SEA-BIRD SCIENTIFIC

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SAS Solar Tracker

Autonomous measurements

The SAS Solar Tracker works in conjunction with the Surface Acquisition System (SAS) (measures above-water ocean colour) to maintain the correct pointing angle with respect to the sun, and thus permits autonomous operation.

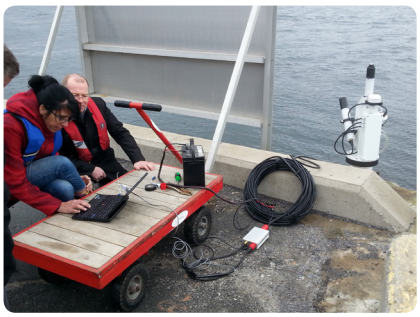
The SAS Solar Tracker autonomously performs measurements when the elevation of the sun and the orientation of the ship allow, subject to operator settings. For example, the SAS Solar Tracker would not collect data at night, or in daylight when the sun is too low in the sky, or when due to ship's course, the ship's structure would block the required view of the water. With data storage for months of operation, the SAS Solar Tracker's autonomy frees busy science crew for other tasks and makes it suitable for deployment on volunteer observing ships.

Features

- Drive Unit to adjust the viewing angle of the frame
- Frame for mounting the sensors
- Precision Lt, Li and Es measurements
- Adjustable viewing angles from Nadir and Zenith
- Orientation (azimuth, pitch, roll) measurements
- Sea-surface temperature
- GPS for geo-referencing and time tagging
- Flexible configuration
- Internal data logging
- Low power consumption

Components

L_t Sensor
The Lt or spectral sea-surface radiance sensor is a Satlantic radiance sensor. A number of sensor options are available, offering a range of spectral capabilities. The OCR-507 offers seven discrete wavelength channels, while the HyperOCR covers the visible spectrum with optional extended calibration into the ultraviolet and infrared regions. The legacy OCR-200 sensor in conjunction with an MVD is also supported. The OCR-507 half-angle FOV (Field-Of-View) is available in 10°, 3°, 1.5°, and 0.7° options. Most applications use the 3° option. Smaller FOV angles are achieved from the 3° model by attaching removable Field Stop Adapter Plates. The HyperOCR half-angle FOV is available in 11.5° and 3° options. Most applications use the 3° option. *Refer to the sensor operation manual for details.*



L_i Sensor
The L_i or indirect (or sky) radiance sensor is a Satlantic radiance sensor. The options available are identical to those for the Lt sensor. **Refer to the sensor operation manual for details.**

E_s Sensor
The E_s or irradiance sensor is a Satlantic irradiance sensor. The options available are identical to those for the Lt sensor. *Refer to the sensor operation manual for details.*

Temperature Sensor (Pyrometer)
The Infrared Temperature Sensor is a Heitronics Model KT 19.85 II radiation pyrometer. The pyrometer measures the sea (or land) surface temperature. It is mounted to the SAS frame at a fixed 40° viewing angle from nadir.

Notes on Measuring Surface Temperatures
At temperatures greater than absolute zero (0 Kelvin), all bodies emit electromagnetic radiation. The wavelength and density of the emitted radiation is dependent upon the temperature of the body. Below about 600 °C, the emitted wavelengths are all contained within the infrared range. The radiation density is dependent on the surface of the body; an ideal source of radiation with maximum radiation density is referred to as a blackbody source. The ratio of actual radiation density of the body to the maximum is the emissivity ε. Emissivity is dependent on a number of factors including the type of material, the material surface, and the radiation wavelength. By measuring the emitted radiation from a body with a known ε, the surface temperature of the body can be determined. Radiation pyrometers measure this kind of radiation. For SAS applications, radiation pyrometers offer several advantages over standard temperature probes, including:

- No contact with the sea (or land) surface is required
- The pyrometer is not in the FOV of the optical sensors
- Temperature data is integrated and synchronized with the SAS data

The KT 19.85 operates in the wavelength range of 8 to 14 µm. In this spectral range, the atmospheric transmissivity is very high, minimizing the effects of carbon dioxide and water vapour on the infrared signal strength.

GPS Receiver
The GPS receiver used with the SAS is a Garmin GPS 19x HVS which is an embedded receiver and an antenna. The GPS receiver tracks multiple satellites at a time and provides precise navigation updates once per second. It is capable of using Wide Area Augmentation System (WAAS) and differential GPS services. The GPS 19x HVS was selected for its ability to withstand rugged operating conditions; it can withstand immersion in 1 m of water for 30 minutes. Refer to the GPS receiver operation manual for details.

SAS Controller and Junction Box
All power and communication from and to the SAS Solar Tracker are routed through the drive unit to the junction box. The SAS Junction Box converts 48 VDC supplied by the MDU over the power/telemetry cable to 12 and 24 VDC for the sensor ports. The Junction Box also converts sensor serial data communication from RS-232 to RS-422 for transmission over the power/telemetry cable to the MDU. Voltage conversion and serial data communication signal conversion enable duplex communication between the SAS and the data logging computer over a long distance. The junction box receives data from sensors (optical Lt, Li, E, sensors, pyrometer, GPS, integrated THS) and optionally ship navigation, controls the drive unit, and streams output via the MDU to a logging computer. It also logs data internally to a USB mass storage device.

Mounting Frame
The SAS Mounting Frame is made from white coated metal, providing a rugged structure for instrument mounting. The frame provides mounting brackets for the sky radiance, water-leaving radiance, and irradiance sensors. The pyrometer is attached via a mounting block, and the GPS is screwed to the top of the frame. The junction box is attached to the back side of the frame. The whole frame is mounted on top of the SAS Solar Tracker Drive Unit, which rotates the frame during operation. The brackets for the sky radiance and water-leaving radiance sensors are mounted on plates that can be adjusted to a viewing angle between 30 and 50 degrees from zenith or nadir, respectively. The irradiance sensor is mounted vertically inside the frame box.

SAS Solar Tracker Drive Unit
The drive unit forms the base of the SAS Solar Tracker. It receives power and transmits telemetry via its 6-pin port, and receives ship navigation data via its 8-pin port. During operation, the drive unit rotates the frame that is mounted on top for optimal measurement direction.

Miniature Deck Unit
The Miniature Deck Unit (MDU) serves as both a nominal 48 VDC power source for the Junction Box and as a RS-422 to RS-232 level converter. It is connected to the DC power supply, the data logging computer and the Junction Box.

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