HySpex
by neo

WONWOO SYSTEMS CO.,LTD
Tel (02) 3289-1290 Fax (02) 3289-1293
서울시 동작구 신대방1가길 38 (신대방 719 동작상떼빌) 106동 209호
www.wonwoosystem.co.kr

Content

WONWOO SYSTEMS CO.,LTD
Tel (02) 3289-1290 Fax (02) 3289-1293
서울시 동작구 신대방1가길 38 (신대방 719 동작상떼빌) 106동 209호
www.wonwoosystem.co.kr

About

neo HySpex
by neo

NEO - playing a leading role in applied research

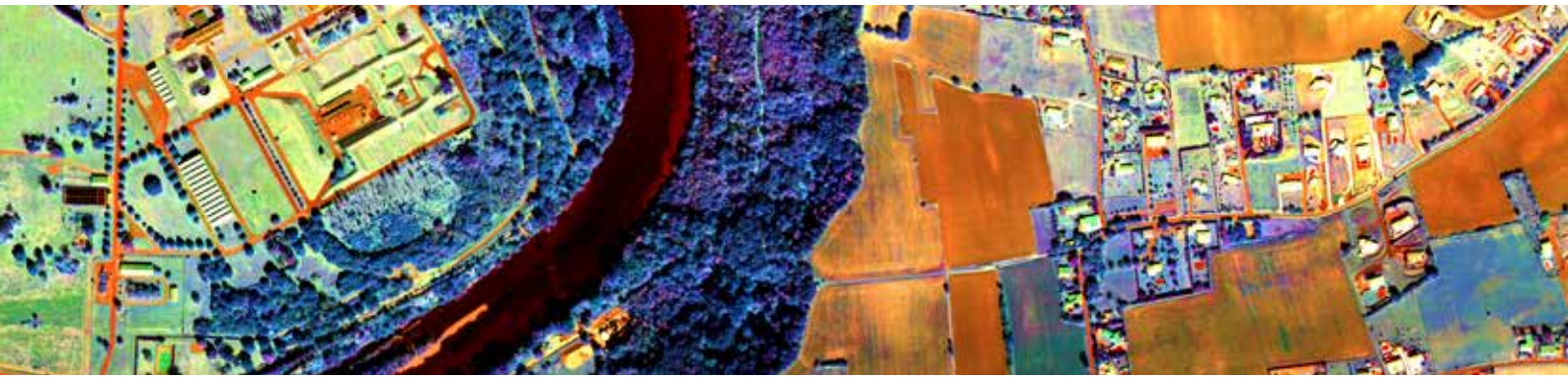
Norsk Elektro Optikk was established in 1985 as a privately owned research company within the field of electro optics. The founders had their scientific and technical background from the Norwegian Defence Research Establishment, at that time the leading research organization in electro optics in Norway. 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.

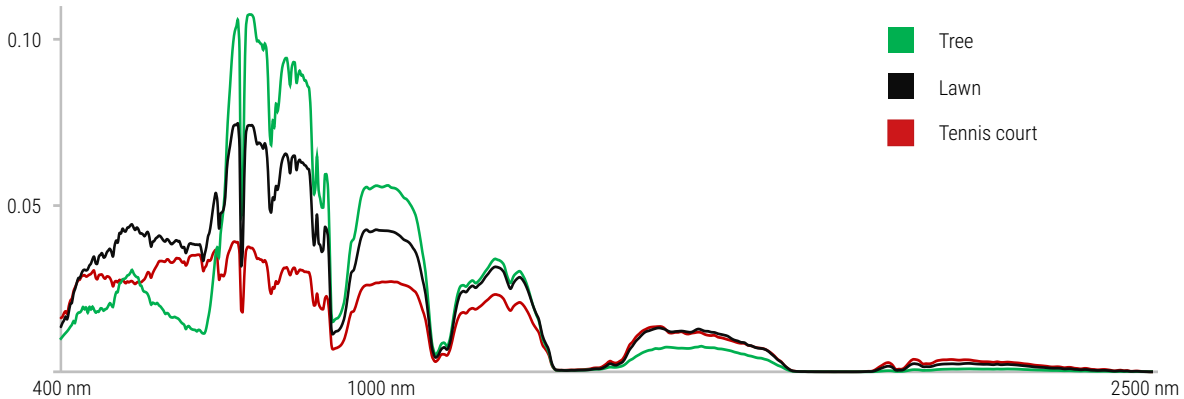
HySpex – the industry leading brand

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 Defense, 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.



HySpex false color RGB data preview (selected bands R:550nm, G:1620nm, B:1250nm).



Sample radiance spectra from the image above.

WONWOO SYSTEMS CO.,LTD
Tel (02) 3289-1290 Fax (02) 3289-1293
서울시 동작구 신대방1가길 38 (신대방 719 동작상떼빌) 106동 209호
www.wonwoosystem.co.kr

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.

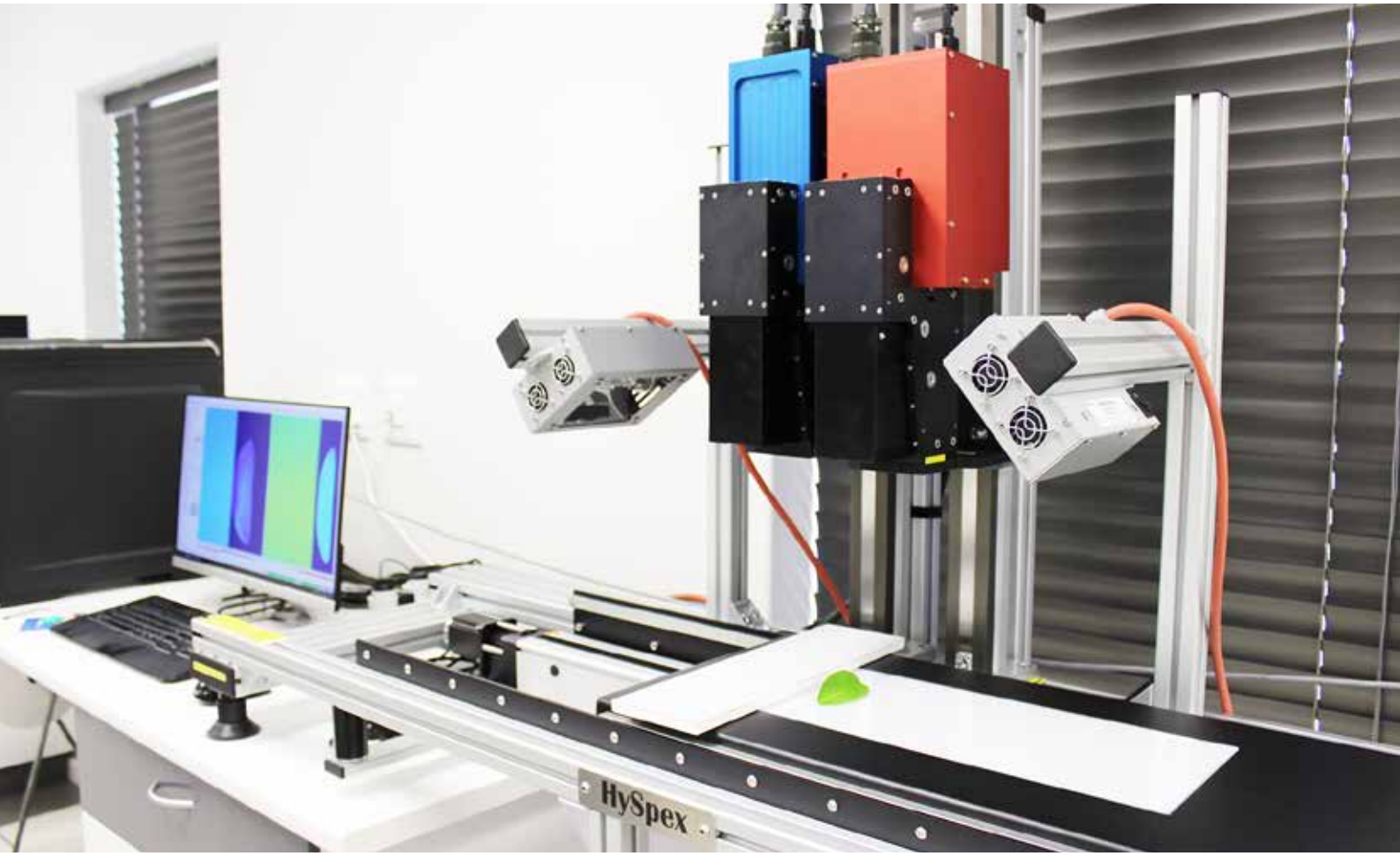
Key quality parameters

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 used for mineface scanning from UAV(left), field operations (middle), and close range phenotyping lab (right).

HySpex Classic



HySpex Classic cameras are designed to be application-generic and can be used at a wide range of platforms. The optics are made for specific high-end detectors and are very 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 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 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.
Alternatively, HySpex systems can be interfaced with the customer's existing navigational hardware.

Laboratory Setup

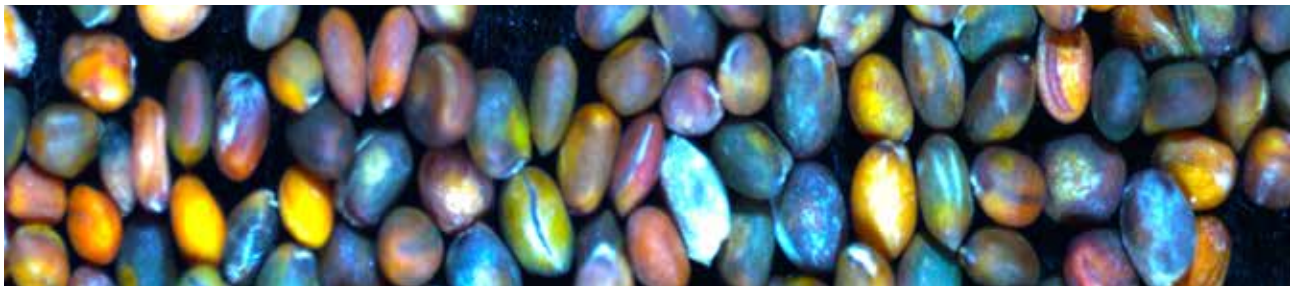
For lab and field use, a scanning stage is needed to scan the cameras and build the hyperspectral data cube of the scene. A user-friendly table-top lab setup with translation stage, VNIR-SWIR light sources, and close-up lenses can also be supplied for scanning of samples of varying sizes. The scanning 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-1024

The HySpex VNIR-1024 hyperspectral camera is developed for field, laboratory, and airborne applications. HySpex VNIR-1024 combines extreme acquisition speeds with no compromise on the data quality. The high frame rate makes VNIR-1024 an ideal camera for low altitude flights or other applications where high frame rates and high radiometric accuracy is required. Like all HySpex cameras, HySpex VNIR-1024 is rigorously tested and calibrated to traceable standards during production. 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 42 µm, to infinity e.g. airborne remote sensing.



MAIN SPECIFICATIONS	
Spectral range	400-1000 nm
Spatial pixels	1024
Spectral channels	108
Spectral sampling	5.4 nm
FOV*	16.1°
Pixel FOV across/along*	0.28/.0.56 mrad
Bit resolution	14 bit
Noise floor	11 e-
Dynamic range	3400
Peak SNR (at full resolution)	> 330
Max speed (at full resolution)	690 fps
Power consumption	6 W
Dimensions (l-w-h)	30.5-9.9-15 cm
Weight	4.2 kg
Camera Interface	CameraLink

*Can be doubled with FOV expander

WONWOO SYSTEMS CO.,LTD
Tel (02) 3289-1290 Fax (02) 3289-1293
서울시 동작구 신대방1가길 38 (신대방 719 동작상떼빌) 106동 209호
www.wonwoosystem.co.kr

HySpex VNIR-1800

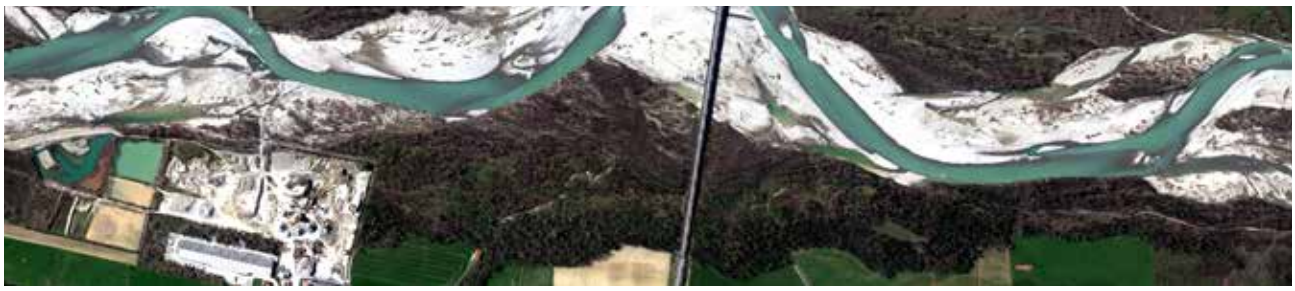
The HySpex VNIR-1800 hyperspectral camera is developed for field, laboratory, and airborne applications. HySpex VNIR-1800 utilizes a cutting edge actively cooled and stabilized scientific CMOS detector. This makes VNIR-1800 the ideal camera for high-end data acquisitions where high radiometric accuracy is required. The dynamic range of 20 000 ensures outstanding SNR levels even in darker areas of an image of highly dynamic scenes. With a max 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 24 µm, to infinity e.g. airborne remote sensing.

MAIN SPECIFICATIONS	
Spectral range	400 – 1000 nm
Spatial pixels	1800
Spectral channels	186
Spectral sampling	3.26 nm
FOV*	17°
Pixel FOV across/along*	0.16/0.32 mrad
Bit resolution	16 bit
Noise floor	2.4 e-
Dynamic range	20000
Peak SNR (at full resolution)	> 255
Max speed (at full resolution)	260 fps
Power consumption	30 W
Dimensions (l–w–h)	39 – 9.9 – 15 cm
Weight	5.0 kg
Camera Interface	CameraLink

*Can be doubled with FOV expander

HySpex VNIR-3000N

HySpex VNIR-3000N is developed for field, laboratory, and airborne applications. HySpex VNIR-3000N utilizes the same spectrograph as the other classical HySpex VNIR models. With a pixel size of 3.45µm, compared to 6. 5µm for VNIR-1800, HySpex VNIR-3000N will have less than 1.6 pixels per FWHM of the PSF spatially and less than 1.8 bands spectrally, ensuring that narrow band features will be resolved equally for all cameras. With 3000 spatial pixels, 300 bands and a noise floor of 2.4e-, HySpex VNIR-3000N will provide outstanding SNR levels in dark environments. The camera is offered with a USB connection, allowing you to operate the camera from any computer and reducing the cost of supplementing equipment. To visualize that the camera has a wider PSF per pixel and band relative to our normal extremely sharp cameras, we have added an N for Nyquist to the model name.



MAIN SPECIFICATIONS	
Spectral range	400-1000 nm
Spatial pixels	3000
Spectral channels	300
Spectral sampling	2.0 nm
FOV*	16°
Pixel FOV across/along*	0.096/0.32 mrad
Bit resolution	12 bit
Noise floor	2.37 e-
Dynamic range	11000
Peak SNR (at full resolution)	> 170
Max speed (at full resolution)	117 fps
Power consumption	30 W
Dimensions (l–w–h)	39 – 9.9– 15 cm
Weight	5.0 kg
Camera Interface	USB3

*Can be doubled with FOV expander

WONWOO SYSTEMS CO.,LTD
Tel (02) 3289-1290 Fax (02) 3289-1293
서울시 동작구 신대방1가길 38 (신대방 719 동작상떼빌) 106동 209호
www.wonwoosystem.co.kr

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 max frame rate of 400 fps, combined with an aberration-corrected optical system with high optical throughput (f/2), the data quality, speed and sensitivity is 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 e.g. airborne remote sensing.

MAIN SPECIFICATIONS	
Spectral range	930-2500 nm
Spatial pixels	384
Spectral channels	288
Spectral sampling	5.45 nm
FOV*	16°
Pixel FOV across/along*	0.73/0.73 mrad
Bit resolution	16 bit
Noise floor	150 e-
Dynamic range	7500
Peak SNR (at full resolution)	> 1100
Max speed (at full resolution)	400 fps
Power consumption	30 W
Dimensions (l–w–h)	38 – 12– 17.5 cm
Weight	5.7 kg
Camera Interface	CameraLink

*Can be doubled with FOV expander


HySpex


LN-0612 AC
HySpex

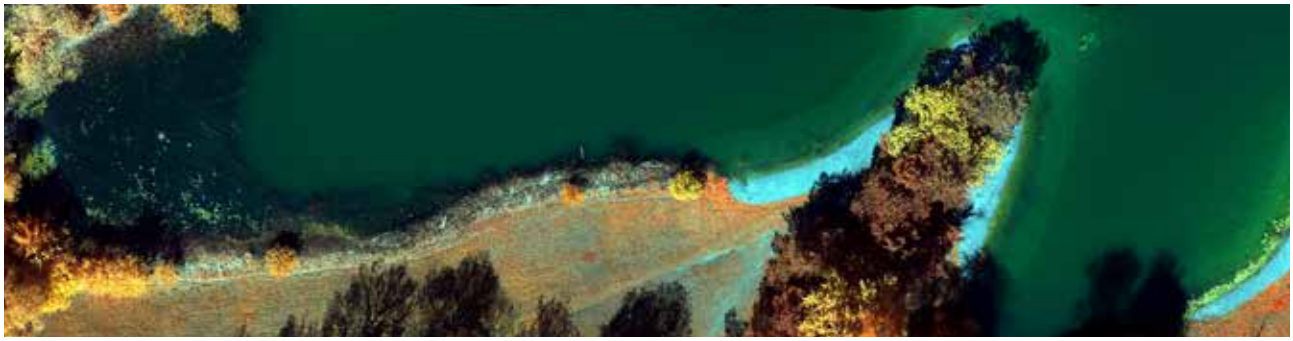
The Viking Era: Mjolnir

Contracted by the Norwegian and French Ministry of Defense, 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 is especially important when operating with the gimbal to compensate for the dynamic lever arm.

UAV Configuration



UAV - BFD XQ-1400S

HySpex can be mounted on any UAV platform capable of lifting the total payload.

- BFD XQ-1400S provides ~30 min. flight endurance with Mjolnir payload
- Ground control software for advanced flight plans
- High stability in wind

GIMBAL

The advanced 3-axis digital stabilizer, gStabi H16, weighs only 2.2 kg (4.85 lbs). NEO delivers the gStabi H16 with a circular quick release, allowing it to be seamlessly fit on a wide range of multi-rotors. Capable of handling payloads up to 7 kg (15.43 lbs), the gimbal can support all HySpex Mjolnir models.

- Gimbal and Mjolnir powered by same battery
- Encoder with resolution up to 0.005°
- Ultra accurate IMU sensor with temperature compensation

APPLANIX APX-15/20 UAV

- Advanced Applanix IN-FusionTM 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

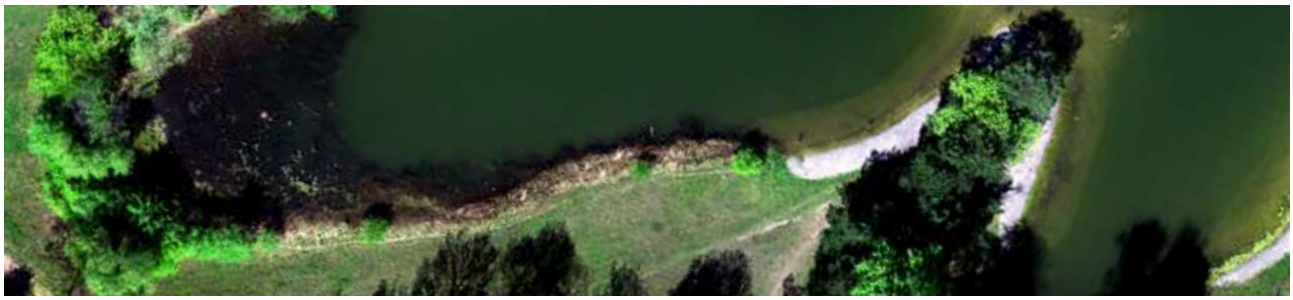
A 1m close-up lens is also available for closer range ground measurements.

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 and sampling	200 bands @ 3 nm
F-number	F1.8
FOV	20°
Pixel FOV across/along	0.27/0.27 mrad
Bit resolution	12 bit
Noise floor	2.3 e-
Dynamic range	4400
Peak SNR (at full resolution)	> 180
Max speed (at full resolution)	285 fps
Power consumption	50 W
Dimensions (l–w–h)	250 – 175 – 170 mm
Weight	< 4 kg

*Includes IMU/GPS and DAU – <6.5 kg including standard battery

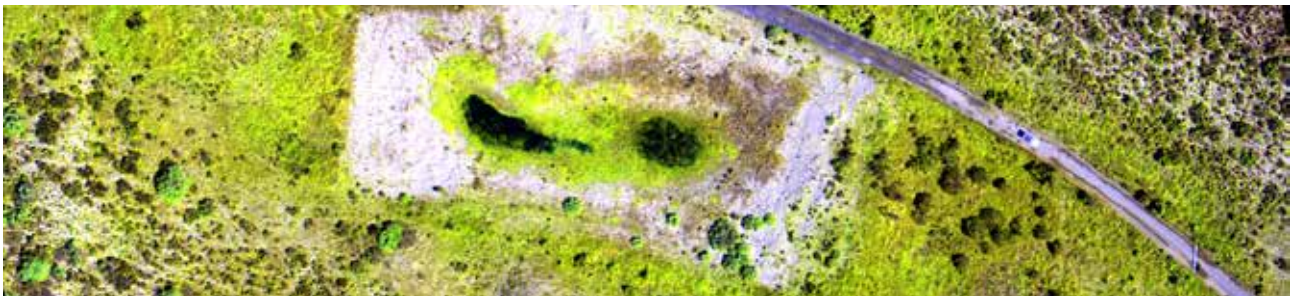
WONWOO SYSTEMS CO.,LTD
Tel (02) 3289-1290 Fax (02) 3289-1293
서울시 동작구 신대방1가길 38 (신대방 719 동작상떼빌) 106동 209호
www.wonwoosystem.co.kr

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 and sampling	300 bands @ 5.1 nm
F-number	F1.9
FOV	20°
Pixel FOV across/along	0.54/0.54 mrad
Bit resolution	16 bit
Noise floor	80 e-
Dynamic range	10000
Peak SNR (at full resolution)	> 900
Max speed (at full resolution)	100 fps
Power consumption*	50 W
Dimensions (l–w–h)*	254 – 175 – 170 mm
Weight*	< 4.5 kg

*Includes IMU/GPS and DAU – <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.

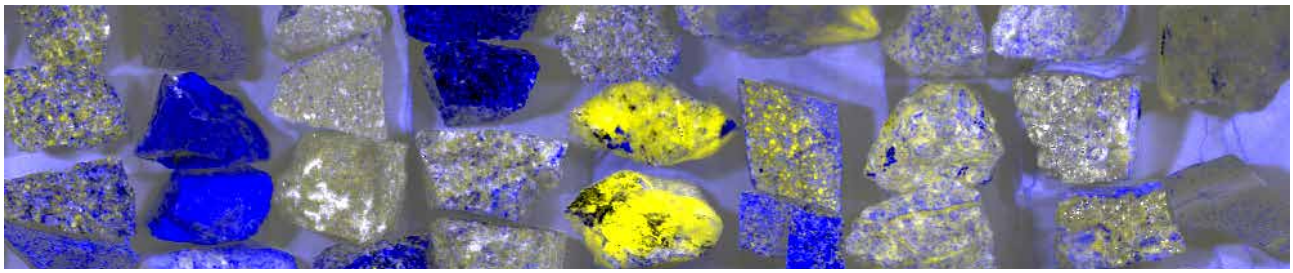
MAIN SPECIFICATIONS	V-1240	S-620
Spectral range	400 – 1000 nm	970 – 2500 nm
Combined spectral range	400 – 2500	
Spatial pixels	1240	620
Combined spatial pixels	620	
Spectral channels and sampling	200 bands @ 3.0 nm	300 bands @ 5.1 nm
Combined spectral channels	490	
F-number	F1.8	F1.9
FOV	20°	20°
Combined FOV	20°	
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	2.3 e-	80 e-
Dynamic range	4400	10000
Peak SNR (at full resolution)	> 180	> 900
Max speed (at full resolution)	285 fps	100 fps
Power consumption*	50 W	
Dimensions (l–w–h)*	374 – 202 – 178 mm	
Weight*	~ 6 kg	

*Includes IMU/GPS and DAU – <6.5 kg including standard battery

WONWOO SYSTEMS CO.,LTD
Tel (02) 3289-1290 Fax (02) 3289-1293
서울시 동작구 신대방1가길 38 (신대방 719 동작상떼빌) 106동 209호
www.wonwoosystem.co.kr

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 framerate 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 camera can be triggered internally, and all cameras support several kinds external triggering. All cameras are operating in Integrate While Read (IWR) mode.
- Speed: Maximized information per data rate of any hyperspectral camera. Speed scalable with reducing the number of spectral channel read-out.
- Reliability and traceability:
  All cameras delivered with traceable calibration to NIST and PTB standards.
  All cameras within the same wavelength range have the same center wavelengths.
  Well-proven and robust design.
- Light sensitivity: High speed acquisitions with light sensitivity 4 times higher than HySpex classic.
- 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 HW into any third-party software and hardware solution.
- Fully integrated hardware and software solution

Third-party software

Through being a shareholder in Prediktera, HySpex can offer seamless integration of HW and data processing SW, providing their users with unparalleled capability not only to collect high quality data, but also bridge the gap between hyperspectral data and end-user results. This will prove to be especially effective for industrial applications that require real-time detection.

Together we can offer:

- Turnkey HW and SW solution for easy and quick test and development of operational algorithms/models.
- High-end hyperspectral cameras for R&D with toolbox to resize data and spectrally optimize for an industrial application.
- Runtime engine for real time processing with CPU and GPU computing support, allowing real-time processing of data from all cameras at max acquisition speed.
- Easy export from offline SW package to the runtime engine.
- Connector Software to interface with the customer's graders, sorters or similar.

HySpex is compatible and open to collaborating with all third-party processing software suppliers on the market.

WONWOO SYSTEMS CO.,LTD
Tel (02) 3289-1290 Fax (02) 3289-1293
서울시 동작구 신대방1가길 38 (신대방 719 동작상떼빌) 106동 209호
www.wonwoosystem.co.kr

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 400-1000nm 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 framerate 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 aperture options V-1024N				
Working distance	Field of View	Pixel size	Max speed (91 bands*)	Max speed (45 bands*)
1.0 m	16°/293 mm	0.286 mm	0.22 m/s	0.44 m/s
1.0 m	40°/748 mm	0.730 mm	0.56 m/s	1.12 m/s
1.9 m	40°/1331 mm	1.300 mm	1.00 m/s	2.00 m/s

* With square pixels. Reducing the number of spectral channels with ROI will proportionally increase the max framerate.

MAIN SPECIFICATIONS	
Spectral Range	400-800/430-820/485-960/400-1000 nm
Spectral bands	72/72/88
Max speed*	1000/1000/800
Spectral sampling	5.5 nm
Spectral FWHM	<2 bands
Spatial FWHM	< 1.7 pixels
Spatial pixels	1024
Keystone	<15% of a pixel
Smile	<15% of band
FOV	16° / 40°
Bit resolution	12
Noise floor	11e
Peak SNR	>286
Dynamic range	2560
ROI*	8 independent ROIs
Dimensions (l-w-h)	316 – 105 – 153 mm

* Reducing the number of spectral channels with ROI will proportionally increase the max framerate

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 950-1730nm.

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 framerate 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 aperture options				
Working distance	Field of View	Pixel size	Max speed (232 bands*)	Max speed (116 bands*)
1.0 m	16°/282 mm	0.44 mm	0.22 m/s	0.40 m/s
1.0 m	40°/704 mm	1.10 mm	0.55 m/s	1.10 m/s
1.9 m	40°/1344 mm	2.10 mm	1.05 m/s	4.20 m/s

* With square pixels. Reducing the number of spectral channels with ROI will proportionally increase the max framerate.

MAIN SPECIFICATIONS	
Spectral Range	950-1730 nm
Spectral bands	232
Max speed*	500 fps
Spectral sampling	3.36 nm
Spectral FWHM	<2 bands
Spatial FWHM	<1.5 pixels
Spatial pixels	640
Keystone	<20% of a pixel
Smile	<20% of band
FOV	16° / 40°
Bit resolution	12 bit
Noise floor	HG:8.5/MG:32/LG:270 e-
Peak SNR	HG:150/MG:275/LG:800
Dynamic range	HG:2650/MG:2360/LG:2360
ROI*	All bands can be selected/deselected individually
External trigger options	LVDS, 5V/12V/24V TTL
Dimensions (l-w-h)	364 – 105 – 153 mm

* Reducing the number of spectral channels with ROI will proportionally increase the max framerate

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 is configurable within one octave in the SWIR spectral range from 950-2500nm.

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 framerate 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 aperture options S-384N				
Working distance	Field of View	Pixel size	Max speed (200 bands*)	Max speed (100 bands*)
1.0 m	16°/280 mm	0.73 mm	0.42 m/s	0.84 m/s
1.0 m	40°/699 mm	1.82 mm	1.05 m/s	2.10 m/s
1.9 m	40°/1344 mm	3.50 mm	2.02 m/s	4.03 m/s

* With square pixels. Reducing the number of spectral channels with ROI will proportionally increase the max framerate.

MAIN SPECIFICATIONS	
Spectral Range	960-1920/1100-2200/1250-2500nm
Spectral bands	178/204/231
Max speed*	650/564/500 fps
Spectral sampling	5.45nm
Spectral FWHM	<2 bands
Spatial FWHM	< 1.3 pixels
Spatial pixels	384
Keystone	<15% of a pixel
Smile	<15% of band
FOV	16° / 40°
Bit resolution	16
Noise floor	150 e
Peak SNR	7500
Dynamic range	2560
ROI*	All bands can be selected/deselected individually
External trigger options	LVDS, 5V/12V/24V TTL
Dimensions (l-w-h)	368 – 131 – 175 mm

* Reducing the number of spectral channels with ROI will proportionally increase the max framerate

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.

	VNIR-1024	VNIR-1800	VNIR-3000N	SWIR-384
Spectral range [nm]	400-1000	400 – 1000	400-1000	930-2500
Spatial pixels	1024	1800	3000	384
Spectral channels	108	186	300	288
Spectral sampling [nm]	5.4	3.26	2.0	5.45
FOV*	16.1°	17°	16°	16°
Pixel FOV across/along [mrad]*	0.28/.0.56	0.16/0.32	0.096/0.32	0.73/0.73
Bit resolution	14 bit	16 bit	12 bit	16 bit
Noise floor	11 e-	2.4 e-	2.37 e-	150 e-
Dynamic range	3400	20000	11000	7500
Peak SNR (at full resolution)	> 330	> 255	> 170	> 1100
Max speed (at full resolution)	690 fps	260 fps	117 fps	400 fps
Power consumption	6 W	30 W	30 W	30 W
Dimensions (l-w-h) [mm]	305 - 99 - 150	390 - 99 - 150	390 - 99 - 150	380 - 120 - 175
Weight	4.2 kg	5.0 kg	5.0 kg	5.7 kg
Camera Interface	CameraLink	CameraLink	USB3	CameraLink

*Can be double with FOV expander

WONWOO SYSTEMS CO.,LTD
Tel (02) 3289-1290 Fax (02) 3289-1293
서울시 동작구 신대방1가길 38 (신대방 719 동작상떼빌) 106동 209호
www.wonwoosystem.co.kr

HySpex Mjolnir

Contracted by the Norwegian and French Ministry of Defense, 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.

	V-1240	S-620	VS-620	
Spectral range [nm]	400-1000	970-2500	400-2500	
Spatial pixels	1240	620	620	
Spectral channels	200	300	490	
Spectral sampling [nm]	3.0	5.1	3.0	5.1
Field of View	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	2.3 e-	80 e-	2.3 e-	80 e-
Dynamic range	4400	10000	4400	10000
Peak SNR (at full resolution)	> 180	> 900	> 180	> 900
Max speed (at full resolution)	285 fps	100 fps	100 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	

*Includes IMU/GPS and DAU

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 framerate 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.

	V-1024 N	S-640i N	S-384 N
Spectral Range [nm]	400-800/430-820/485-960/400-1000	950-1730	960-1920/1100-2200/1250-2500
Spectral bands	72/72/88	232	178/204/231
Max speed*	1000/1000/800	500	650/564/500 fps
Spectral sampling [nm]	5.5	3.36	5.45
Spectral FWHM	<2 bands	<2 bands	<2 bands
Spatial FWHM	< 1.7 pixels	<1.5 pixels	< 1.3 pixels
Spatial pixels	1024	640	384
Keystone	<15% of a pixel	<20% of a pixel	<15% of a pixel
Smile	<15% of band	<20% of band	<15% of band
FOV	16° / 40°	16° / 40°	16° / 40°
Bit resolution	12	12	16
Noise floor [e-]	11	HG:8.5/MG:32/LG:270	150
Peak SNR	>286	HG:150/MG:275/LG:800	7500
Dynamic range	2560	HG:2650/MG:2360/LG:2360	2560
ROI*	8 independent ROIs	All bands can be selected/deselected individually	All bands can be selected/deselected individually
External trigger options		LVDS, 5V/12V/24V TTL	LVDS, 5V/12V/24V TTL
Dimensions (l-w-h) [mm]	316 – 105 – 153	364 – 105 – 153	368 – 131 – 175
Camera Interface	CameraLink	GigE	CameraLink

* Reducing the number of spectral channels with ROI will proportionally increase the max framerate

WONWOO SYSTEMS CO.,LTD
Tel (02) 3289-1290 Fax (02) 3289-1293
서울시 동작구 신대방1가길 38 (신대방 719 동작상떼빌) 106동 209호
www.wonwoosystem.co.kr

HySpex
by neo

www.wonwoosystem.co.kr

WONWOO SYSTEMS CO.,LTD
Tel (02) 3289-1290 Fax (02) 3289-1293
서울시 동작구 신대방1가길 38 (신대방 719 동작상떼빌) 106동 209호
www.wonwoosystem.co.kr