

MAIA S2 The multispectral camera

Datasheet Rev. 0.2 - 02/2018



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MAIA S2 is a product by



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1 DATASHEET

1.1 OVERVIEW

MAIA S2 is a multispectral camera designed to be employed on board UAV systems, entirely made in Italy and jointly developed by SAL Engineering - Modena and by EOPTIS - Trento. MAIA S2 is based on an array of 9 sensors with 1.2 Mpixel (9 monochrome with relative band-pass filters) for the analysis of the VIS-NIR spectrum at the same wavelenght intervals of the ESA's Sentinel-2[™] satellite, from 433 nm to 899.5 nm.

1.2 OPTICS

CMOS sensors settled in MAIA S2 has 1280x960 pixels and the dimension of each pixel is 3.75 μ m x 3.75 μ m. Sensors present excellent characteristics in terms of sensitivity. Each sensor is global shutter and shoot simultaneously: it follows that it is not necessary to stabilize acquisition with gimbal, which is indispensable with roling shutter sensors to avoid distorsions, crawling and blurring pixels in the images. The high quality and the radiometric validity of data obtained with MAIA S2 are then guaranteed even during high speed flghts.

Each optics of every produced MAIA S2 is calibrated in laboratory and for each camera the Calibration Certificate is available, with the following parameters:

- calibrated Focal Length;
- position of Principal Point;
- distortion lens parameters.

Calibration and certificate is carried out by 3DOM group - 3D Optical Metrology of FBK - Fondazione Bruno Kessler based in Trento (IT), in their laboratories.

1.3 CONNECTIONS AND DEVICES

The user can interact with the camera to configure operating parameters and to manage the images both through the GigaEthernet port and through integrated Wi-Fi. Many parameters can also be configured through the dedicated keypad using the On-Screen Display on the output port of the composite video. Thanks to a web panel, MAIA S2 permits a fine regulation of all parameters concerning the acquisition activities, from exposure time of each sensor to shot frequency. Automatic configurations are available for standard operations.

MAIA S2 can communicate and can be interconnected with various devices including:

- GNSS: GPS L1 or L1 / L2; GLONASS, Galileo, Beidou, for an accurate log of synchronized shutter positions (available in PPP, PPK, RTK);
- VIDEO TX for real-time transmission of images of the selected sensor, also remotely;
- RDX for remote control of the camera (frame rate, video source selection, wi-fi activation);
- GIMBAL for attitude and balance control (an integrated IMU with 3 accelerometers and 3 gyroscopes provides orientation parameters).



1.4 MULTISPECTRAL IMAGES

Images are stored in an internal hard disk (120 Gb SSD) that provides high speed and the possibility to save about 10,000 images in the maximum format allowed (12-bit raw).

MultiCam Stitcher Pro is the images pre-processing software integrated with MAIA S2, that allows the correction of geometrical distortion, radial distortion of the raw images, and allows to stitch the images of each single band on one multispectral image with the pixel-pixel convergence. It also allows you to calculate, for each image, NDVI, SAVI index and any type of customized band calculations nd combination of bands.

MultiCam Stitcher Pro allows the radiometric calibration of images in different ways:

- reference image on white target, of which you know the reflectance coefficients;
- empirical parameters based quantum efficiency of the sensor, bandwidth, transmittance of the filters and exposure times;
- through parameters data obtained by Incident light sensor ILS that analyzes the radiance of the light source for each acquisition.

The multispectral images can be exported in formats recognized by multispectral analysis softwares (eg. ERDAS[™], ENVI[™], PCI Geomatics[™], etc.) and photogrammetric processing softwares, in order to generate 3D models and orthophotos of single-band images or indexes.

MultiCam Stitcher Pro software is jointly developed by SAL Engineering Srl and 3DOM - 3D Optical Metrology - Fondazione Bruno Kessler (FBK), based in Trento (IT).





1.5 WAVELENGHT INTERVALS

Mono-chromatic sensors are matched with bandpass filter-set based on the wavelenghts intervals as follows:

FILTER ID	COLOR	START wl (nm)	STOP wl (nm)	Cwl (nm)	fwhm (nm)
BP1	VIOLET	433	453	443	20
BP2	BLUE	457.5	522.5	490	65
BP3	GREEN	525	575	560	35
BP4	RED	650	680	665	30
BP5	RED EDGE 1	697.5	712.5	705	15
BP6	RED EDGE 2	732.5	747.5	740	15
BP7	NIR 1	773	793	783	20
BP8	NIR 2	784.5	899.5	842	115
BP9	NIR 3	855	875	865	20

Table 1 Table of wavelenght intervals of the filter-set settled in MAIA S2 multispectral camera.



Table 2 Diagram of wavelenght intervals of the filter-set settled in MAIA S2 multispectral camera.



1.6 TECHNICAL FEATURES

Sensors	Number	9 Mono-Chromatic sensors + Bandpass filters
	Array	Array 3x3 – Centre to centre: 25mm
	Resolution	1.2 Mpixel (1280x960) each
	Туре	Global Shutter
	Image format	4:3
	Pixel size	3.75 μm x 3.75 μm
Optics	Lens	Fixed focus
	Focal lenght	7.5 mm
	Open	f/#2.8
	FOV	35° HFOV; 26° VFOV; 43° DFOV
Exposure	Туре	Manual
		Automatic
		Automatic based on Max Time Exposure
	Start	Simultaneous for each sensor
	Exposure time	0.1 ms - 50 ms – Typical: 1 ms
Acquisition	Туре	Single shot
		Continuous with external trigger
		Continuous at fixed-time interval
	Max frame rate	3 frames/sec with RAW 10 bit and RAW 12 bit;
		6 frames/s with RAW 8 bit
File format	File format	RAW 8 bit
		RAW 10 bit
		RAW 12 bit
Memory	Туре	Internal SSD
	Capacity	120GB (standard); 250GB; 500GB (on demand)
	Image size	21.2 MByte in RAW10 e RAW12
		11.8 MByte in formato RAW8
Embedded data	Exposure time for each sensor.	
	Timestamp at the shot time.	
	Time, position, speed, fix GNSS.	

Interfaces	Gigabit Ethernet.
	WiFi in Hot Spot by DHCP server.
	Serial for GNSS (level RS-232, 3.3V TTL)
	Synchro input – Trigger (3.3V TTL)
	Synchro output – Strobe (3.3V TTL)
	Composite Video output
	2 channels PWM input from radiolink (3V3 TTL)
	IMU/GYRO connection
	3 leds for events and status
	Keyboard with 8 function buttons.
	All 3.3V input can tolerate 5V.



Configuration	Web interface from Ethernet or Wifi			
-	Video input with on-screen text + keyboard			
	Radiolink inpu	ut		
RAW images	Professional software for elaborating multispectral images:			
processing software	- tiff multi-layer extraction;			
			- geometrical correction (undistortion);	
			 pixel-pixel stitching; 	
			- radiometric correction (manual, auto,	
			white);	
			 radiometric radial correction; 	
			 index images creation (NDVI, GNDVI); 	
			- band math (raster calculator);	
			- false-color images creation;	
			 multichannel images creation; 	
			- mono-chromatic images creation;	
			- preview of raw dataset.	
Physical Characteristics	Width	99 mn	n	
	Height	129 m	m	
	Depth	47 mn	n	
	Fixing	4 fixin	g holes M3x0.5-6H	
	Weight	420 g		
Power	Tension		From +9V _{DC} to +26V _{DC}	
	Consumption		~7.5W typ.	
			800mA a 9V (1.5A edge)	
Environmental	Temperature		0 °C to 40 °C; 32 °F to 104 °F	
conditions	Temp. Of stor	rage	0 °C to 60 °C; 40 °F to 140 °F	
	Humidity		20-80% RH non-condensing	
	Protection cla	iss	IP50 according to IEC-60529	



2 REVISIONS

Version	Date	Notes
Rev. 0.0	08/2016	Preliminary
Rev. 0.1	09/2017	First internal software update
Rev. 0.2	02/2018	Update of texts, contents, layout for MAIA S2