HySpex
by neo

Content

About

NEO - playing a leading role in applied research

Norsk Elektro Optikk was established in 1985 as a privately owned research company within the field of electro optics. The founders had their scientific and technical background from the Norwegian Defence Research Establishment, at that time the leading research organization in electro optics in Norway. The company's objective is to play a leading role in applied research within its area of expertise to develop and manufacture advanced industrial products for an international market.

The company has grown to be the largest independent research and development organization in electro optics in Norway and has established itself as a reputed manufacturer of advanced electro optical products. NEO is certified to the ISO 9001:2015 International quality standards.

HySpex – the industry leading brand

The hyperspectral imaging activities at NEO started in 1995 with the HISS (Hyperspectral Imager for Small Satellites) project for ESA. The R&D activities in hyperspectral imaging have been internally funded through commercialization of the technology together with participation in several EU projects, as well as projects funded by the Ministry of Defence, the Norwegian Research Council etc.

Today, HySpex is established as an industry leading brand for both airborne and ground based hyperspectral imaging. HySpex sensors are renowned for their stability, flexibility, and superior data quality.
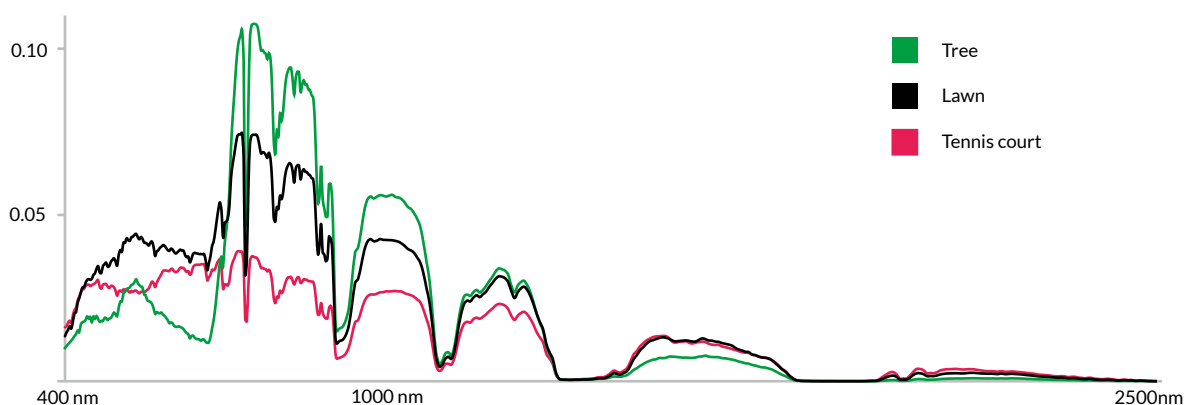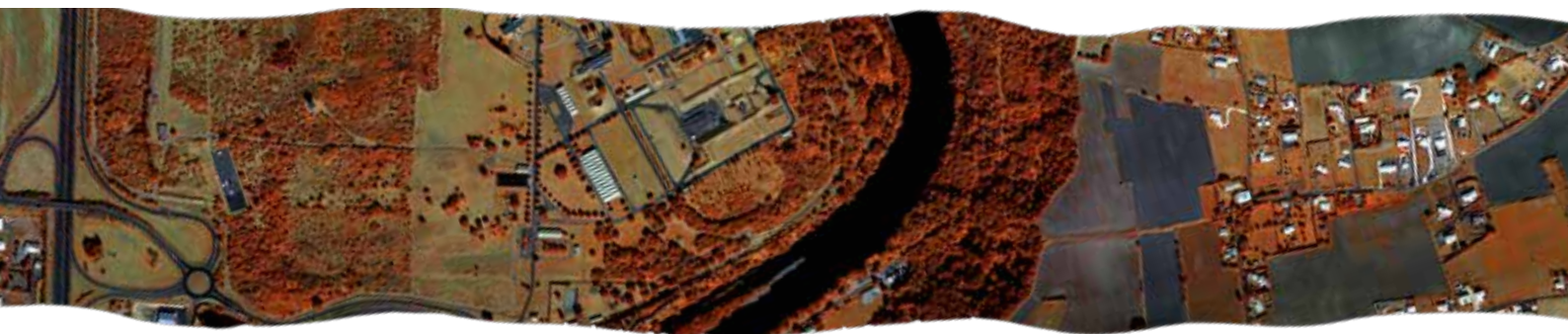
False color RGB of airborne HySpex dataset (top), and three single pixel spectra across the spectral range (bottom).

Data Quality

All HySpex cameras undergo rigorous testing and characterization during production. The tests are documented in an elaborate test report for each camera, identifying both the test procedures and results.

Transparency in the calibration and testing procedures is key to provide the end-user with an overview of performance parameters that are crucial to the quality of the system, but not necessarily communicable on a top-level datasheet.

Pushbroom imagers

All HySpex cameras are pushbroom hyperspectral imagers. When acquiring data, the camera captures all spectral information simultaneously from a narrow line of the spatial scene. As the camera is scanned across the scene or vice versa, the spatial scene is captured and added to the hyperspectral cube. The output data product thus contains both a spatial scene together with the contiguous spectral information from each pixel in the spatial scene. HySpex cameras can be supplied as turn-key acquisition solutions, allowing the user to acquire scientific-grade quality data immediately after delivery.

Key quality parameters

All HySpex cameras provide scientific-grade data quality. To be classified as a scientific-grade imager, the camera should, as a minimum, document having:
– Good SNR for all specified wavelengths
– Low spectral and spatial distortions per pixel and band
– Sharp optic relative to a pixel
– Low F# optics
– Low noise floor and high full well detector
– Traceable calibration
– Robust, stable, and repeatable system

HySpex cameras in gimbal for UAV (left), field operations (middle), and close-range phenotyping lab (right).

HySpex Classic
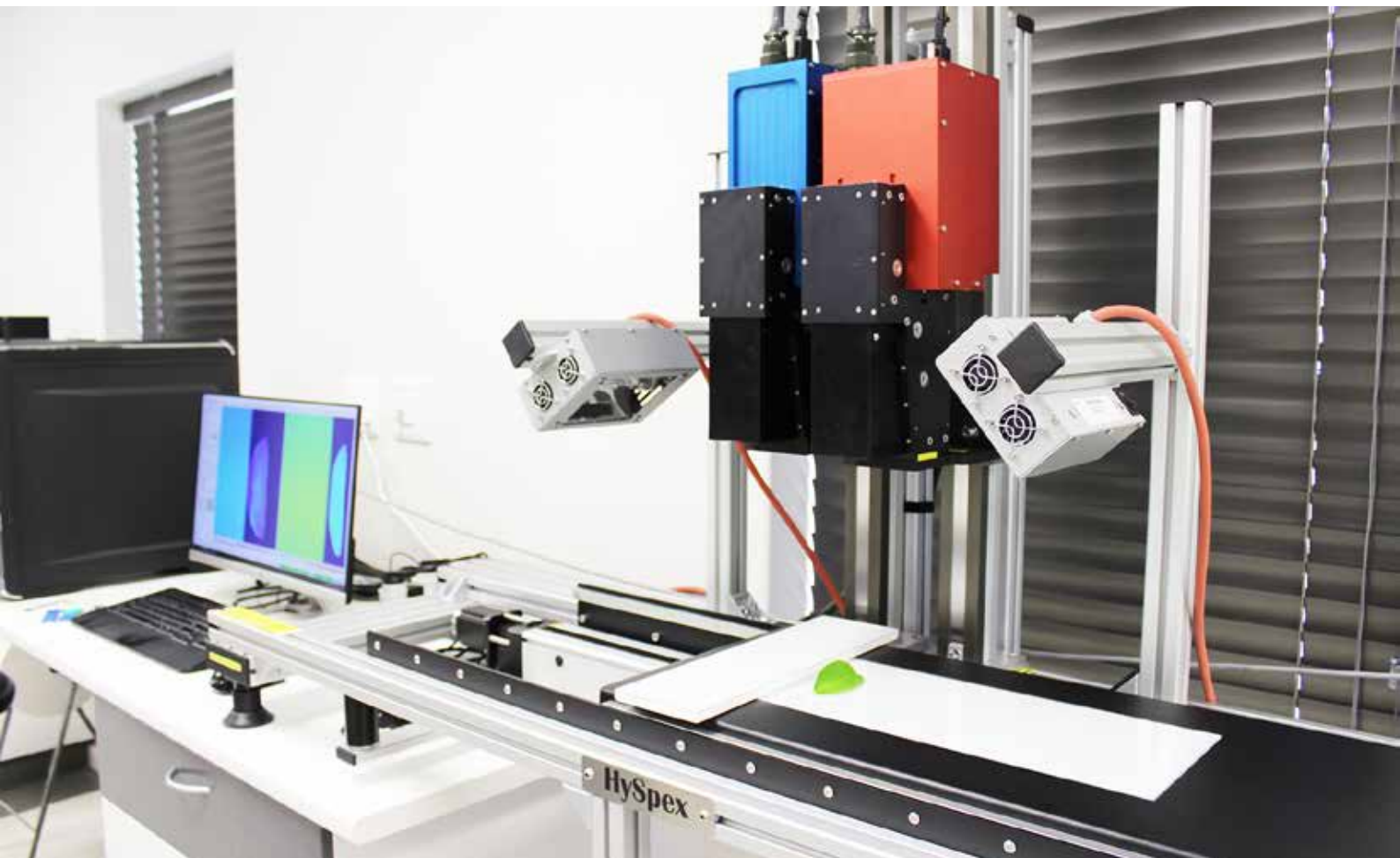
The Central Analytical Facilities (CAF) Vibrational Spectroscopy Unit at Stellenbosch University

HySpex Classic cameras are designed to be application-generic and can be used on a wide range of platforms. The optics are designed for specific high-end detectors. They are very sharp per pixel and band, and they minimize optical distortions such as smile and keystone down to 10% of a pixel over the full spectral and spatial range covered by the camera. Also, the spatial and spectral resolution is optimized to be as similar as possible for all points in the FOV and all spectral bands. HySpex classic cameras are the most flexible cameras, offering exceptional spectral integrity per pixel for all applications. All HySpex cameras are delivered with calibration traceable to NIST and PTB standards.

Nyquist cameras

In contrast to a camera designed to be as sharp as possible, cameras can be designed to sample the point spread function (PSF) with more than one pixel.

To distinguish the camera designs, HySpex has added an "N" to the model's name when approaching 2 bands Full-Width-Half-Max (FWHM) of the PSF in the spectral direction. The N indicates that the system has close to Nyquist sampled PSF spectrally. A Nyquist camera will be able to reproduce the actual spectrum, avoiding spectral aliasing.

Standard configurations for HySpex Classic

Airborne Applications

High resolution and high speed, combined with low weight and power consumption, make HySpex cameras very well suited for airborne data acquisition. A typical airborne installation consists of the HySpex cameras coupled with an airborne data acquisition unit, a navigation system (IMU/GPS) and a mounting platform. Both actively stabilized and passively damped mounting platforms can be supplied, as well as standard mounting plates with no damping. IMU/GPS solutions from leading manufacturers can be supplied and integrated with the cameras. HySpex systems can also be interfaced with the customer's existing navigational hardware.

Laboratory Setup

For lab and field use, a scanning stage is needed to build the hyperspectral data cube of the scene. A user-friendly table-top lab setup with translation stage, VNIR-SWIR light sources, and close-up lenses can also be supplied for scanning of samples of varying sizes. The scanning speed is automatically controlled by the data acquisition unit, based on the selected lens option. The lab rack includes a camera adjustment platform, to facilitate camera focus adjustment when using different close-up lenses.

Field Setup

For field operations, NEO supplies a range of high precision rotation stages tailored to fit the number of cameras and the operational scheme is supplied. Long-life Li-ion battery powered solutions are available for increased portability. To ensure stable and reliable acquisitions in challenging field conditions, rugged and portable tripods are supplied. NEO supplies a variety of tripods with pan/tilt heads that will accommodate the payload of the cameras and rotation stage used.

HySpex VNIR-1800

The HySpex VNIR-1800 hyperspectral camera is developed for field, laboratory, and airborne applications. HySpex VNIR-1800 utilizes a cutting edge actively cooled and stabilized scientific CMOS detector, making it an ideal camera for high-end data acquisitions where high radiometric accuracy is required.

The dynamic range of 18 000 ensures outstanding SNR levels even in darker areas of an image of highly dynamic scenes. With a maximum frame rate of 260 fps, combined with aberration- corrected optics and high optical throughput (f/2.5), HySpex VNIR-1800 offers a unique combination of data quality, high speed, and sensitivity.

A wide range of close-up lenses allows the use of the camera at working distances ranging from a few centimeters, with a spatial resolution of 21.4 µm, to infinity, for e.g. airborne remote sensing.

MAIN SPECIFICATIONS	
Spectral range	400-1000 nm
Spatial pixels	1800
Spectral channels	186 **|** 372
Spectral sampling	3.2 **|** 1.6 nm
F-number	f/2.5
FOV*	16.5°
Pixel FOV across/along*	0.16/0.32 mrad
Bit resolution	16 bit
Noise floor	3.68e- | 2.6 e-
Dynamic range	18000 | 13000
Peak SNR (at full resolution)	> 255 | > 180
Max. speed (at full resolution)	260 fps
Power consumption	30 W
Dimensions (l–w–h)	390 - 99 - 150 mm
Weight	5.0 kg
Camera Interface	CameraLink

Can be doubled with FOV expander

HySpex
SWIR-384

The HySpex SWIR-384 hyperspectral camera is developed for field, laboratory, and airborne applications. The state of the art MCT sensor with cooling down to 150K yields low background noise, high dynamic range, and exceptional SNR levels.

With a maximum frame rate of 400 fps, combined with an aberration-corrected optical system with high optical throughput (f/2), the data quality, speed and sensitivity are truly state of the art.

A wide range of close-up lenses allows the use of the camera at working distances ranging from a few centimeters, with a spatial resolution of 53 µm, to infinity for e.g. airborne remote sensing.
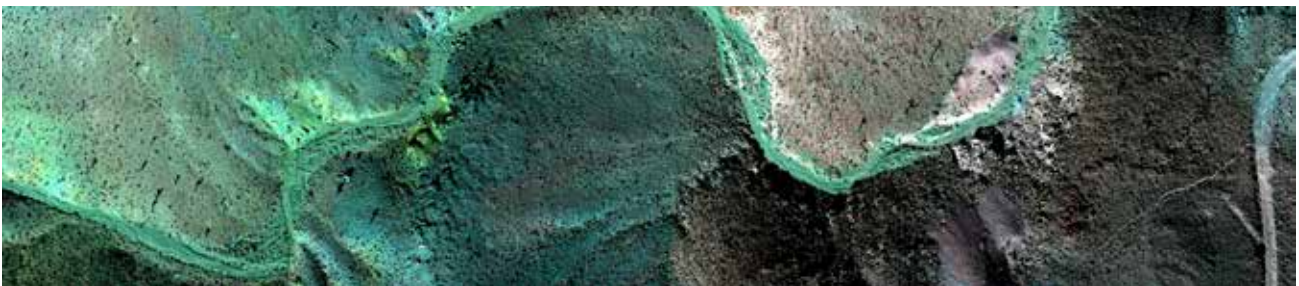
MAIN SPECIFICATIONS	
Spectral range	950-2500 nm
Spatial pixels	384
Spectral channels	288
Spectral sampling	5.4 nm
F-number	f/2
FOV*	16.1°
Pixel FOV across/along*	0.73/0.73 mrad
Bit resolution	16 bit
Noise floor	LG: 250 e- | HG: 150e-
Dynamic range	LG: 5200 | HG: 2800
Peak SNR (at full resolution)	LG: > 1100 | HG: >640
Max. speed (at full resolution)	395 fps
Power consumption	30 W
Dimensions (l–w–h)	380 - 120 - 175 mm
Weight	5.7 kg
Camera Interface	CameraLink

*Can be doubled with FOV expander

HySpex SWIR-640

The HySpex SWIR-640 hyperspectral camera delivers unique performance, utilizing a cutting-edge MCT sensor for high spatial resolution. The FPA is cooled to an ultra-low temperature of 150K using a sterling cooler, ensuring minimal background noise, high dynamic range, and exceptional signal-to-noise ratios. The camera has an aberration-corrected optical system with high optical throughput (f/2.3), resulting in unmatched data quality, sensitivity, and resolution.

Its versatility is further enhanced by an array of close-up lenses, enabling use at working distances from a few centimeters (with a spatial resolution of 32 μm) to infinity for applications like airborne remote sensing.
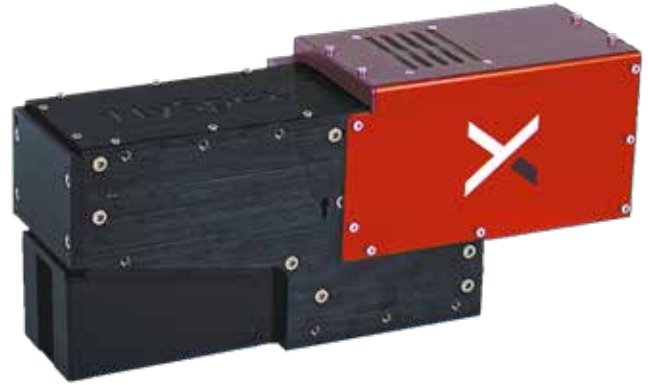
MAIN SPECIFICATIONS	
Spectral range	960-2500 nm
Spatial pixels	640
Spectral channels	362
Spectral sampling	4.3 nm
F-number	f/2.3
FOV*	15.8°
Pixel FOV across/along*	0.43/0.43 mrad*
Bit resolution	16 bit
Noise floor	LG: 350 e-	HG: 80e-
Dynamic range	LG: 3650	HG: 1850
Peak SNR (at full resolution)	LG: >1050	HG: >350
Max speed (at full resolution)	225 fps
Power consumption	10 W
Dimensions (l–w–h)	360 – 110 – 150 mm
Weight	4.1 kg
Camera Interface	CameraLink

*Can be doubled with FOV expander

HySpex
VS-1200

The HySpex VS-1200 is a novel high-resolution instrument designed for airborne applications at altitudes greater than 400m.

The camera produces the highest scientific grade level data commercially available, having FWHM less than 1.2 pixels spatially and less than 1.5 pixels spectrally. The combined VNIR-SWIR cube has co-registration errors and smile and keystone distortions of less than 10% of a pixel.

With 40 degrees FOV, the camera is ideal for mapping large areas with high accuracy and resolution

MAIN SPECIFICATIONS	V-2400	S-1200
Spectral range	400-1000 nm	950-2500 nm
Combined spectral range	400-2500 nm	
Spatial pixels	2400	1200
Combined spatial pixels	1200	
Spatial resolution	FWHM < 1.2	
Spectral channels	400/200	300
Combined spectral channels	680/490	
Spectral resolution (pixels)	FWHM < 1.5 (in 400 band mode)	FWHM < 1.5
F-number	F1.8	F1.9
FOV	40°	40°
Combined FOV	40°	
Pixel FOV across/along	0.27/0.54 mrad	0.54/0.54 mrad
Combined pixel FOV across/along	0.54/0.54 mrad	
Bit resolution (raw data)	12 bit	16 bit
Noise floor	2.4 e−	80 e−
Dynamic range	4400	10000
Max speed (at full resolution)	250 fps	170 fps
Power consumption*	150 W	
Dimensions (ø-h)*	373–398 mm	
Weight	~35 kg	

*Including Data Acquisition Unit

The Viking Era:
Mjolnir

Contracted by the Norwegian and French Ministry of Defence, NEO designed a high-end airborne hyperspectral sensor, with an optical architecture different from the classic cameras. Upon completion of the project, NEO used the optical architecture to develop Mjolnir ['mjɔl:nir] – a very compact camera designed specifically for UAV use.

The HySpex Mjolnir hyperspectral imaging system for UAVs provides a unique combination of small form factor and low mass, combined with high-performance specifications and scientific grade data quality. The UAV bundle offered by NEO integrates a hyperspectral camera with an onboard computer and an integrated navigation system, all fitted into a self-contained module.

Being operationally fully independent of the UAV, HySpex Mjolnir cameras are designed to be compatible with a wide range of UAVs. APX-15 and APX-20 support dual IMU which can improve GPS accuracy when operating with the gimbal to compensate for the dynamic lever arm.

UAV
Configuration

UAV

HySpex can be mounted on any UAV platform capable of lifting the total payload.
- Standard solution provides ~20 minutes flight endurance with Mjolnir payload
- Ground control software for advanced flight plans
- List of certified UAVs: www.hyspex.com

Gimbal

NEO delivers gimbals with a circular quick release, allowing it to be seamlessly fit on a wide range of multi-rotors.
- Gimbal and Mjolnir powered by same battery
- Ultra-accurate IMU sensor with temperature compensation

IMU/GPS

Mjolnir can be interfaced with all leading navigation systems. NEO offers Applanix APX-15/20 UAV as the standard solution
- Advanced Applanix IN-Fusion™ GNSS-Inertial integration technology
- 100 Hz real-time position, roll, pitch and heading output for direct georeferencing of sensor data
- IMU data rate 200 Hz
- 336 Channels (GPS, GLONASS, BeiDou, Galileo, QZSS, SBAS)
- Solid-state MEMS inertial sensors w/Applanix SmartCalTM compensation technology
- Unfiltered, unsmoothed pseudo-range measurements data for low noise, low multipath error, low time domain correlation and high dynamic response

Ground Configuration

All Mjolnir systems can easily be deployed for fieldwork by mounting it on a tripod with a rotation stage.

- Lightweight, robust, compact and self-contained design
- Working distances: 20 m – ∞
- Can be fully battery powered
- Quick mounting and easy operation with scan speed fully synchronized with camera frame rate
- Easy wireless operation from tablet or laptop

A 1m close-up lens is also available for closer range ground measurements.

HySpex Mjolnir V-1240

The HySpex Mjolnir V-1240 hyperspectral imaging system for UAVs provides a unique combination of small form factor and low mass, combined with high- performance specifications and scientific grade data quality.

With a weight of less than 4 kg and less than 50 W power consumption, HySpex Mjolnir V-1240 is very well suited for a wide range of UAVs.

The system is also compatible with several off-the-shelf gimbals. NEO offers high-performance unmanned aerial vehicles, fully integrated with the HySpex Mjolnir V-1240. The UAV is fitted with a standard battery package allowing up to 30 minutes of flight time. All HySpex Mjolnir systems can also be mounted on a tripod and rotation stage for ground use.

MAIN SPECIFICATIONS	
Spectral range	400-1000 nm
Spatial pixels	1240
Spectral channels	200 | 400
Spectral sampling	3 nm | 1.5 nm
F-number	f/1.8
FOV	20°
Pixel FOV across/along	0.275/0.275 mrad
Bit resolution	12 bit
Noise floor (native)	3.2 e- | 2.3 e-
Dynamic range	> 13200 | >11700
Peak SNR (at full resolution)	> 260 | > 220
Max speed (at full resolution)	250 fps
Power consumption	50 W*
Dimensions (l–w–h)	250 – 175 – 170 mm
Weight*	< 4 kg*

*Includes IMU/GPS and DAU. <5 kg including standard battery.

HySpex
Mjolnir S-620

The HySpex Mjolnir S-620 hyperspectral imaging system for UAVs is the SWIR version of the Mjolnir camera series. Similar to the VNIR version, it provides a unique combination of small form factor and low mass, combined with high-performance specifications and scientific grade data quality.

With a weight of less than 4.5 kg and less than 50 W power consumption, HySpex Mjolnir S-620 is very well suited for a wide range of UAVs.

NEO offers high-performance unmanned aerial vehicles, fully integrated with the HySpex Mjolnir S-620. The UAV is fitted with a standard battery package allowing up to 30 minutes of flight time. All HySpex Mjolnir systems can also be mounted on a tripod and rotation stage for ground use.
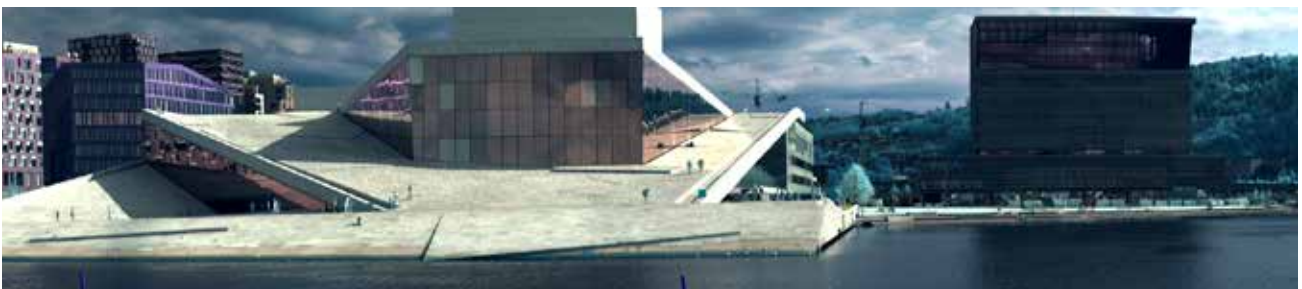
MAIN SPECIFICATIONS	
Spectral range	970-2500 nm
Spatial pixels	620
Spectral channels	300
Spectral sampling	5.1 nm
F-number	F1.9
FOV	20°
Pixel FOV across/along	0.55/0.55 mrad
Bit resolution	16 bit
Noise floor (native)	LG: 350 e- | HG: 80 e-
Dynamic range	LG: 10000 | HG: 5000
Peak SNR (at full resolution)	LG: > 2000 | HG: > 600
Max speed (at full resolution)	170 fps
Power consumption	50 W*
Dimensions (l–w–h)	254 – 175 – 170 mm
Weight*	< 4.5 kg*

Includes IMU/GPS and DAU. <5.5 kg including standard battery.

HySpex
Mjolnir VS-620

For applications requiring low mass, combined with high-performance specifications and scientific grade data quality on the full VNIR-SWIR range, HySpex Mjolnir VS-620 is an ideal solution. Sharing the on- board data acquisition unit and navigation system, HySpex Mjolnir VS-620 is both space-efficient and cost-effective.

The VNIR and SWIR optical axis are coaligned in the along track direction, assuring perfect coregistration in the flight direction. In addition to the high-quality hyperspectral data cube, covering the spectral range from 400 - 2500 nm, with 490 bands, double resolution data in the VNIR range is always readily available. With smile and keystone less than 0.1 pixels for each spectral range, the merged Mjolnir VS-620 data product will have coregistration/keystone better than 0.2 pixels for the full VNIR-SWIR range.

MAIN SPECIFICATIONS	V-1240	S-620
Spectral range	400 - 1000 nm	970 - 2500 nm
Combined spectral range	400 - 2500 nm	
Spatial pixels	1240	620
Combined spatial pixels	620	
Spectral channels and sampling	200 bands @ 3.0 nm*	300 bands @ 5.1 nm
Combined spectral channels	490	
F-number	f/1.8	f/1.9
FOV	20°	20°
Combined FOV	20°	
Pixel FOV across/along	0.275/0.55 mrad	0.55/0.55 mrad
Combined pixel FOV across/along	0.55/0.55 mrad	
Bit resolution (raw data)	12 bit	16 bit
Noise floor	6.6 e-	LG: 350e- | HG: 80 e-
Dynamic range	26000	LG: 10000 | HG: 5000
Peak SNR (at full resolution)	> 430	LG: >2000 | HG: >600
Max speed (at full resolution)	250 fps	125 fps
Power consumption**	50 W**	
Dimensions (l–w–h)	374 – 202 – 178 mm	
Weight**	~6 kg***	

*	Also available in 400 bands
**	Includes IMU/GPS and Data Acquisition Unit
***	<6.5 kg with standard battery

Baldur V-1024 N at the Lerøy fillet facility in Båtsfjord, Norway

Industrial
Baldur

Designed to be fast, flexible, robust and repeatable, HySpex offers the Baldur line of industrial cameras. Baldur utilizes the same optical design as the classic systems, with some modifications. All Baldur cameras are Nyquist cameras giving a spectral resolution of 2 spectral bands while capturing 4 times as much light as the classic systems. To ensure that the most information per frame rate is provided, the spectral resolution is kept very close to 2 bands. Additionally, the spatial resolution is better than 1.7 pixels for all Baldur models, yielding very sharp cameras, albeit not to the extremes of the classic and Mjolnir cameras.

Baldur benefits

- **Flexibility:** All Baldur cameras support multiple regions of interest (MOI).
- **Trigger:** All cameras can be triggered internally, but also support nearly all kinds of external triggering. All cameras are operating in Integrate While Read (IWR) mode
- **Speed & light sensitivity :** Maximized information per data rate of any hyperspectral camera. Speed scalable with spectral channel read-out reduction. 4 times higher light sensitivity than HySpex classic.
- **Reliability, traceability and repeatability:** All cameras delivered with traceable calibration to NIST and PTB standards. All cameras within the same wavelength range have the same center wavelengths.
- **SDK:** All HySpex cameras (Baldur, Classic and Mjolnir) are delivered with a high-end SDK and library that makes it simple to integrate the HySpex hardware into any third-party software and hardware solution.
- Fully integrated hardware and software solution

HySpex
Baldur V-1024 N

Designed to be fast, flexible, robust and repeatable, HySpex offers the Baldur line of industrial cameras.

Baldur V-1024 N covers the full VNIR spectral range from 408-996nm and is configurable within one octave in the same range.

All Baldur cameras are Nyquist cameras giving a spectral resolution of 2 spectral bands while capturing 4 times as much light as the classic systems. To ensure that the most information per frame rate is provided, the spectral resolution is kept very close to 2 bands.

Additionally, the spatial resolution of Baldur V-1024 N is better than 1.7 pixels, yielding a very sharp camera.

On-scene scan speed for various foreoptics options					
Foreoptics type	Working distance [mm] from camera to object	Field of view	Pixel size	Max. speed*	Max. speed**
Microscope	21,1	17,6°/37 mm	0.036 mm	0.02 m/s	0.04 m/s
30 cm	202,8	16.8°/93.7 mm	0.091 mm	0.06m/s	0.09m/s
1.0 m	886,8	16.1°/285 mm	0.279 mm	0.18 m/s	0.28 m/s
44 cm / 40°	417,4	37.1°/325.8 mm	0.318 mm	0.21 m/s	0.32 m/s
1.0 m / 40°	900	38.8°/679.8 mm	0.664 mm	0.43 m/s	0.68 m/s

*With 113 bands and square pixels.   **With 72 bands and square pixels.

MAIN SPECIFICATIONS	
Spectral range	410-780 / 493-945 / 408-996nm
Spectral bands	72 / 88 / 113
Max. speed*	1020 / 840 / 650
Spectral sampling	5.5 nm
F-number	f/1.9
Spectral FWHM	< 2 bands
Spatial FWHM	< 1.7 pixels
Spatial pixels	1024
FOV	15.9° / 32.6°
Bit resolution	12 bit
Noise floor	31e-
Peak SNR	>286
Dynamic range	2560
ROI*	8 independent ROIs
External trigger options	LVDS, 3.3V / 5V TTL
Dimensions (l–w–h)	316 – 105 – 153 mm

*Reducing the number of spectral channels with ROI will proportionally increase the maximum frame rate

HySpex
Baldur S-640i N

Designed to be fast, flexible, robust and repeatable, HySpex offers the Baldur line of industrial cameras.

Baldur S-640i N covers the spectral range from 970-1670nm.

All Baldur cameras are Nyquist cameras giving a spectral resolution of 2 spectral bands while capturing 4 times as much light as the classic systems. To ensure that the most information per frame rate is provided, the spectral resolution is kept very close to 2 bands.

Additionally, the spatial resolution of Baldur S-640i N is better than 1.5 pixels, yielding a very sharp camera.

On-scene scan speed for various foreoptics options					
Foreoptics type	Working distance [mm] from camera to object	Field of view	Pixel size	Max. speed*	Max. speed**
Microscope	27,4	6.9°/20.9 mm	0.033 mm	0.02 m/s	0.04 m/s
30 cm	204,8	18.5°/103,7 mm	0.162 mm	0.09 m/s	0.18 m/s
1.0 m	888,3	17.4°/309.4 mm	0.483 mm	0.27 m/s	0.54 m/s
44 cm / 40°	428,3	39.9°/325.3 mm	0.551 mm	0.31 m/s	0.62 m/s
1.0 m / 40°	989,8	41.9°/801 mm	1.252 mm	0.70 m/s	1.40 m/s
1.9 m / 40°	1844,3	41.9°/1453.3 mm	2.271 mm	1.27 m/s	2.54 m/s

*With 208 bands and square pixels.   **With 72 bands and square pixels.

MAIN SPECIFICATIONS	
Spectral range	970-1670 nm
Spectral bands	208
Max. speed*	560 fps
Spectral sampling	3.41 nm
F-number	f/2
Spectral FWHM	< 2 bands
Spatial FWHM	< 1.5 pixels
Spatial pixels	640
FOV	16.7° / 32.2°
Bit resolution	12 bit
Noise floor	HG:8.5e²/MG:32e⁻/LG:270e⁻
Peak SNR	HG:>150/MG:>275/LG:>800
Dynamic range	HG:2650/MG:2360/LG:2360
ROI*	Pairs of bands can be selected/deselected individually
External trigger options	LVDS, 3.3V / 5V TTL
Dimensions (l–w–h)	364 – 105 – 153 mm

*Reducing the number of spectral channels with ROI will proportionally increase the maximum frame rate

HySpex
Baldur S-384 N

Designed to be fast, flexible, robust and repeatable, HySpex offers the Baldur line of industrial cameras.

Baldur S-384 N covers the spectral range from 960-2500nm.

All Baldur cameras are Nyquist cameras giving a spectral resolution of 2 spectral bands while capturing 4 times as much light as the classic systems. To ensure that the most information per frame rate is provided, the spectral resolution is kept very close to 2 bands.

Additionally, the spatial resolution of Baldur S-384 N is better than 1.3 pixels, yielding a very sharp camera.

On-scene scan speed for various foreoptics options					
Foreoptics type	Working distance [mm] from camera to object	Field of view	Pixel size	Max. speed*	Max. speed**
Microscope	27,4	6.6°/20.1 mm	0.052 mm	0.02 m/s	0.04 m/s
30 cm	204,8	17.8°/99.5 mm	0.259 mm	0.10 m/s	0.20 m/s
1.0 m	888,3	16.7°/296.9 mm	0.773 mm	0.30 m/s	0.61 m/s
44 cm / 40°	428,3	38.1°/335.1 mm	0.873 mm	0.34 m/s	0.69 m/s
1.0 m / 40°	989,8	40°/761.8 mm	1.984 mm	0.78 m/s	1.57 m/s
1.9 m / 40°	1844,3	40°/1382.7 mm	3.601 mm	1.42 m/s	2.84 m/s

*With 288 bands and square pixels.   **With 144 bands and square pixels.

MAIN SPECIFICATIONS	
Spectral range	960-2500 nm
Spectral bands	288
Max. speed*	395 fps
Spectral sampling	5.45 nm
F-number	f/2
Spectral FWHM	<2 bands
Spatial FWHM	<1.3 pixels
Spatial pixels	384
FOV	16.1° / 30.8°
Bit resolution	16 bit
Noise floor	LG: 250 e-	HG: 150 e-
Peak SNR	LG: 5200	HG: 2800
Dynamic range	LG: >1100	HG: >640
ROI*	All bands can be selected/deselected individually
External trigger options	LVDS, 3.3V / 5V TTL
Dimensions (l–w–h)	368 – 131 – 175 mm

*Reducing the number of spectral channels with ROI will proportionally increase the maximum frame rate

Edvard Munch's "The Scream" imaged by HySpex VNIR-1600

Prediktera Software

A complete turnkey solution

Following a previous investment and successful implementation of joint projects where hyperspectral imaging software and hardware were integrated with industrial run-time operations, NEO made Prediktera AB a fully owned subsidiary of NEO. Prediktera produces state-of-the-art software for hyperspectral imaging, making it easier and faster to develop and apply hyperspectral imaging applications.

What we offer

By working closely in development and customer projects, we are offering a seamless experience making it easy to get started and productive with HySpex systems:

- All HySpex systems are delivered with Breeze Recorder for data acquisition
- Turnkey solutions speeding up the development of data analysis and applications
- An efficient workflow reducing effort from research to deployed online solution
- High-end hyperspectral cameras with integrated software ranging from laboratory to industrial use
- Supporting industrial real-time analysis of data from continuous processes at high speed
- Easily integrated with existing process equipment and control systems

The software is used in research, application development, routine analysis and easily extends into real-time industrial analysis solutions. The software is used today in a wide range of industries such as food, geology, mining, recycling, agriculture, pharma, and pulp & paper.

Prediktera Software

Complete toolset

Move beyond manual scripting and juggling of separate software tools, and discover the easier and faster way to achieve success in hyperspectral imaging using Prediktera's software suite.
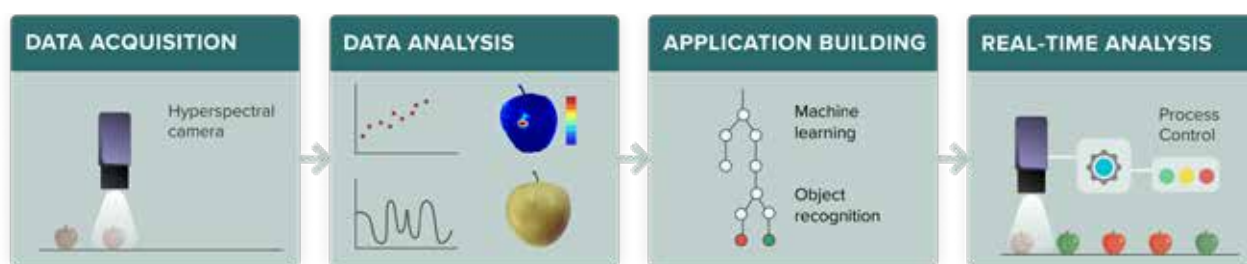
Data analysis features

| MODELLING AND DATA ANALYSIS	
Classification and Quantification	Pixel and object analysis using available methods (see below)
Machine Learning	Neural network, Random forest, SVM, Auto modelling + more
Chemometrics	PLS, PLS-DA, Hierarchical PLS-DA, PCA, SIMCA, K-means
Spectral library analysis	Constrained Spectral unmixing, Spectral angle mapper (SAM)
Band math	Vegetation Index and user created functions
Neural network ONNX models	Import models from external software (e.g. Pytorch and Matlab)
Python interface	Apply your code for data processing inside of Breeze
Breeze Geo	USGS MICA, MWL
OBJECT IDENTIFICATION AND IMAGE SEGMENTATION	
Spectral analysis	Machine learning, Chemometrics, Band math etc.
Shape based analysis	Deep learning, YOLO v4 and v5, Faster R-CNN, ONNX
Other segmentation functions	Pixel binning, Grid & pixel coordinates, Manual ROI etc.

Bundled Software

Breeze Recorder for data acquisition

Breeze Recorder is a reduced version of Breeze for easy data acquisition, and it is included with all HySpex cameras. Prediktera also offers a free 3 month trial for the complete software suite.

- Connect to HySpex cameras and sample movers
- Explore recorded image and spectral data
- Export data as radiance, reflectance or absorbance
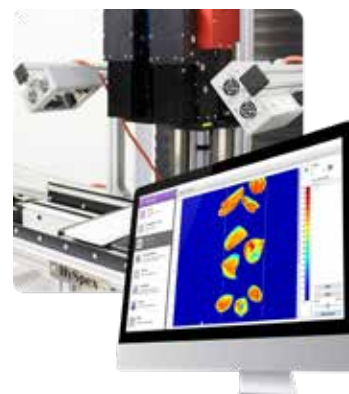
Prediktera Software

Lab & field

Breeze.

Breeze, by Prediktera, is a versatile software designed specifically for efficient hyperspectral data analysis. Ideal for research, application development and routine analysis. Speed up your work with powerful features and ease of use.

- Classification and quantification data analysis
- Compatible with all HySpex cameras and sample movers
- Python interface and built-in toolbox of algorithms and models
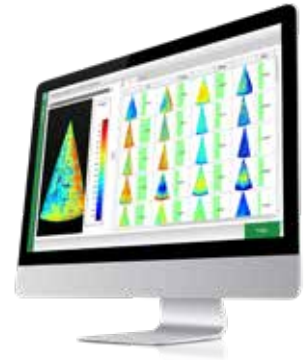
Industrial integration

Breeze Runtime.

Breeze Runtime makes it easy to implement hyperspectral imaging analysis into existing systems and processes. It enables real-time data analysis such as classification, quantification and object identification of materials at high speeds.

- API for flexible integration to various systems
- Fast and robust data processing for high speed sorting

Geology

Breeze Geo.

Breeze Geo provides an all-in-one solution that covers every step from data acquisition and analysis to logging and exporting of mineralogical interpretations. It includes several algorithms and modelling techniques allowing for advanced data exploration and interpretation of the data.

- Built-in spectral library and mineral classification (USGS MICA)
- Spectral feature modelling (MWL)
- Core logging and depth registration

The Geological Survey of Denmark and Greenland (GEUS) ready for take-off with the HySpex helicopter mount.

Custom Solutions

HySpex hyperspectral cameras are delivered as turnkey solutions for all applications. High resolution and high speed, combined with low weight and power consumption, make NEO's HySpex cameras very well suited for all kinds of industries.

Mjolnir IP65

The IP65 version of Mjolnir VS-620 is designed specifically for environmental monitoring where the camera is installed in an exposed and unattended remote location for continuous operation over extended periods of time. The camera is mounted on an IP67-graded FLIR pan/tilt head.

Core Scanner

The HySpex Core Scanner is an integrated solution for hyperspectral drill core imaging developed by NEO and Prediktera, in close cooperation with renowned academic and industrial partners through CASERM*. The system incorporates HySpex VNIR and SWIR cameras for scientific-grade hyperspectral imagery.
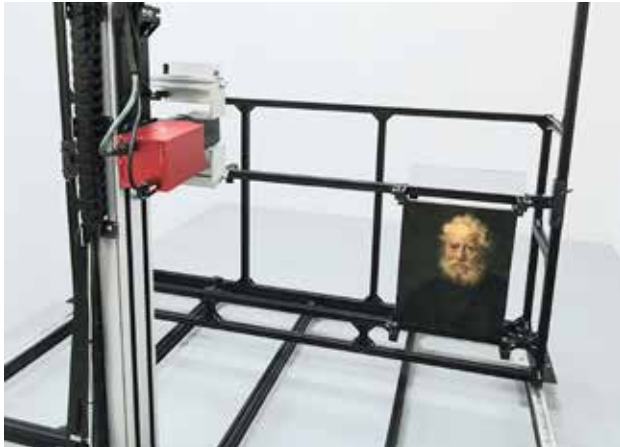
Together with Prediktera's new Breeze Geo software tools, mineral mapping of the highest quality and highest resolution is achieved.

Center to Advance the Science of Exploration to Reclamation Mining.
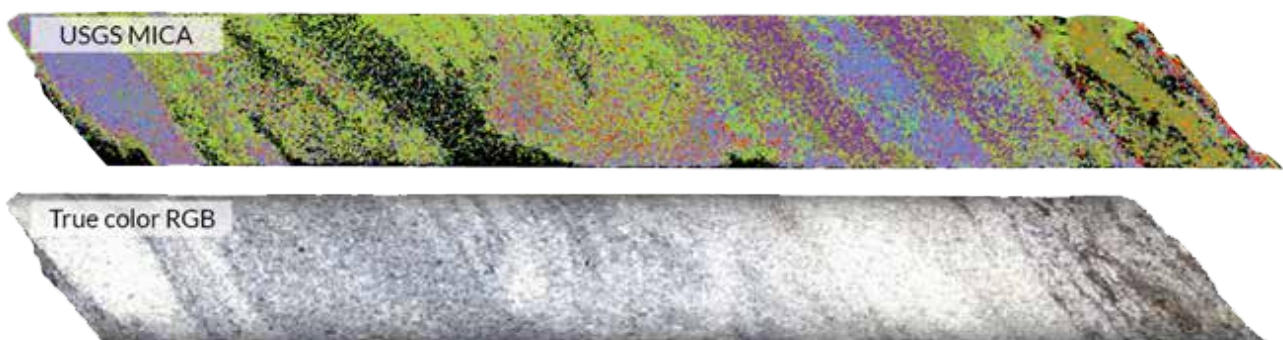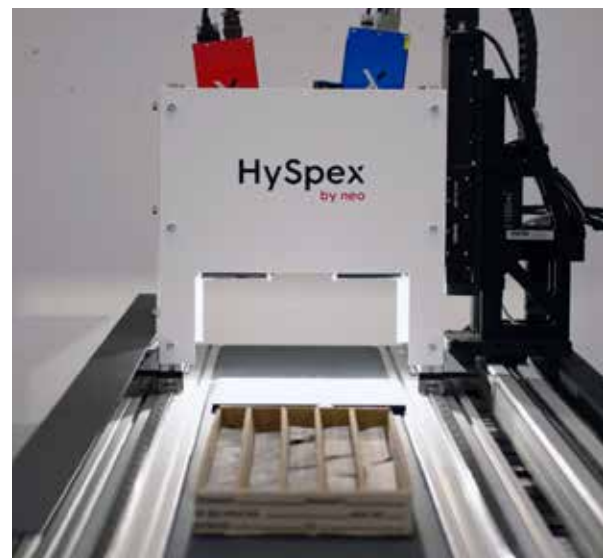
Sample data from core scanner. USGS Mineral Identification and Classification Algorithm (top) and RGB (bottom)

Custom Solutions

Art Scanner

NEO was contracted by C2RMF (Le Centre de recherche et de Restauration des musées de France) at the Louvre Museum in Paris to develop a novel instrument system for hyperspectral imaging of large paintings and other pieces of art.

The system was installed at C2RMF's location in early 2011. As a part of NEO's on-site installation and training session, the system proved to be a very useful tool providing stunning images and revealing previously unknown features of old paintings.

Phenotyper

For customers working in vegetation and agriculture, a phenotype scanner is available. The scanner is designed to scan the full length of the plants (up to 2m). The scanner can be equipped with a horizontally scanning stage, to scan multiple plants or sections, and a rotation stage, mounted on the vertical scanning stage, which can be used to scan the top of the scene following the vertical scan.
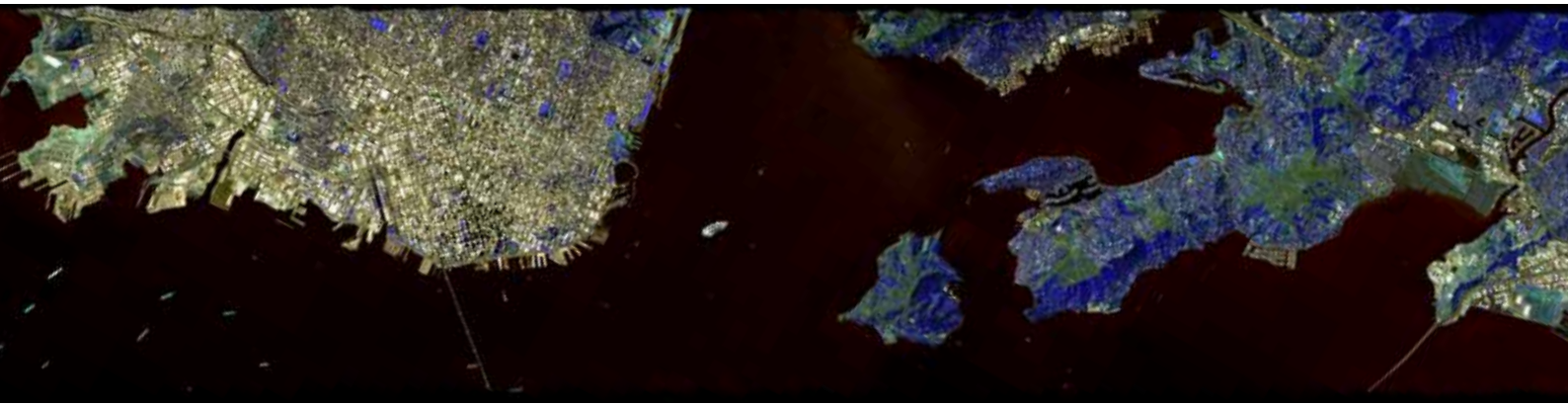

Stratospheric

In 2022 HySpex designed a new stratospheric VNIR and SWIR system. The HySpex Stratospheric Mjolnir cameras are modified versions of the standard Mjolnir cameras, designed for altitudes between 10km to 20km (260mbar to 40mbar). The first airborne campaign was conducted by and for NASA and USGS on NASA's ER-2 manned aircraft in September 2022 at 20km altitude.

NEO in Space

Private Space

With over 20 years of experience in designing and manufacturing HySpex cameras, NEO is well-positioned providing hyperspectral cameras for satellites. The evolving private space industry has simplified qualification schemes, enabling NEO to serve a broader market beyond national agencies and large companies.

NEO can supply adaptations of existing HySpex camera models for satellites, typically with a focus on short delivery times, as well as developing new hyperspectral cameras designed specifically for the space market.

False color RGB representation of HySpex data cube acquired during first stratospheric flight at 20 km altitude.

Dedicated Space Instruments

Hypernor camera

Supported by the Norwegian Space Agency, NEO has developed Hypernor. In contrast to existing and planned hyperspectral imagers that are large and costly, Hypernor, weighing less than 10 kg, offers a low-cost solution compatible with microsatellites under 50 kg take-off mass.

It overcomes common limitations of small satellite platforms, providing superior data compared to larger instruments, particularly in ground sampling distance (GSD).

Beyond Hypernor, NEO is engaged in ongoing projects with the Norwegian and European Space Agency, as well as the European Defence Agency. The HYPER-IP project focuses on developing a novel SWIR hyperspectral camera for satellites, aiming to demonstrate advanced capabilities.

NEO is continuously open to explore new possibilities and collaborations.

HySpex Classic

HySpex Classic cameras are designed to be application-generic and will be used at a wide range of platforms. The optics are made for specific high-end detectors and are extremely sharp per pixel and band, and are designed to minimize optical distortions such as smile and keystone down to 10% of a pixel over the full spectral and spatial range covered by the camera. Also, the spatial and spectral resolution remove is optimized to be as similar as possible for all points in the FOV and all spectral bands. HySpex classic cameras are the most flexible cameras, offering exceptional spectral integrity per pixel for all applications.

All HySpex cameras are delivered with calibration traceable to NIST and PTB standards.

MAIN SPECIFICATIONS	VNIR-1800	SWIR-384	SWIR-640	VS-1200
Spectral range [nm}	400-1000	950-2500	960-2500	400-2500
Spatial pixels	1800	384	640	1200
Spectral channels [bands]	186 **|** 372	288	362	490 **|** 680
Spectral sampling [nm]	3.2 **|** 1.6	5.4	4.3	**V:** 1.5 **|** 3.0 **S:** 5.17
FOV*	16.5°	16.1°	15.8°	40°
Pixel FOV across/along* [mrad]	0.16/0.32	0.73/0.73	0.43/0.43	0.54/0.54
Bit resolution	16 bit	16 bit	16 bit	16 bit
Noise floor	3.68 e-	2.6 e-	250 e-	150 e-	350e-	80 e-	**V:** 2.4 e- **S:** 80 e-
Dynamic range	18000	13000	5200	2800	3650	1850	**V:** 4400 **S:** 10000
Peak SNR (at full resolution)	>255	>180	>1100	>640	>1050	>350	>800
Max. speed (at full resolution)	260 fps	395 fps	225 fps	**V:**250 fps **S:**170 fps
Power consumption	30 W	30 W	10 W	150 W
Dimensions (l–w–h)** [mm]	390 - 99 - 150	380 - 120 - 175	360 - 110 - 150	373 - 398
Weight	5.0 kg	5.7 kg	4.1 kg	35 kg
Camera Interface	CameraLink	CameraLink	CameraLink	CameraLink

*Can be doubled with FOV expander for VNIR-1800, SWIR-384 and SWIR-640
** Dimensions as [l–w–h] for VNIR-1800, SWIR-384 and SWIR-640. [Ø-h] for VS-1200

HySpex Mjolnir

Contracted by the Norwegian and French Ministry of Defence, NEO designed a high-end airborne hyperspectral sensor, with an optical architecture different from the classic cameras. Upon completion of the project, NEO used the optical architecture to develop Mjolnir – a very compact camera designed specifically for UAV use.

The HySpex Mjolnir hyperspectral imaging system for UAVs provides a unique combination of small form factor and low mass, combined with high- performance specifications and scientific grade data quality.

The UAV bundle offered by NEO integrates a hyperspectral camera with an onboard computer and an integrated navigation system, all fitted into a self-contained module.

MAIN SPECIFICATIONS	V-1024	S-620	VS-620
Spectral range [nm}	400-1000	970-2500	400-2500
Spatial pixels	1240	620	620
Spectral channels [bands]	200/400	300/400	490/680
Spectral sampling [nm]	3.0/1.5	5.1/3.83	**V:**3.0/1.5 **S:**5.1/3.83
FOV	20°	20°	20°
Pixel FOV across/along [mrad]	0.27/0.27	0.54/0.54	0.54/0.54
Bit resolution	12 bit	16 bit	16 bit
Noise floor	2.4 e⁻	80 e⁻	**V:**2.3 e⁻ **S:**80 e⁻
Dynamic range	4400	10000	**V:**4400 **S:**10000
Peak SNR (at full resolution)	> 180	> 900	**V:** 180 **S:** 900
Max. speed (at full resolution)**	250 fps	170 fps	125 fps
Power consumption*	50 W	50 W	50 W
Dimensions (l–w–h) [mm]	250 ⍰ 175 ⍰ 170	365 ⍰ 175 ⍰ 170	374 ⍰ 202 ⍰ 178
Weight*	< 4 kg	< 4.5 kg	< 6.0 kg

*Includes IMU/GPS and DAU
** Max. synchronized speed

HySpex Baldur

Designed to be fast, flexible, robust and repeatable, HySpex offers the Baldur line of industrial cameras.

All Baldur cameras are Nyquist cameras giving a spectral resolution of 2 spectral bands while capturing 4 times as much light as the classic systems. To ensure that the most information per frame rate is provided, the spectral resolution is kept very close to 2 bands.

Additionally, the spatial resolution better than 1.7 pixels for all Baldur cameras, yielding very sharp cameras.

MAIN SPECIFICATIONS	V-1024 N	S-640i N	S-384 N
Spectral range [nm]	410-780/493-945/408-996	970-1670	960-2500
Spectral bands	72/88/113	208	288
Max. speed*	1020/840/650 fps	560 fps	395 fps
Spectral sampling	5.5 nm	3.41 nm	5.45 nm
F-number	f/1.9	f/2	f/2
Spectral FWHM	< 2 bands	< 2 bands	<2 bands
Spatial FWHM	< 1.7 pixels	< 1.5 pixels	<1.3 pixels
Spatial pixels	1024	640	384
FOV	15.9°/32.6°	16.7°/32.2°	16.1°/30.8°
Bit resolution	12 bit	12 bit	16 bit
Noise floor**	31e-	8.5e- | 32e- | 270e-	250e- | 150e-
Peak SNR**	>286	>150| >275 | >800	5200 | 2800
Dynamic range**	2560	2650| 2360 | 2360	>1100 | >640
ROI*	8 independent ROIs	All bands can be selected/deselected individually	
External trigger options	LVDS, 3.3V / 5V TTL	LVDS, 5V/12V/24V TTL	
Dimensions (l–w–h) [mm]	316 – 105 – 153	364 – 105 – 153	368 – 131 – 175
Camera Interface	CameraLink	CameraLink	CameraLink

Contact us
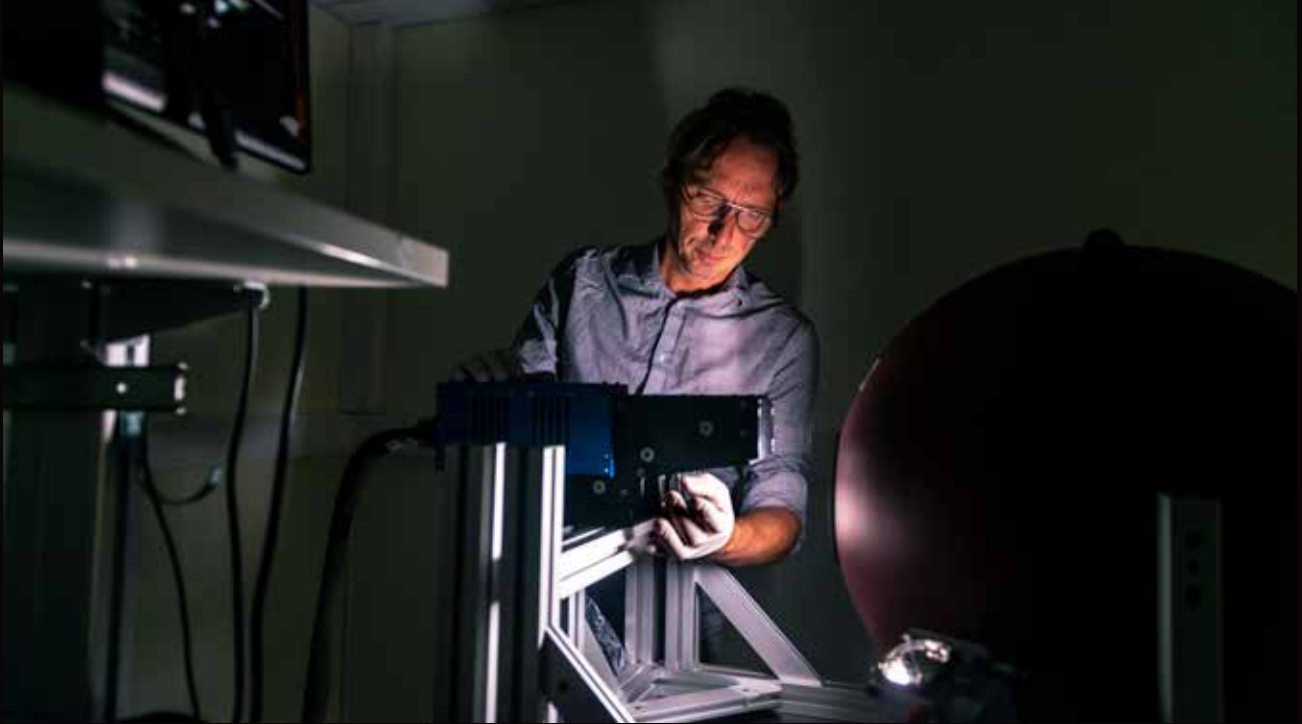
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