and an optional third detector (InGaAS)
		0.9 to 20	µm	
	Spectral resolution	1, 2, 4, 8, 16, 32, 64, 128	cm ⁻¹	Computer selectable
		0.1 to 1000	nm	According to wavelength (Figure 5, p. 6)
		Field of view (FOV)	80	mrاد
25	mrاد		Medium FOV telescope 2x magnification	
5	mrاد		Narrow FOV telescope 7x magnification	
45	mrاد		Instrument FOV without telescope	
FOV response uniformity	± 5	%	Over 80% of the FOV (Figure 4, p. 6)	
Radiometric	NESR	2.5 x 10 ⁻⁹	W/sr/cm ² /cm ⁻¹	At 1300 cm ⁻¹
		2.5 x 10 ⁻¹⁰	W/sr/cm ² /cm ⁻¹	At 2000 cm ⁻¹
		3 x 10 ⁻¹¹	W/sr/cm ² /cm ⁻¹	At 6300 cm ⁻¹
	Measurement rate	1 to 125	spectra/s	(Table 1, p. 6)
Operational	Dimensions	36 x 41 x 30	cm	L x W x H, (p. 7)
	Weight	< 23	kg	Without telescope
	Power consumption	< 45	W	115 VAC or 230VAC
	Temperature	-20 to 40	°C	Power consumption is increased when T < 20°C
	Pressure	12 to 105	kPa	
	Humidity	0 to 90	%	Non condensing
	Vibration	≤ 1	G(RMS)	Over frequency range 5-500Hz
	Shock	≤ 6	G	During 10 ms

Figure 1 - VSR specifications table



TECHNICAL SPECIFICATIONS

WHAT CAN YOU MEASURE WITH THE LR TECH VSR™ TECHNOLOGY?

FEATURES

- STANDARD** Sealed interferometer module
- STANDARD** Cryogen-free second input port cold source (see Figure 2, page 5)
- STANDARD** Mid-wave IR (InSb) and long-wave IR (HgCdTe (MCT)) detectors
- OPTIONAL** Short-wave IR (InGaAs) detector
- OPTIONAL** Boresight video camera
- STANDARD** Interchangeable FOV using 3 different telescope options
- OPTIONAL** Radiometric calibration external sources
- OPTIONAL** Ruggedized field computer
- OPTIONAL** Tripod
- 1 LICENCE INCL.** EDGAR™ control, data acquisition and data processing software
- STANDARD** Real-time radiometric calibration
- STANDARD** Remote connection using TCPIP
- STANDARD** Transport cases

The electromagnetic energy emitted or reflected by an object is indicative of its temperature, chemical constituents and the environment between the object and the observer. The VSR has the sensitivity to measure target emissions at long distances, enhancing operational safety while at the same time providing an accurate representation of the target signature along both the spectral and temporal dimensions.

This capability is essential for the study of the chemical and physical properties of the target, especially those which are short-lived or have fluctuating emissions.

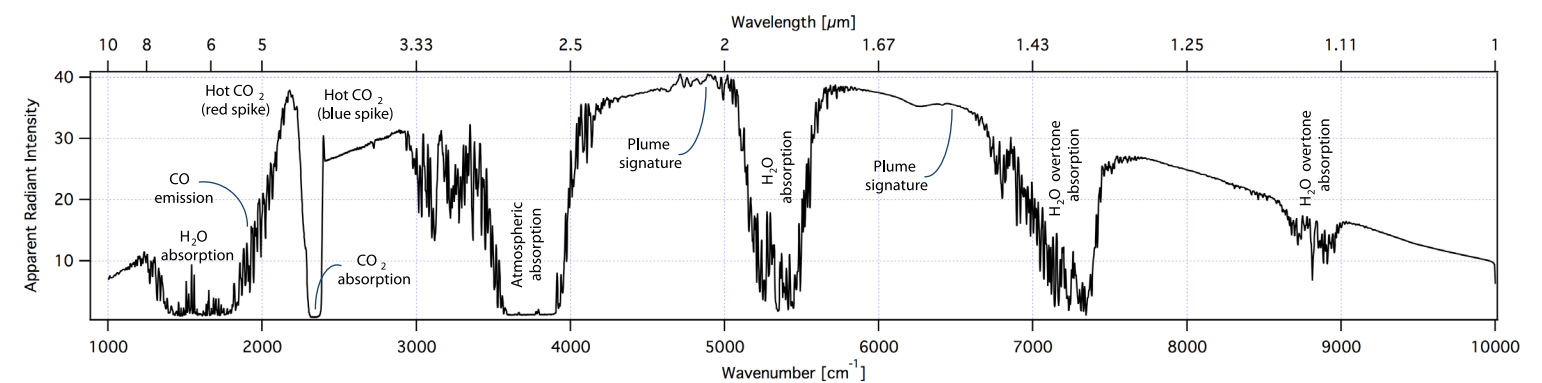
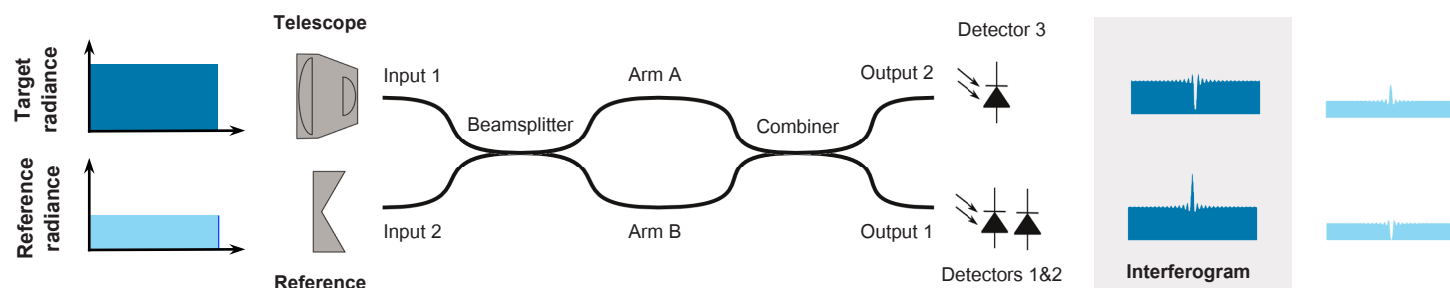
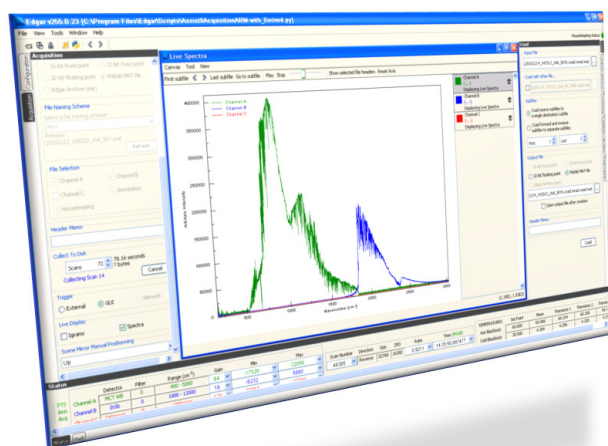


Figure 2 - Schematic representation of the VSR™ Fourier Transform spectrometer



THE EDGAR™ SOFTWARE



The EDGAR™ software is used to control the hardware, generate and manipulate raw data (interferograms), and produce numerous derived data products automatically. It can also calculate atmospheric profiles when operated in the sounding configuration.

EDGAR™ supports a variety of industry-standard formats, including Matlab™, NETCDF and binary formats.

The EDGAR software package also lets you remotely control any LR Tech instrument.

DOUBLE INPUT & DOUBLE OUTPUT

The VSR™ interferometer acts as wavelength-dependent sinusoidal modulator. Since all wavelengths interfere constructively at zero path difference (ZPD), a maximum of intensity is recorded at this location, the so-called interferogram ZPD burst, as illustrated below. Away from ZPD, the various wavelengths become out of phase and settle to around half of the input light (target radiance). Since the interferometer cannot generate nor delete light, the signal at output 2 is the complement of signal in output 1, so the sum equal to the original amount of energy.

Despite the reversal of interferogram, all the energy can be exploited by equipping each output port with a detector, as featured in the VSR™. Because of symmetry, the instrument also features a second input port (input 2). In the case of the VSR™ a high-emissivity, temperature-controlled reference is used to provide a stable signal (reference radiance). This light is modulated by the interferometer and this modulated signal is added to the scene signal (red). Since it is very stable, this signal is removed during the radiometric calibration process, yielding only the signal from the scene.

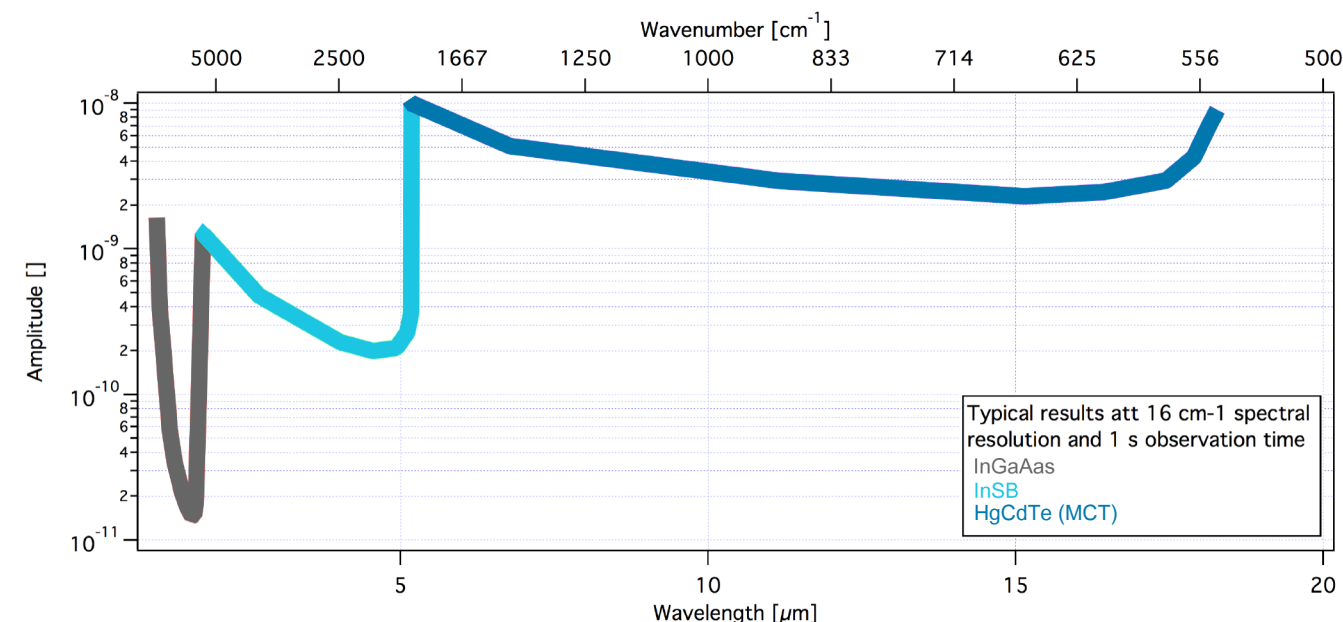
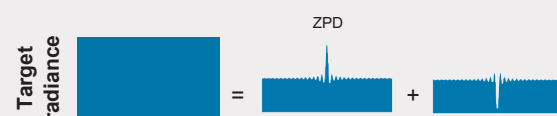


Figure 3

The Noise Equivalent Spectral Radiance (NESR) is the measured RMS noise of the instrument. It is expressed versus wavelength (bottom) and wavenumber (top).

Figure 4

Typical field of view map of a VSR™ instrument. Describes the uniformity of the field of view of the instrument.

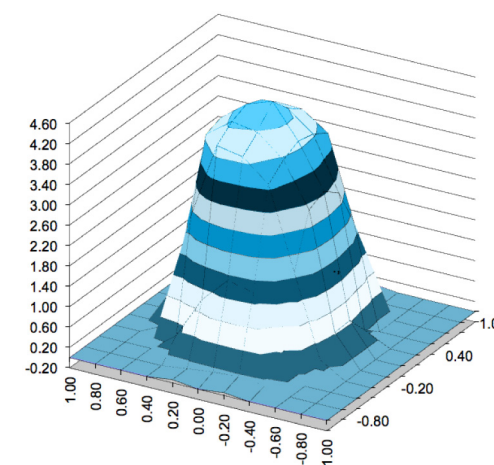


Figure 5

Spectral resolution in nanometer, as a function of wavelength, for the available spectral resolution settings of the VSR™.

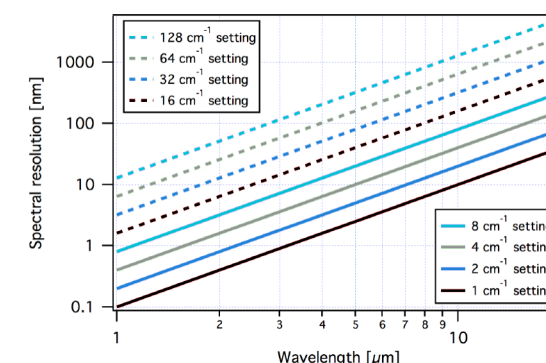


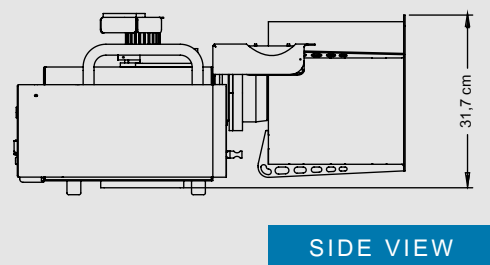
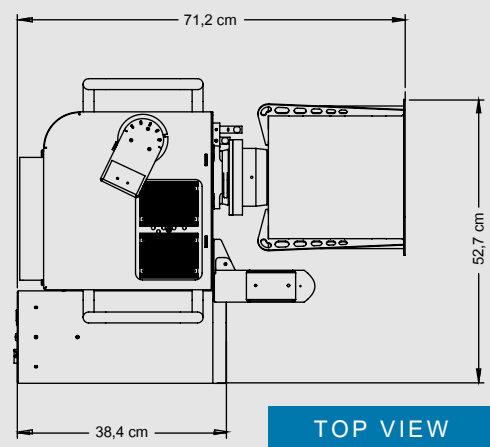
Figure 6

Data rate in number of spectra per second, as a function of spectral resolution setting and interferometer sweep speed. This data has been calculated in laboratory conditions.

Spectral resolution [cm ⁻¹]	Measurement rate [spectra/s]		
	Low speed 32kHz	Medium speed 250kHz	High speed 375kHz
1	0.95	7	10.3
2	1.9	13.6	19.4
4	3.7	24.5	34.7
8	7.3	44.8	57.6
16	14.1	66.5	85.2
32	25.8	103	110.8
64	43.4	143	-
128	62.8	167	-



DIMENSIONS



**CONFIGURE YOUR VSR™ INSTRUMENT
ACCORDING TO YOUR NEEDS**



VSR instrument installed on its tripod with optional Medium FOV telescope, optional boresight camera and optional thermo electric cold reference source installed

Side view of the VSR instrument with optional boresight camera and optional Stirling Cooler Cold Reference Source

VSR instrument installed on its tripod, with optional Narrow FOV telescope, optional boresight camera and optional thermo electric cold reference source installed.





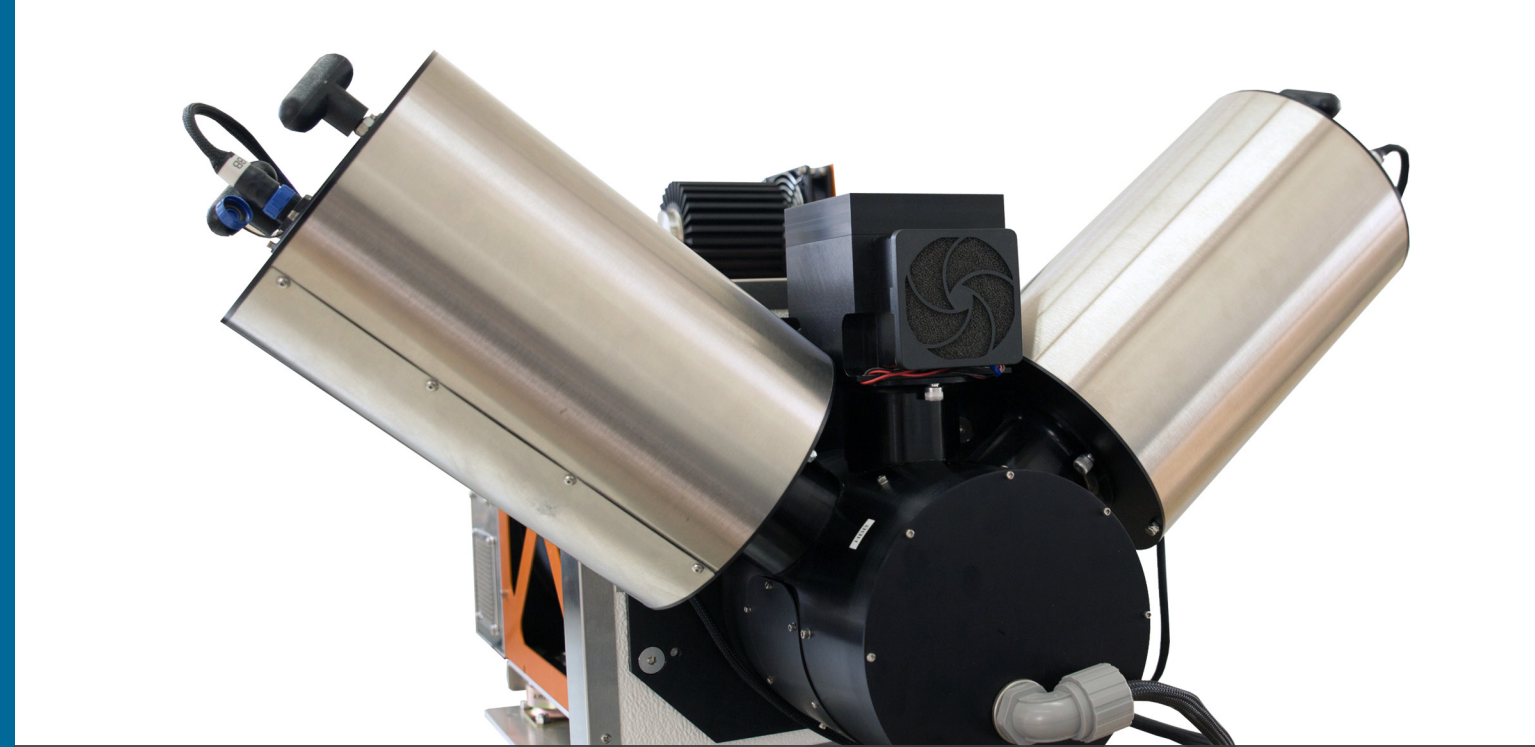
NAST-I

In 2009, LR Tech upgraded the NAST-I instrument, from NASA. NAST-I provides experimental observations validate radiance measurements and geophysical products obtained from various instruments installed on satellite platforms. It is also used to finalize the specifications and to test proposed designs and data processing algorithms for the Cross-Track Infrared Souder (CrIS).



ARM MOBILE FACILITY 2

In 2010, LR Tech has been awarded a contract to provide an ASSIST-II atmospheric sounder to be installed in the ARM Mobile Facility 2. The AMF is equipped with multiple instruments, ranging from standard meteorological instrumentation, broadband and spectral radiometer suite, and remote sensing instruments. It is designed to operate in any environment, from the cold of the Arctic to the heat of the tropics.



ASSIST-II

The ASSIST II is the field deployable sounder that the atmospheric community has been waiting for. It is the first product that includes a self-calibrating spectroradiometer, a network-enabled control software that can operate from anywhere in the world and an integrated data processing pipeline that generates in near real time the end products that you need, autonomously.

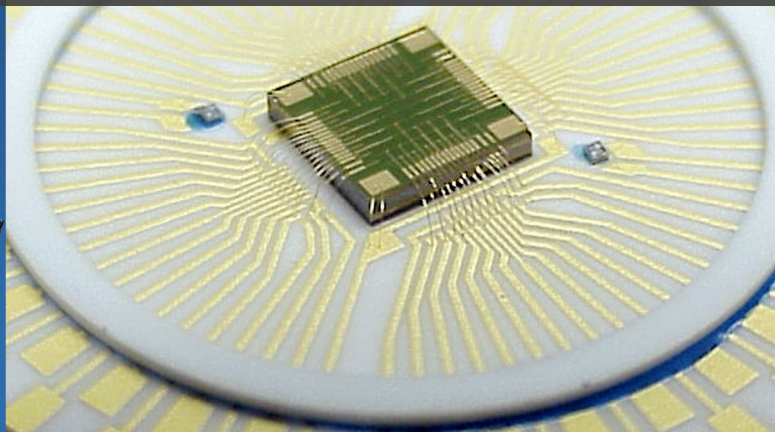
LR TECH EXPERTISE JOIN THE WORLDWIDE USERS

EPA ASPECT

The office of emergency management of the US Environmental Protection Agency (EPA) awarded a contract to LR Tech in 2004 to overhaul the control of the ASPECT high speed infrared spectrometer. Since then, EPA has recently replaced their previous LR Tech upgraded FT-IR system by VSR™ instruments. The VSR™ instruments installed on ASPECT airborne platform consist of a VSR™ with optional LR Tech calibration source and pointing mirror system.

FOCAL PLANE ARRAY

Over the years, LR Tech has developed different types of custom detectors, including multi-pixels detectors. Contrary to conventional arrays, LR Tech multi-element detectors provide spatial information while at the same time preserving signal dynamic range. Combined with a variety of fast scanning spectro-radiometers, these arrays have demonstrated the utility of spatial resolution and its ability to enhance sensitivity. These arrays are composed of 64 elements (8X8 pixels) with a total surface area of 3X3 mm.



LR TECH PRODUCTS SHOWCASE WE HAVE THE RIGHT PRODUCT FOR YOUR APPLICATION

AIRBORNE SPECTRO-RADIOMETER

LR has developed a new Fourier transform spectrometer (FTS) for airborne applications. Our new compact airborne spectro-radiometer is a small and lightweight FTS based on a two-port optical design. It uses a Stirling-cooled detector encompassing MCT (650 – 1875 cm⁻¹) and InSb (1750 – 5745 cm⁻¹) sensors allowing a broad spectral coverage (15.4 – 1.75 μm).

