

## **Optical Data Transmission in a Turbid Environment**

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Award Number: N00014-10-1-0202

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## **LONG-TERM GOALS**

The goal of this research is to measure the effects of varying amounts of suspended particulate near the sea floor on data transmission with a free space, omni-directional, optical link and to test the viability of communicating through the air-sea interface. A better understanding of turbulence and turbidity and their influence on the optical channel are critical to the development of optical communications in coastal waters.

## **OBJECTIVES**

1. Deploy an optical telemetry system in a location where optical properties are measured by our collaborators.
2. Demonstrate optical telemetry through the air-sea interface.
3. Identify relationships between optical link performance and observed optical water properties

## **APPROACH**

The approach is to use existing optical communications equipment and deploy it in shallow water at a location where optical and acoustic water properties are being studied by other investigators. Our optical communications testing to date has been limited to over night tests with a single transmissometer measurement. Our collaborators will provide measurement of 9 wavelengths of absorption and attenuation, multiple backscatter, CDOM fluorometer and several other parameters. We will measure optical link performance and received power for two wavelengths of light. Dr Boss will compute underwater visibility which we will use to model the light field produced by the optical modem. Collaborating with Dr. Hill, Sherwood and Trowbridge, our data will be used to develop and constrain a sediment concentration module that will be incorporated to the Community Sediment Transport Modeling System (CSTMS).

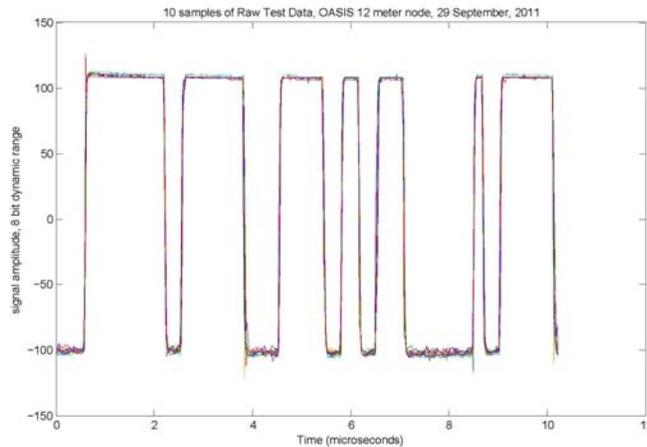
## **WORK COMPLETED**

In September and October 2011, two optical telemetry systems were deployed at the MVCO 12m node and ASIT tower. The 12 m node system consisted of tripods equipped with optical receivers and emitters located at 1 and 3 meters off the sea floor. These tripods were initially deployed with 24 meters near the USGS/UMaine tripod. After a period of one week, one tripod was moved to reduce separation to 15 m. Received power levels, bit error rate statistics and raw data “snapshots” were collected at night for the link 3 meters off the seafloor for a period of three weeks. The optical receiver located 1 meter off the seafloor was damaged during or soon after deployment. Two attempts to replace the faulty receiver were made but were unsuccessful due to poor weather and connectivity issues with MVCO.

At the ASIT tower an upward looking optical system equipped with a 450 nm transmissometer was deployed on the beam located 4 meters below the surface. A downward looking system was located at a location 12m from the surface. Received power levels, bit error statistics and “raw data” snapshots were collected for 1 month.

## RESULTS

Equipment was just recovered last week (Nov 26). Results are not yet available, however a snapshot of raw data acquired at the 12 meter node is shown below.



*Tcy 'qr wēcnf cw 'ht q'34'b gwt 'p qf g.'O XEQ*

## IMPACT/APPLICATIONS

The performance of optical communications in highly varying turbid environments will enhance understanding of the viability of optical communications in such environments. This is important for developing performance models for optical communications.

## RELATED PROJECTS

The WHOI optical communications group is also funded by NSF

## PUBLICATIONS

- Farr, N., A. Bowen, M. Tivey, J. Ware, C. Pontbriand (2010). An integrated, underwater optical/acoustic communications system. MTS/IEEE Oceans Conference, Sydney, Australia.
- Farr, N., M. Tivey, J. Ware, C. Pontbriand (2010) Optical communication system expands CORK seafloor observatory's bandwidth. MTS/IEEE Oceans Conference, Seattle, WA.
- Farr, N., M. Tivey, J. Ware, C.T. Pontbriand, and D.E. Frye (2010) Integrated optical/acoustic communications system for deep sea data transfer and vehicle control. Eos Trans. AGU 91(26), Ocean Sci. Meet. Suppl., Abstract MT23A-05.