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# Use of the Polarize Radiance Distribution Camera System in the RADYO Program

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## LONG-TERM GOALS

My work involves experimentally investigating the interrelationships and variability of optical properties in the ocean and atmosphere. My goal is to define the variability of the optical properties, particularly those dealing with light scattering, and to improve the prediction capabilities of image and radiative transfer models used in the ocean. My near term ocean optics objectives have been: 1) to improve the measurement capability of measuring the in-water and above-water spectral radiance distribution and extending this capability to polarization, 2) to investigate the variability of the Point Spread Function (PSF) as it relates to the imaging properties of the ocean, and 3) to improve the characterization of the Bi-directional Reflectance Distribution Function (BRDF) of benthic surfaces in the ocean, and 4) to understand the capabilities and limitations of using radiative transfer to model the BRDF of particulate surfaces.

## OBJECTIVES

The major objective of this research is to understand the downwelling spectral polarized radiance distribution, in the near surface of the ocean.

## APPROACH

We are currently building, with ONR (through the DURIP program) a camera system capable of measuring the polarization state of the downwelling radiance distribution. This instrument follows in the footsteps of other instruments we have developed (Voss and Liu, 1997) and uses a combination of 3-4 images of the radiance distribution to form this polarized radiance distribution. Because the downwelling radiance distribution is very dynamic, we need to have a system that will quickly make these images as matched as possible, so this requires a completely new design.

The system we have designed uses 4 fisheye camera lenses with coherent fiber bundles behind each image. Each fisheye will have a polarizer in a different orientation. After the image is in the coherent fiber bundle, these bundles will be brought together and imaged on a CCD array camera, through a filter changer (for spectral information). Thus in a single image we will have 4 separate fisheye images of the scene, each with different polarization information. The work in this proposal will be in characterizing this instrument, then using it in the RadYO program.

## **WORK COMPLETED**

We have only just started on this project. To date we have ordered all of the necessary parts to make the system. As these parts come in we will be evaluating them and then designing the instrument housings necessary to put the system in the water. We anticipate being able to do the mechanical design in the next month (October, 2006), with the hope of having a workable system, although not finished, by the new year. This could be somewhat optimistic, depending on the machining required.

## **RESULTS**

We have just started on the project so there are no results at this point.

## **IMPACT/APPLICATIONS**

This system will provide a brand new measurement capability. In the RaDYO program this instrument will be used in combination with other measurements of the sea surface and optical parameters. The goal of the overall RadYO program is to understand how the radiance distribution is modified in the near surface, and what factors are important to this modification.

## **RELATED PROJECTS**

This project is part of the overall ONR RadYO program. We also have DURIP support to build the instrument, fundamental to this work. Our work on the polarized radiance distribution is also related to our efforts with NASA funding to look at both the upwelling radiance distribution and the polarized upwelling radiance distribution.

## **REFERENCES**

K. J. Voss and Y. Liu, "Polarized radiance distribution measurements of skylight: I. system description and characterization", 1997, *Applied Optics*, **36** :6083-6094.