

Hyperspectral Camera

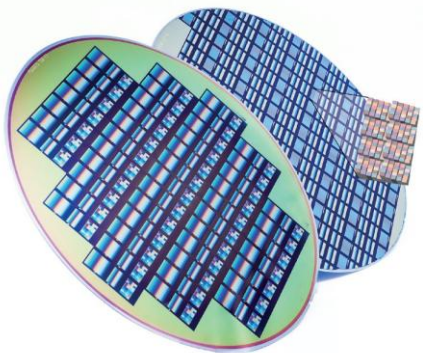
초분광 카메라

Camera types

- Snapshot – 스냅샷
- Snapscan – 스냅샷 + 라인스캔
- Linescan – 라인스캔
- Mobile – 휴대형
- Drone – 드론 시스템

Snapshot Spectral Camera

- 반도체 공정을 활용한 filter patterned on chip 초분광 센서
- One-shot 촬영 방식
- 가볍고 컴팩트한 구조



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Snapshot – VIS / NIR



	Snapshot VIS	Snapshot NIR
공간 해상도	2048 x 1088 픽셀 (after reconstruction)	
분광 밴드	16 밴드	25 밴드
파장 범위	460 ~ 600nm	665 ~ 960nm
FWHM	< 15nm collimated	< 15nm collimated
측정 속도	최대 120 hyperspectral cubes/sec	
Bit depth	10 bit	
수광부	16 / 25 / 35 / 50mm, F2.0, C마운트	
광학 보정	Software corrected	
통신 인터페이스	USB3.0 + GPIO	
크기(mm)	31(L) x 26(W) x 26(H)	31(L) x 26(W) x 26(H)
무게	32g (렌즈 제외시)	32g (렌즈 제외시)

Snapshot – SWIR

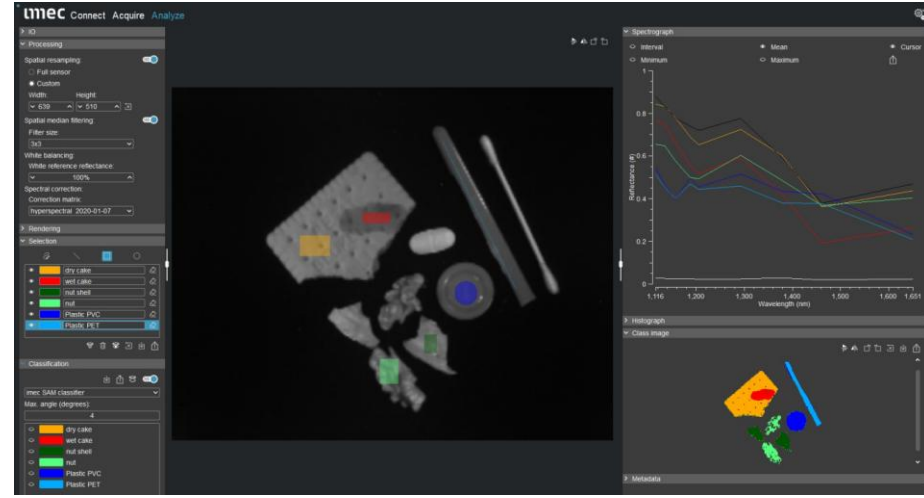


Snapshot SWIR	
공간 해상도	640 x 512 픽셀
분광 밴드	9 밴드
파장 범위	1100 ~ 1650nm
FWHM	< 10 ~ 15nm
측정 속도	최대 120 hyperspectral cubes/sec
Bit depth	13 bit
수광부	16 / 25 / 35 / 50mm, F2.8, SWIR C마운트
이미지 센서	InGaAs based 640 sensor with TEC cooler electronic
픽셀 크기	15 μ m pixels
통신 인터페이스	USB3.0 + GPIO
크기(mm)	130(L) x 65(W) x 65(H)
무게	680g (렌즈 제외시)

Snapshot – HSI Mosaic software



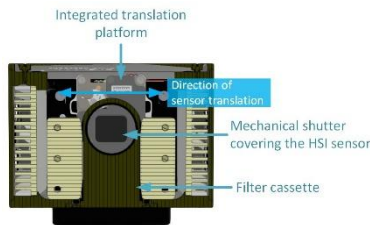
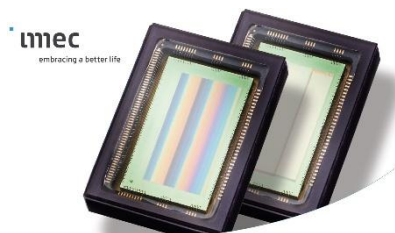
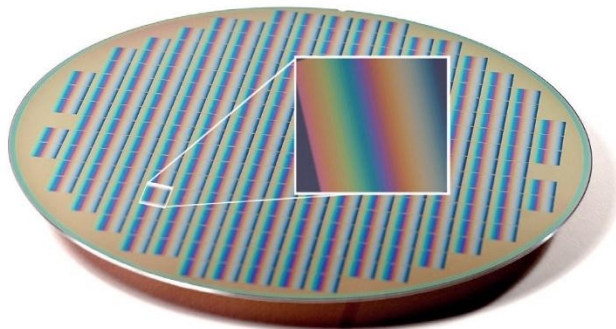
Single band images



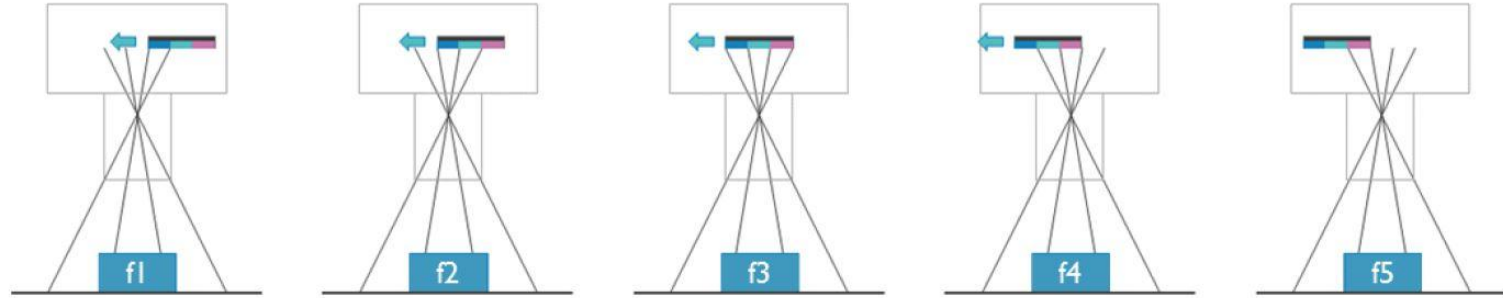
SAM classification

Snapscan Hyperspectral Camera

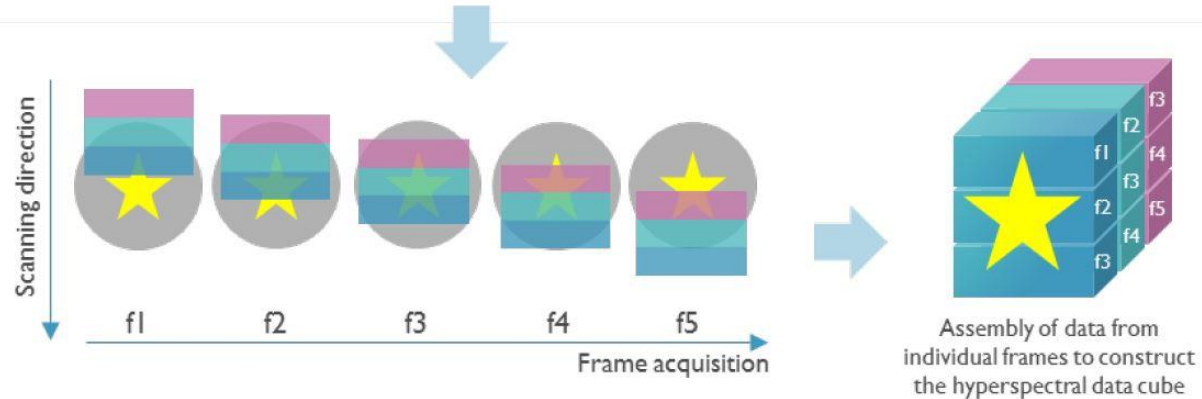
- 반도체 공정을 활용한 filter patterned on chip 초분광 센서
- 내부 스캔 촬영 방식
- 고해상도의 full spectrum 이미지



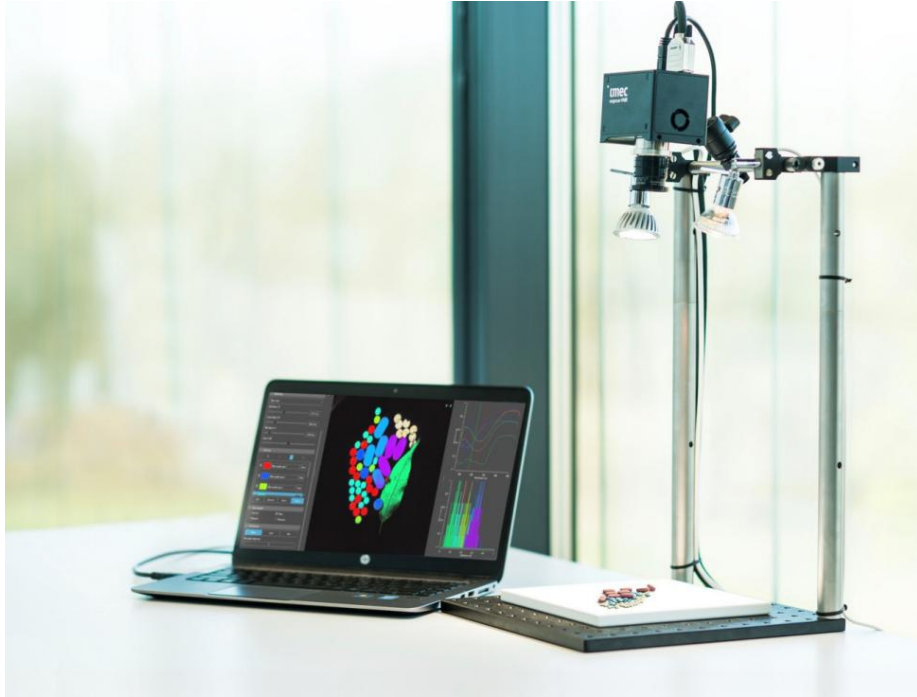
Snapscan Hyperspectral Camera



Both the object and the camera remain stationary. The sensor inside the camera moves to acquire the complete hyperspectral data.

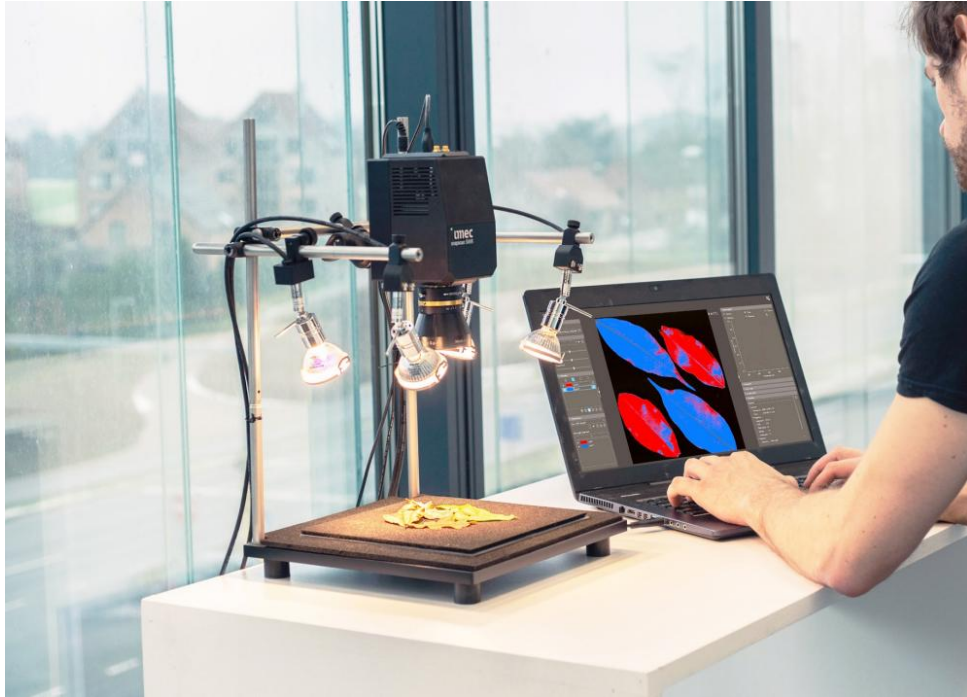


Snapscan – VNIR / NIR



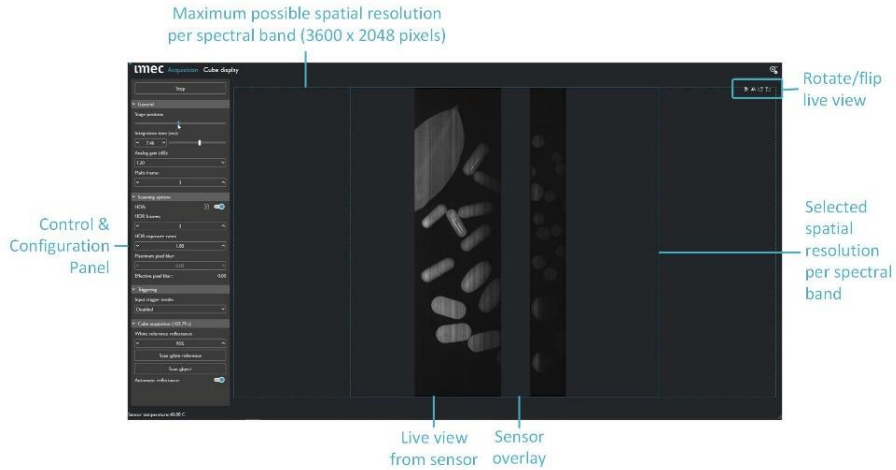
	SNAPSCAN VNIR	SNAPSCAN NIR
공간 해상도	최대 3600 x 2048 픽셀	
분광 밴드	150 밴드	80 밴드
파장 범위	470 ~ 900nm	700 ~ 975nm
FWHM	< 10 ~ 15nm	
측정 속도	2s ~ 20s (depends on acquisition parameters)	
스캔 시스템	내장형 piezo scanning platform	
Bit depth	10 bit	
수광부	20 / 24 / 35 / 50mm, F2.0, C마운트	
냉각 방식	fan based + TE cooling electronics	
셔터	자동 영점 조정을 위한 기계식 셔터 내장	
SNR	> 100 ~ 200	
통신 인터페이스	USB3.0 + GPIO	
크기(mm)	100(L) x 70(W) x 70(H)	
무게	645g (렌즈 제외시)	

Snapscan – SWIR



SNAPSCAN SWIR	
공간 해상도	최대 1200 x 640 픽셀
분광 밴드	100 밴드
파장 범위	1100 ~ 1700nm
FWHM	< 5 ~ 10nm
측정 속도	2s ~ 10s (depends on acquisition parameters)
스캔 시스템	내장형 piezo scanning platform
Bit depth	13 bit
수광부	16 / 25 / 50mm available based upon request
냉각 방식	fan based + TE cooling electronics
셔터	자동 영점 조정을 위한 기계식 셔터 내장
SNR	최대 600 : 1
통신 인터페이스	USB3.0 + GPIO
크기(mm)	90(L) x 90(W) x 130(H)
무게	1072g (렌즈 제외시)

Snapscan – HSI Snapscan software



Live view display for acquisition mode

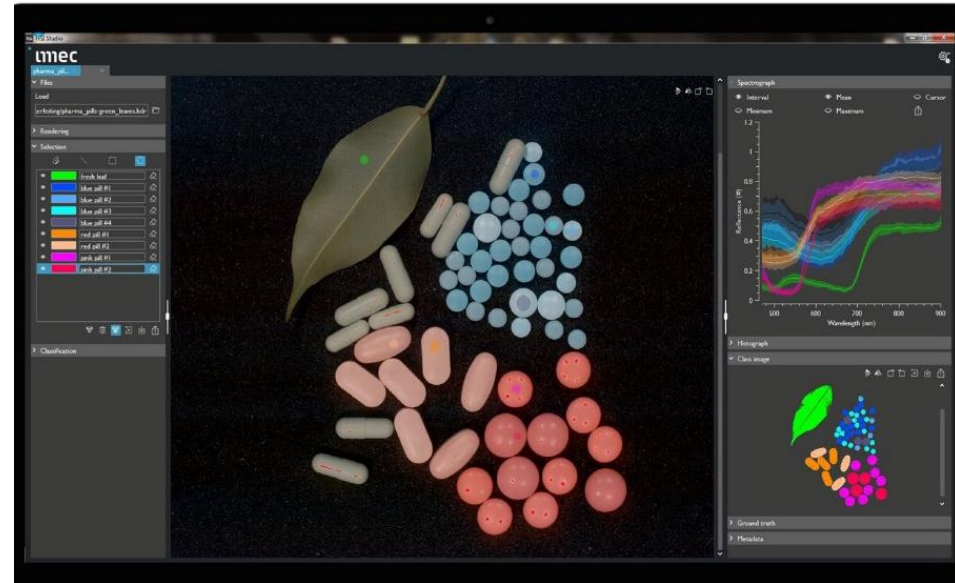
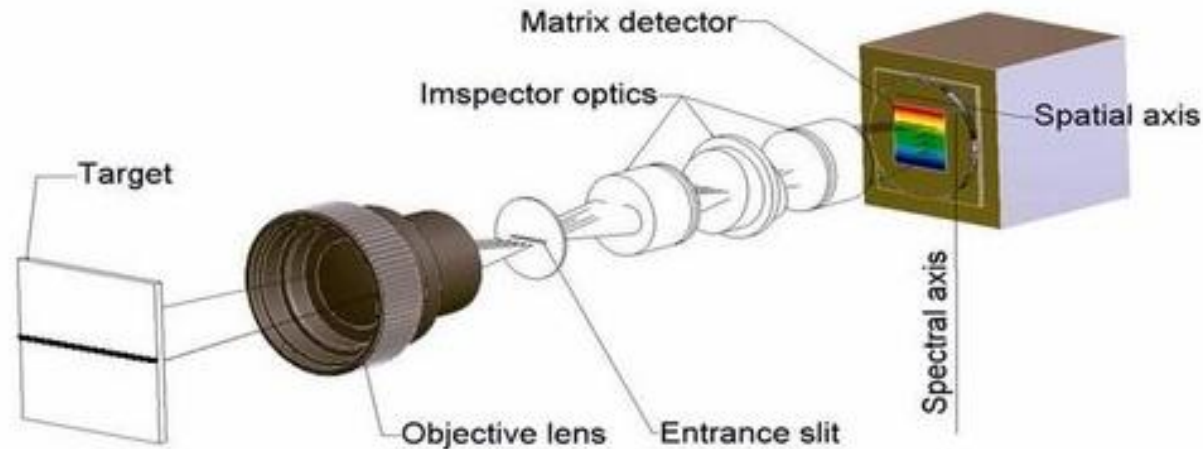


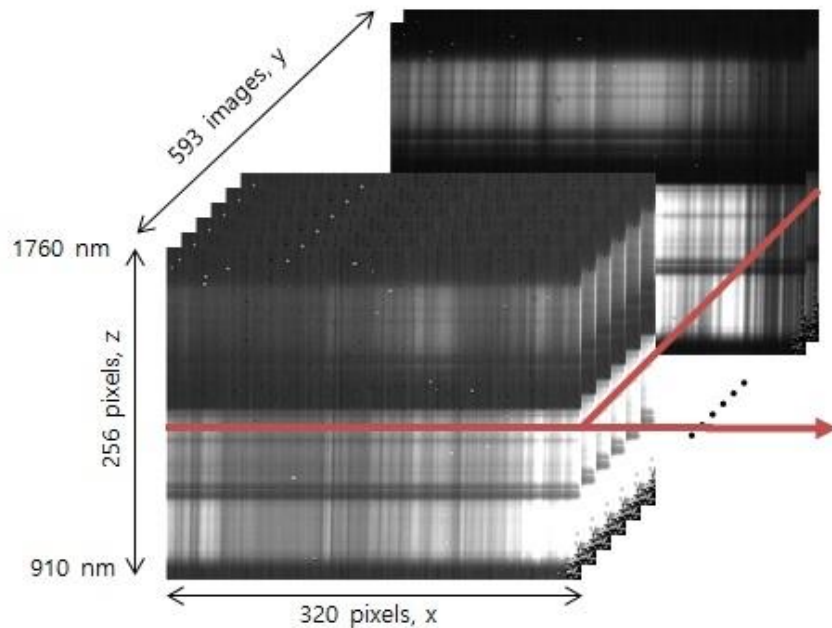
Image analysis and classification in cube display mode

Linescan Hyperspectral Camera

- 투과형 분광 광학계
- 라인 스캔 촬영 방식
- 고해상도의 full spectrum 이미지



Linescan Hyperspectral Camera



Visualization in 1290 nm

Linescan Hyperspectral Camera



Linescan – FX camera



Spectral Range	400 – 1000 nm
Spectral Bands	224
Spectral FWHM	5.5 nm
Spatial Sampling	1024 px
Frame Rate	330 FPS full frame 9900 with 1 band selected
FOV	38°
F-number	F/1.7
Camera SNR (Peak)	600:1
Camera Interface	GigE Vision or CameraLink
Dimensions	150 x 85 x 71 mm
Weight	1.26 kg

Integrated shutter and order blocking filter

Linescan – FX camera



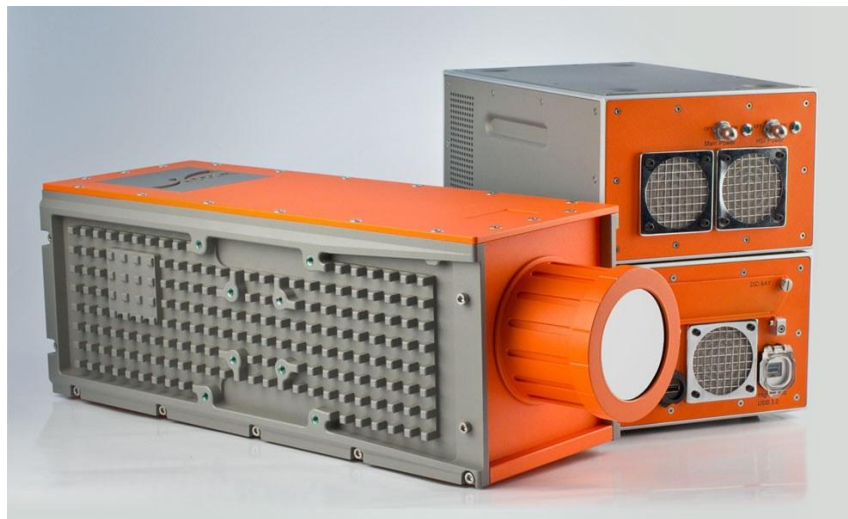
Spectral Range	900 – 1700 nm *
Spectral Bands	224
Spectral FWHM	8 nm
Spatial Sampling	640 px
Frame Rate	670 FPS full frame 15 000 FPS with 4 bands selected
FOV	38°
F-number	F/1.7
Camera SNR (Peak)	1000:1
Camera Interface	GigE Vision or CameraLink
Dimensions	150 x 85 x 75 mm
Weight	1.56 kg
Integrated shutter	

Linescan – FX camera



Spectral Range	2.7 – 5.3 μm
Spectral Bands	154
Spectral FWHM	35 nm
Spatial Sampling	640 px
Frame Rate	380 FPS (Full image with default binning)
FOV	24° / 45° / 60°
F-number	F/2.0
Camera SNR (Peak)	1600:1 (Dynamic range with 1.5 ms integration time)
Camera Interface	GigE Vision or Custom ethernet
Dimensions	280 x 202 x 169 mm
Weight	7 kg
Integrated shutter	

Linescan – SWIR



OPTICAL CHARACTERISTICS		TYPICAL SPECIFICATIONS
Spectral range		1 000 - 2 500 nm
Spectral resolution FWHM		12 nm (30 μm slit)
Spectral sampling		5.6 nm
Spatial resolution		rms spot radius < 15 μm
F/#		F/2.0
Slit width		30 μm (50 or 80 μm optional)
Effective slit length		9.2 mm
ELECTRICAL CHARACTERISTICS		
Detector		Cryogenically cooled MCT detector
Spatial pixels		384
Spectral bands		288
Pixel size		24 x 24 μm
Detector cooling		Stirling, 25 000 h MTF
Optics temperature stabilization		Yes
Camera output		16 bits CL
SNR		1 050:1 (at max. signal level)
Data cable		Length 5 meters
Frame grabber		National Instruments NI 1427
Camera control		USB / RS232
Frame rate		450 fps (maximum full frame)
Exposure time range		0.1 - 20 ms
Power consumption		Nominal < 50 W
Input voltage		Wide 24V

Linescan – FENIX



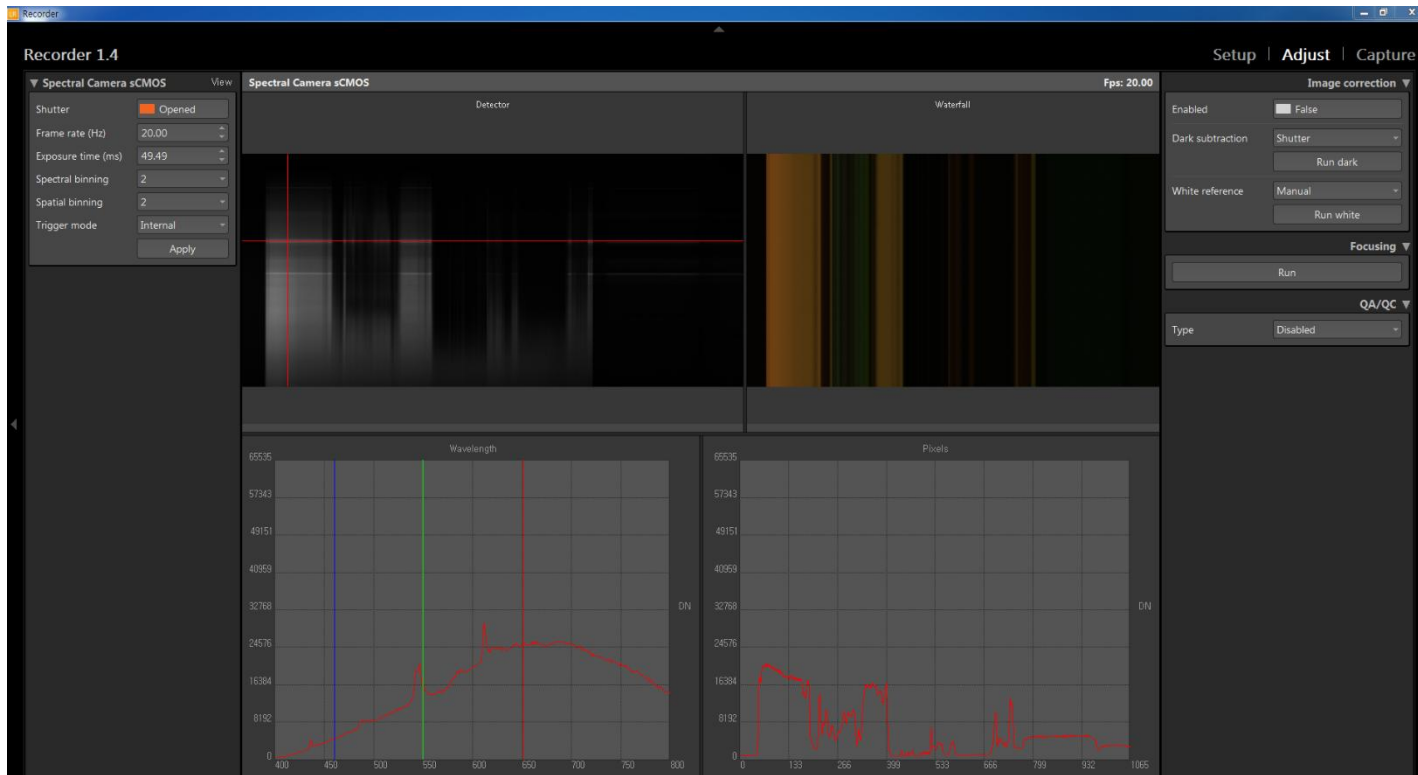
	VNIR			SWIR
Camera specifications				
Spectrograph	High efficiency transmissive imaging spectrograph			
Spectral range	380 - 970 nm		970 - 2 500 nm	
Spectral resolution	3.5 nm		12 nm	
F/#	F/2.4			
Smile / Keystone	< 0.2 pixels			
Polarization sensitivity	Throughput practically independent of polarization			
Signal-to-noise ratio (peak)	600 - 1 000:1 *		1 050:1	
Spatial resolution	384 pixels			
Frame rate	Up to 100 Hz			
Integration time	Adjustable within frame period			
FOV	32.3°			
IFOV	0.084°			
Swath width	0.58 x altitude			
Altitude for 1m pixel size	660 m			
Electro mechanical shutter	Yes			
Detector	CMOS			Stirling cooled MCT
Spectral binning options	2x	4x	8x	-
Number of spectral bands	348	174	87	274
Spectral sampling / band	1.7 nm	3.4 nm	6.8 nm	5.7 nm
Data interface	CameraLink 12-bit			CameraLink 16-bit
Typical power consumption **	150 W			
Maximum power consumption **	500 W			
Environmental characteristics				
Storage temperature	- 20 ... +50 °C			
Operating temperature	+ 5 ... +40 °C, non-condensing			

Linescan – LWIR



SPECTRAL CAMERA LWIR	OWL	HS
Optical characteristics		
Spectral range	8 - 12 μm	8 - 12 μm
Spectral bands	84	30
Spectral resolution	100 nm**	400 nm
Spectral sampling/band	48 nm	150 nm
Spatial pixels	384 pixels	
Field of view	With fore lens L43***: 24° With fore lens L32***: 32.2°	With fore lens L41*** 32.2°
Spatial sampling	L43 0.063° / L32 0.084°	0.084°
Aberrations	Insignificant astigmatism, smile or keystone < 0.1 pixels	
Optics temperature	Stabilized	Uncooled
Electrical characteristics		
Detector	MCT	LWIR uncooled microbolometers
Numerical aperture	F/2.0	F/1.0
Pixel size	24 x 24 μm	25 x 25 μm
Cooling	Stirling-cycle cooler	Uncooled
Camera output	14-bit LVDS	GigE Pleora
Frame grabber	NI-PCI 1422 or 1424 National Instruments	-
Frame rate	up to 100 fps	60 fps
Shutter/internal calibration	Yes / Optional	No
Power consumption	< 200 W + 400 W (calibrator)	3 - 5 W
SNR	Target 300 K	Target 400 K
	* 8 μm 450	* 8 μm 240
	* 10 μm 580	* 10 μm 210
	* 12 μm 230	* 12 μm 180
NESR (mW/m ² sr μm)	* 8 μm 21	* 8 μm 270
	* 10 μm 18	* 10 μm 310
	* 12 μm 40	* 12 μm 800
NETD/ spectral pixel	0.2K	1K

Linescan – LUMO data acquisition software



Mobile Hyperspectral Camera

- 디지털 카메라 방식의 휴대형 초분광 카메라
- 측정에서 분석까지 자율적 운용 가능
- 내장 GPS를 활용한 측정데이터의 위치정보 기록
- USB연결 또는 WIFI를 통신을 이용한 원격 제어



Mobile Hyperspectral Camera



Feature	Value
Spectral camera	VNIR 400~1000 nm (CMOS)
Viewfinder camera	5 Mpix
User interface SW	By Specim
Storage	SD card max 32 GB
Data Format	Specim Dataset with ENVI compatible data files
Battery	5200 mAh Li-Ion (Type 26650)
Operational time	Appx. 100 measurements with one SD card and battery
Display & keyboard	4.3 " touch screen + 13 physical buttons
Camera interface	USB Type-C
Size	207 x 91 x 74 mm (depth with lens 125,5 mm)
Weight	1.3 kg
F/number	1.7
Wavelength band	400~1000 nm
Spectral resolution FWHM	7 nm
Spatial Sampling	512 pix
Spectral bands	204

Drone Hyperspectral Camera – Linescan

- Push-broom 방식
- GPS/IMU 통합형 센서
- 다양한 플랫폼 호환

항목	특징
Sensor Type	Push-broom Line Imaging Spectrometer
Detector Type	CCD/CMOS hybrid 1408 spatial pixels
Focal Length / FOV	16mm / 29.5degrees
Spectral Range	400 ~ 1,000nm
Spectral Bands	155 bands (2bin)
Spatial Pixels	704 pixels (2bin)
INS	GPS + Mems IMU
Size / Weight	13.7 x 8.8 x 7.1cm / 680g



THANK YOU
