# Demo Abstract: Low Cost, Medium Range Optical Communication for Underwater Test Beds

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## 1. INTRODUCTION

To develop novel underwater sensor network technologies, experimental validation is crucial. Unfortunately, full scale deployment is often hard and costly. Therefore, aquatic testbeds that are scaled down versions of the final system and that can be deployed in pools or ponds, serve a valuable purpose. To support such testbeds, we created an underwater optical modem prototype that has a range suitable for such testbed deployments (around 5-10m), while utilizing only low-cost components. In general, these low cost parts provide less sensitivity than more expensive alternatives. To compensate for this, we exploit sophisticated detection algorithms (based on spread spectrum) to maximize the communication range.

## 2. OPTICAL MODEM

Our optical modem prototype is shown during a test in a swimming pool in Figure 1. It uses a single Super-Green LED (unit cost $1), a blue-green filtered photodiode (unit cost $2) and interfaces with a 32 MIPS Freescale DSP.

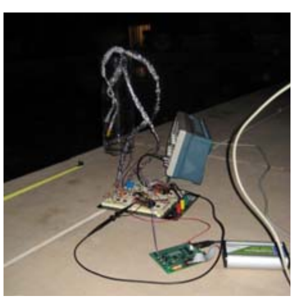

**Figure 1. Optical modem prototype and test setup**

Ultimately, the communication range is determined by the ability to detect whether or not a signal is present (e.g. in WiFi, the ability to detect the preamble determines the maximum range). In our modem, signal detection is based on direct sequence spread spectrum (DSSS), using a 32-chip Gold sequence at a 10 KHz chip rate. To compensate for varying received signal strength and unknown noise conditions, signal detection uses an adaptive threshold. Figure 2 shows the decorrelated data and the adaptive decision threshold as collected during a test in a swimming pool at dusk (under ambient light from light posts), where the distance between transmitter and receiver was 4 m. Actual data communication beyond mere signal detection is achieved by using pulse position modulation (PPM).

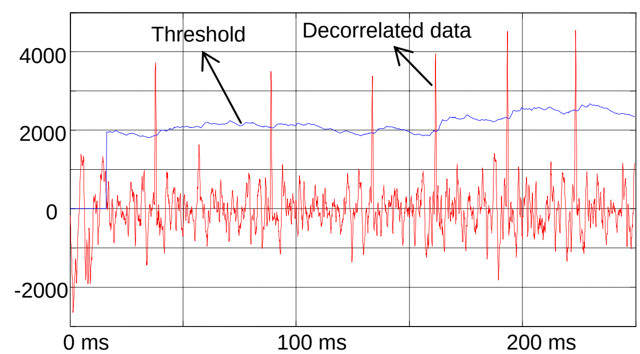


**Figure 2. Experimental evaluation of signal detection**

## ACKNOWLEDGEMENTS

This work was supported in part by the NSF under award number ECCS-0622005 (REU supplement). Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect those of NSF.