

LISST-VSF

Multi-angle Polarized Light Scattering Measurements

VSF • DoLP • Beam Transmission • Depth • Temperature

The LISST-VSF from Sequoia is the first commercially available submersible instrument for measuring the volume scattering function (VSF) *in situ* with polarization discrimination capability. The instrument covers the angular range from 0.1-150 degrees in water. The range 0.1 to 14.3 degrees is covered with a LISST-100X standard ring detector. The larger angles, 15-150 degrees, are scanned by a

rotating 'eyeball' optic. As it spins the eyeball views scattering along a laser beam from different points (hence different angles). Polarization of the incident laser beam is alternated between horizontal and vertical, the received scattered light is split into its two linear polarization components and sensed by separate photomultiplier tubes permitting calculation of the particulate VSF and degree of linear

polarization (DoLP). A full measurement is completed in about 2 seconds. Polarization information is only covered over the 15-150 degree range, At smaller angles, scattered light maintains the original laser polarization closely. The instrument is programmable and powered externally. A submersible rechargeable battery pack is included.



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FEATURES

- In-situ measurements of P_{11} (VSF) and P_{12} (DoLP) elements of the scattering Mueller matrix from 15-150° in water
- VSF (P_{11}) at small angles, 0.1 to 15° in 32 logarithmic angle steps
- Integration of 0.1-150° VSF provides a good estimate of total particle scattering coefficient b_p
- Beam attenuation c_p measured with LISST-100X optics
- Roving Eyeball optics permit 1° resolution in angles between 15 -150°
- Approximately 2 seconds per measurement set (2 polarizations of incident laser beam)
- Daylight rejection by laser modulation
- Extension of dynamic range in VSF measurements using control of laser power and photomultiplier gain
- Data from small and large angles in a single data stream, including depth and temperature

SPECIFICATIONS (subject to change without notice)

Parameters measured

- Small-angle VSF in 32 log-spaced angles, from 0.1 to 15°
- VSF and P_{12} (DoLP) over 15-150° in 1° steps
- Temperature from -5° to 50°C with 10 mdeg resolution
- Operational depth (50 m max depth @ 8 cm resolution)

Operating Concentration range

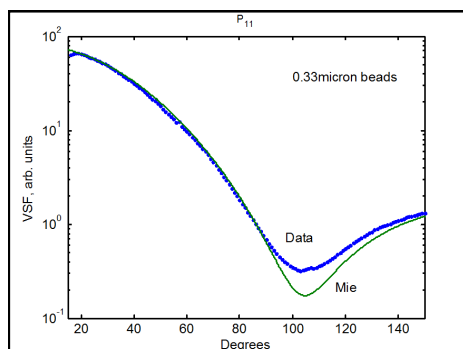
- Beam attenuation > 0.1 m⁻¹

Technology

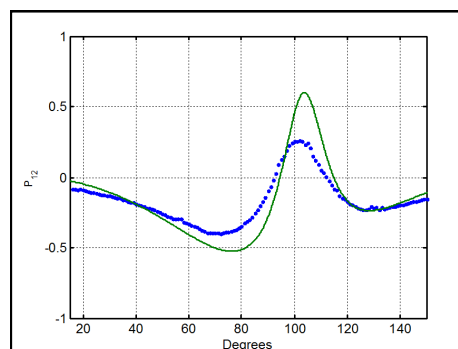
- Fiber-coupled laser diode @ 515 nm
- Ring Detector for small-angle VSF <15°
- Roving Eyeball and PMT at 15-150°

Mechanical and electrical

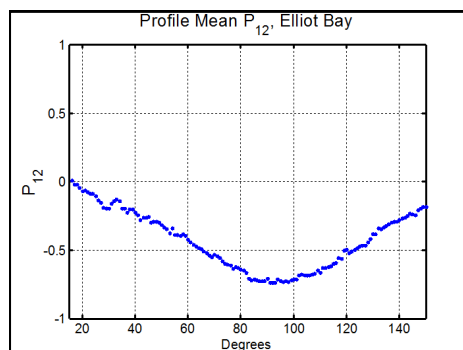
- Dimensions 12.7 cm (5.0") \varnothing × 95.7cm (37.7") L
- Weight: 13.1kg (28.9 lbs) in air
- Depth rating: 300 m survival depth (50 m operational depth)
- External power supply: 12-15VDC @ approx. 1.5A sampling, max 18VDC
- Sampling rate: approx. 2-3 seconds for a full measurement of VSF and P_{12}
- Data storage: 128GB, equivalent to 24,000 measurements
- Rechargeable external battery pack included (NiMH 14.4 V nom., 15 Ah)



Measured P_{11} (VSF) of 0.33µm beads compared to Mie theory



P_{12} (normalized by P_{11}) of 0.33µm beads compared to Mie theory



In situ P_{12} (normalized by P_{11}) of water in Elliot Bay, WA, USA



Detail of the LISST-VSF optics path, showing the receive optics and the Roving Eyeball