

Optical Volume Scattering Function (VSF) Measurement with LISSTs

The optical scattering function (VSF) describes how incident light on a volume of water is scattered into various directions. It is an important *inherent optical property* of water – a term used by optical oceanographers. The VSF at small forward angles is important in determining beam spread or in image degradation underwater. Large angle VSF is relevant to propagation of light in water, remote sensing, and ocean color.

Sequoia makes unique submersible VSF sensors, e.g. small angle sensors (LISST-100X, LISST-200X), and wide-angle autonomous sensors (LISST-VSF) with additional 1-degree resolution to 150-degrees. A custom version, LISST-STOKES was developed to measure the weak depolarization that can occur at small angles.

Small Angle VSF Sensors: LISST-200X and LISST-100X measure the small angle forward VSF over the angle ranges in water, respectively, 0.039 to 13, and 0.039 to 6.5. The instruments also obtain a high-quality estimate of beam-attenuation coefficient, c . Thus the scattering phase function (VSF/ c) may be determined. At such small angles, a change in polarization state of light is very small, and these instruments ignore it. A different instrument, LISST-STOKES was developed as a special device. It is not a standard product. If interested, please contact us.

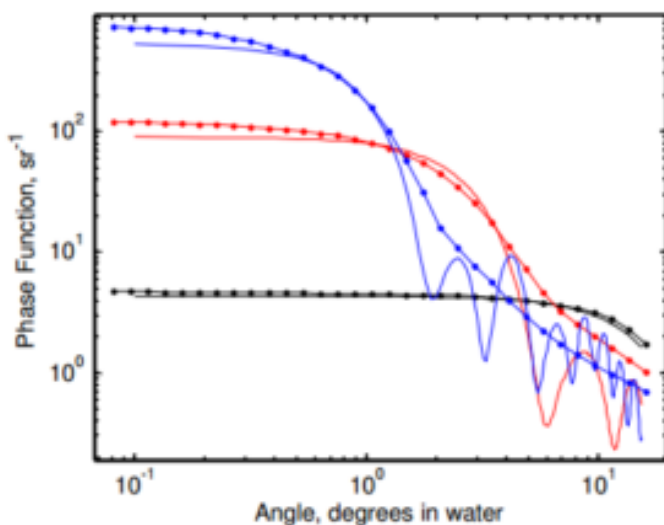


Figure 1: Comparison of phase functions for 3 sizes: 1.1, 6.7, and 18.1 microns, computed for spheres and measured for irregular particles with a LISST-100X. [from *Optics Express*, 2009, v 71 n11, pp 8811 to -14.

Wide Angle VSF Sensor System: With NASA SBIR sponsorship, a wide-angle VSF instrument LISST-VSF was developed. It incorporates the small forward angle capability of the above instruments with the larger angle coverage out to 150-degrees using a ‘roving eyeball’. A rotating light-gathering ‘eyeball’ collects scattered light from different points along a laser beam. The eyeball includes polarization discrimination optics so that the instrument delivers the scalar VSF and the depolarization over 12-150 degrees.

The figure below shows data collected with polystyrene beads of 2 micron size. The agreement with Mie theory is good.

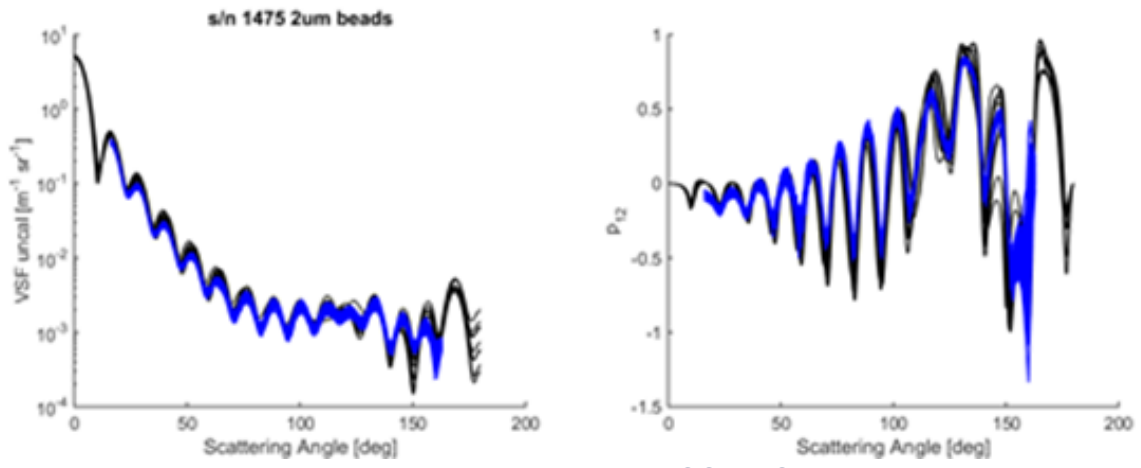


Figure 2: VSF and depolarization measurement with the LISST-VSF.