SOLMIRUS

ATMOSPHERIC IMAGING SOLUTIONS

FSO/DE Atmospheric Station

All-Sky Infrared + Visible Imaging with Day/Night Turbulence Monitoring

Overview

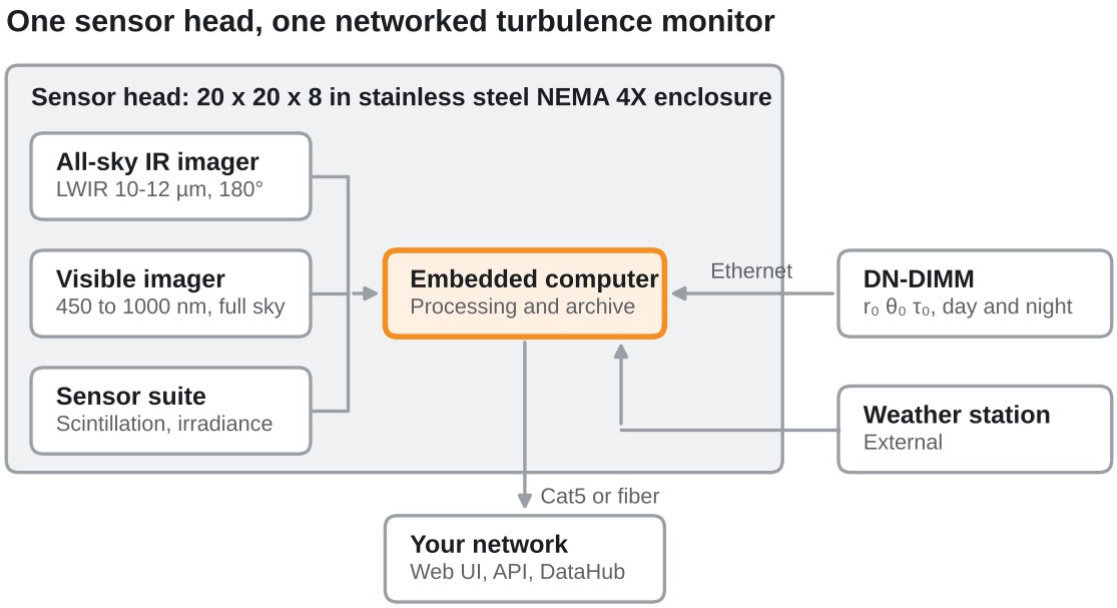
The FSO/DE Atmospheric Station puts calibrated all-sky infrared imaging, all-sky visible imaging and a full atmospheric sensor suite into one 20 × 20 × 8 in stainless steel NEMA 4X enclosure, networked to a DN-DIMM for day-and-night turbulence and an external weather station. Built for free-space optical (FSO) communications and directed energy / high energy laser (HEL) programs, one station delivers every parameter that decides whether an optical path is usable: cloud cover, cloud opacity, turbulence (r_0, θ_0, τ_0), absorption, irradiance and weather, 24/7/365.

The infrared channel is the Solmirus ASIS-M1i imager: a radiometrically calibrated 640 × 480 LWIR array behind a proprietary 180° fisheye, with 20+ years of all-sky IR field heritage. The visible channel and sensor suite come from the Miratlas Sky Monitor, deployed at more than 60 stations in 20 countries since 2018. The DN-DIMM extends the DIMM (the reference technique for qualifying major telescope sites) to daylight, unattended.

Key Features

- Calibrated all-sky LWIR imaging: 24/7 cloud detection, cloud opacity and sky temperature, day and night, in all weather
- All-sky visible imaging, 450 to 1000 nm, for daytime cloud cover and nighttime transparency
- Day and night turbulence from one technique: r_0, θ_0 and τ_0 from the networked DN-DIMM, with no handover at dawn or dusk
- Covers every instrument class the CCSDS recommends for optical ground station characterization
- Single sensor head: IR and visible channels plus sensors in one 20 × 20 × 8 in powder-coated stainless steel NEMA 4X enclosure
- STIG-hardened configuration available for government and defense deployments
- Unattended operation: autonomous acquisition, processing and archiving; DN-DIMM self-points, refocuses and recovers from faults
- Open data access: web UI and REST API on the instrument, plus optional cloud DataHub and Grafana dashboards
- US-designed and US-assembled IR channel; proprietary Solmirus 180° LWIR fisheye lens

System Architecture



The IR imager, visible imager and sensor suite share one enclosure and one embedded computer. The DN-DIMM stands separately on its own mount and reports over Ethernet, the external weather station connects to the same computer, and the computer serves all data to the customer network.

Specifications

Values marked TBC are carried over from the separate instruments and will be confirmed for the integrated unit.

All-Sky Infrared Imager (Solmirus ASIS-M1i Channel)

Parameter	Value
Sensor	640 × 480 uncooled LWIR microbolometer focal plane array
Spectral band	10 to 12 µm filter for optimal sky/cloud contrast; application-specific filters optional
Lens	Proprietary coated Solmirus LWIR fisheye, 180° field of view
Calibration	Absolute radiometric calibration; motorized hatch with integrated blackbody reference
Cadence	≤ 30 s per calibrated frame
Thermal management	Peltier heating/cooling with internal temperature monitoring

All-Sky Visible Imager (Miratlas Sky Monitor Channel)

Parameter	Value
Spectral band	450 to 1000 nm
Field of view	Full sky

Parameter	Value
Measurements	Daytime cloud cover, nighttime transparency
Interface	GigE

Integrated Atmospheric Sensors

Sensor	Measures
Sun Scintillation Sensor	Daytime turbulence: r_0 and seeing
Pyrgeometer	Downwelling longwave radiation, sky temperature
Irradiance sensor	Solar irradiance
Water column	Total water column (absorption)
Weather station (external)	Temperature, pressure, humidity, wind, rain and rain rate; no moving parts
External RH and temperature	Ambient humidity and temperature at the enclosure

DN-DIMM Turbulence Monitor (Networked)

Parameter	Value
Technique	Differential Image Motion Monitor, day and night
Optics	Two independent 80 mm telescopes, 200 mm apart, each with its own focuser
Acquisition	1 ms exposures at 400 frames/s
Cadence	One measurement every 30 s, built from 12,000 frames
Outputs	Fried parameter r_0, isoplanatic angle θ_0, coherence time τ_0; corrected for air mass, normalized to zenith, reported at 550 nm
Mount	Alt-Az with absolute encoders; automatic star selection, pointing, centering, refocus and fault recovery
Siting	Outdoors, no dome required; Ethernet link to the sensor head
Availability	Q1 2027

Enclosure and Physical

Parameter	Value
Enclosure	Adalet stainless steel, powder-coated
Dimensions	20 × 20 × 8 in (508 × 508 × 203 mm)
Rating	NEMA 4X
Weight	TBC
Mounting	TBC

Power and Environment

Parameter	Value
Input	100 to 250 VAC, 50/60 Hz (TBC)
Consumption	TBC; Peltier thermal management dominates
Operating temperature	−20 to +55 °C external (TBC)

Connectivity and Software

Parameter	Value
Network	Ethernet, Cat5 or fiber
Onboard computer	Embedded ruggedized control computer; on-board processing and raw data archiving
User interface	Web-based UI for complete instrument control, acquisition and analysis
Data access	REST API on the instrument; rsync archive mirroring; optional Miratlas DataHub (web, REST API, bulk export) and Grafana dashboards

Data Products and Measurements

Product	Source	Day/Night
Calibrated spectral radiance, raw and normalized	IR imager	Both
Normalized radiance vs. air mass, clear-sky subtracted radiance	IR imager	Both
Cloud mask and cloud/no-cloud reporting	IR imager	Both
Brightness temperature per pixel, sky and cloud temperature	IR imager	Both
Cloud cover percentage and optical depth (opacity) in user-defined fields	IR imager	Both
All-sky color imagery, cloud cover, transparency	Visible imager	Both
Fried parameter r_o and seeing	DN-DIMM; Sun Scintillation Sensor	Both; day
Isoplanatic angle θ_o	DN-DIMM	Both
Coherence time τ_o	DN-DIMM	Both
Total water column (absorption)	Sensor suite	Both
Irradiance and downwelling longwave	Sensor suite	Both
Surface weather	Weather station	Both

IR products update at ≤ 30 s and turbulence every 30 s, so cloud and turbulence series share a common timeline for link-availability analysis.

Options

- SHABAR shadow band ranging: daytime Cn^2 profile from 0 to 1,000 m in 24 altitude layers
- C-DIMM night-time turbulence monitor in place of the DN-DIMM
- Application-specific IR filters
- Precipitation sensor
- Large-capacity local storage
- Software analysis, data product and post-processing packages
- Miratlas DataHub subscription and Lamarck atmospheric dataset access
- LaserCom Pathfinder site analysis: cloud, turbulence and availability statistics for a candidate site
- Training, installation and maintenance plans

Applications

- Optical ground station site survey and selection
- Live FSO and laser communication link operations: choosing the best station at the right time
- Directed energy and defense optical systems
- Quantum communication ground stations
- Astronomical observatories and telescope sites
- Atmospheric science and meteorological stations

Contact

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