Sentinel-2 MultiSpectral Instrument (MSI)

highlight shows info to be input into instrument specs json file

[1] https://earth.esa.int/web/sentinel/technical-guides/sentinel-2-msi/msi-instrument

- and is based on a push-broom concept
- A Three-Mirror Anastigmat (TMA) telescope with a pupil diameter equivalent to 150 mm,
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S2A	S2B				
Band Number	Central wavelength (nm)	Bandwidth (nm)	Central wavelength (nm)	Bandwidth (nm)	Spatial resolution (m)
1	442.7	21	442.2	21	60
2	492.4	66	492.1	66	10

- Its 290 km swath width is a larger swath than previous multi-spectral optical missions such as SPOT and LANDSAT.
- Two focal planes based on: monolithic CMOS detectors for VNIR, mercury-cadmium-telluride detectors hybridised on a CMOS read-out circuit for SWIR.
- Two distinct arrays of 12 detectors mounted on each focal plane covering VNIR and SWIR channels respectively. The 12 detectors on each focal plane are in a staggered configuration to cover the entire field of view
- The 12 detectors on each focal plane are mounted in a staggered formation (Figure 3) to cover the whole 20.6o instrument field of view, resulting in a compound swath width of 290 km on the ground track.
- a parallax angle between the two alternating odd and even clusters of detectors is induced in the measurements, resulting in a shift along track of approximately 46 km (maximum) inter-detector. Likewise, the hardware design of both the VNIR and SWIR detectors imposes a relative displacement of each spectral channel

sensor within the detector resulting in an inter-band measurement parallax amounting to a maximum along track displacement of approximately 14 km.

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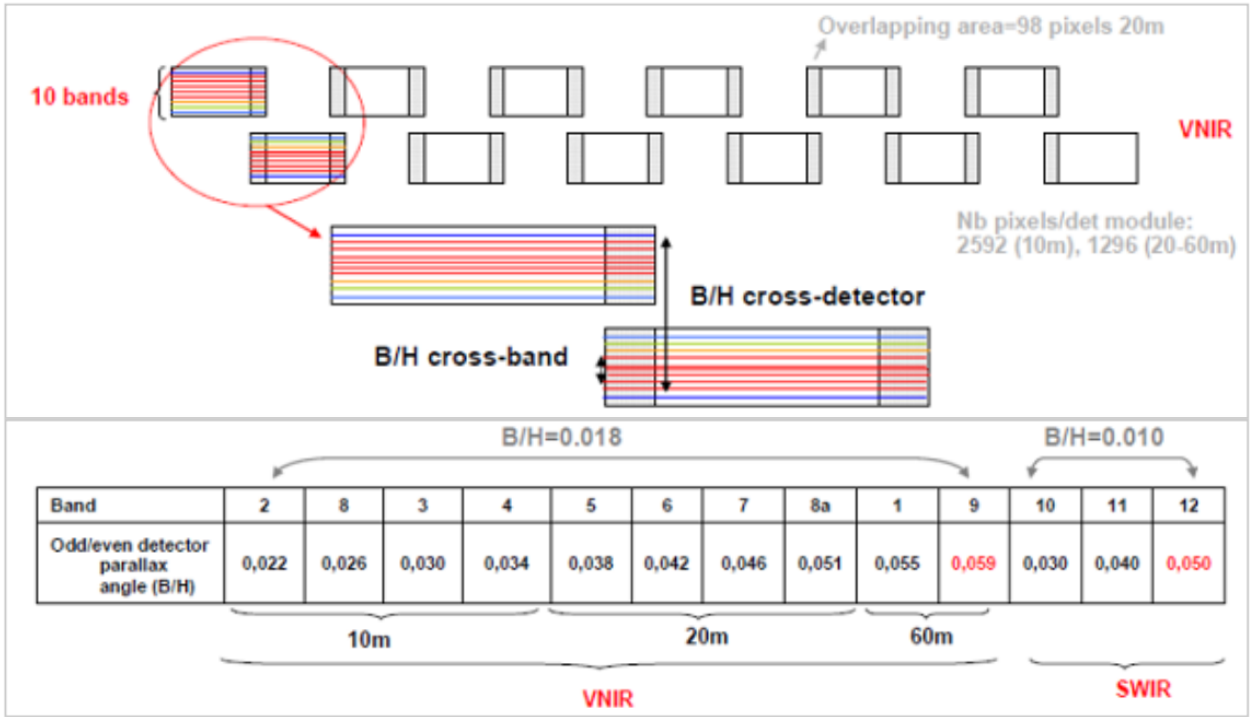

Figure 4: Staggered Detector Configuration and Inter-Detector / Inter-Band Parallax Angles (parallax figures derived from MSI instrument documentation)

[2] https://sentinel.esa.int/web/sentinel/user-guides/sentinel-2-msi/resolutions/radiometric

- 4 x 10 metre Bands: the three classical RGB bands ((Blue (~497nm), Green (560nm), and Red (~665nm)) and a Near Infra-Red (835nm) band; 6 x 20 metre Bands; 3 x 60 metre Bands
- The radiometric resolution of the MSI instrument is 12 bit, enabling the image to be acquired over a range of 0 to 4095 potential light intensity values.

[3] https://directory.eoportal.org/web/eoportal/satellite-missions/c-missions/copernicus-sentinel-2

- The spacecraft mass is ~ 1200 kg, including 275 kg for the MSI instrument, 35 kg for the IR payload (optional) and 80 kg propellant (hydrazine). The S/C power is 1250 W max, including 170 W for the MSI and < 100 W for the IR payload.

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Mirror dimensions of telescope	M1 = 440 mm x 190 mm M2 = 145 mm x 118 mm M3 = 550 mm x 285 mm
Instrument mass, power	~290 kg, < 266 W
Data rate	450 Mbit/s after compression

[3] Pierre Gloesener, F. Wolfs, F. Lemagne, and C. Flebus "Manufacturing, testing and alignment of Sentinel-2 MSI telescope mirrors", Proc. SPIE 10564, International Conference on Space Optics — ICSO 2012, 105640X (20 November 2017); doi: 10.1117/12.2309164; https://doi.org/10.1117/12.2309164

- The telescope field of view is 20.88 degrees across track and 3.46 degrees along track and its effective focal length lies around 600 mm in the field centre.
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VNIR (Visible and Near Infrared)	SWIR (Short-Wave Infrared)
Monolithic CMOS (Complementary Metal–Oxide–Semiconductor)	MCT, CTIA (Capacitive Feedback Transimpedance Amplifier) ROIC
10 filters	3 filters
7.5-15 µm pitch	15 µm pitch
31,152-15,576 pixels	15,576 pixels

Determined MSI Band-2 specs (highlight are "guessed-values"):

- Band 2 is 10m resolution, Nb pixels/det module = 2592

- F# = f/D = 600e-3/150e-3 = 4
- IFOV = d/f = 7.5e-6/600e-3 = 12.5 urad = 0.000716197243913529 deg
- IFOV ~ 10m/ 786km = 12.7226 urad (Another validation)
- CT-FOV/IFOV = 20.6/0.000716197243913529 ~ 28763 CT detectors
- AT-FOV= IFOV = 0.000716197243913529 deg

IFOV for detector of 15um pitch is 0.00143239448782706 deg
CT-FOV/IFOV ~ 14382 CT detectors
(15576 - 14382)/11 ~ 109 which is almost same as the 98 overlapping pixels in [1] Figure 4.


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