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NDBC Ocean Wave Observation System Update

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1. Introduction

The U.S. National Oceanic and Atmospheric Administration's (NOAA) National Data Buoy Center (NDBC) is modifying its ocean wave observation system due to parts obsolescence. The modified system is named Ocean Wave Linux (OWL). OWL will replace the NDBC's older and now obsolete Digital Directional Wave Module (DDWM). Once OWL completes operational verification, the DDWM will be phased out of the NDBC's operational weather buoy network.

Test systems that incorporate both the older DDWM and the prototype build of the new OWL system in one enclosure have been fabricated, and bench tested. Test deployments of the combined systems are planned for open oceans off of the West and East Coasts of the U.S., and the closed waters of the Gulf of Mexico and Great Lakes. An initial deployment was completed on the West Coast at station 46022, located approximately 20 NM west of Eureka, CA and generally showed good results except for wave directions. Debugging revealed some code issues which were addressed. A second deployment with the modified code was completed on the East Coast at station 41002, located approximately 225 NM south of Cape Hatteras, NC. Initial results show good agreement with the DDWM system.

2. OWL Development Strategy

The OWL development strategy replaced hardware, but re-used shoreside processing software and embedded processing algorithms including data formats, data management, Quality Control, and archival, thus reducing development risks and complexity. NDBC's experience in embedded hardware from other NDBC buoy systems was leveraged to reduce the hardware development effort. While the processing algorithm did not change, embedded code was modified as a result of changing the hardware platform and slight differences in the new motion sensor data output and format.

3. OWL Description

The OWL implements the existing wave processing algorithm in a high performance, low power, Linux-based processing platform named Overo® and manufactured by Gumstix, Inc. Buoy motion, thus wave action, is sensed with a new motion sensor named VN100-T and manufactured by VectorNav Technologies. The VN100-T still provides the same type nine axis data set as the older sensor. A custom NDBC designed board named Smart Module (SM), performs the power and communications control function for the sensor and processor (see Fig. 1). The SM also communicates the resulting wave data message to a satellite transmitter which is part of NDBC's weather observation system named Self-Contained Ocean Observation Payload (SCOOP). These changes avoid parts obsolescence and improves power efficiency by lowering power demand from both processing and sensing.

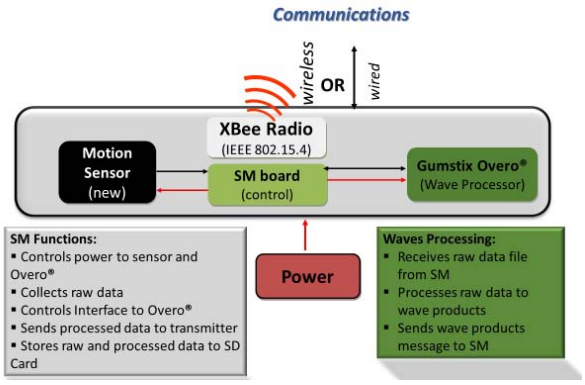

Figure 1. OWL System Architecture

4. OWL Laboratory Tests

The NDBC performed extensive tests to verify proper code operation, motion sensing, and operation of the electronics. Tests included using the NDBC's Desktop Wave Simulator (DTWS) and the Ocean Wave Instrumentation Facility (OWIF) to simulate wind and swell ocean waves, respectively. Other laboratory tests were conducted to confirm proper operation at extreme temperatures, measurement accuracy of earth's magnetic field, and power consumption. The OWL achieves a sixty-five percent reduction in power consumption compared to DDWM.

5. Initial Field Test Results

After an initial test deployment of the OWL at station 46022 in May 2018 a combined DDWM and OWL system was deployed at station 41002 in May 2019. This placed both wave systems in one package co-located on the same hull and mooring. The sensors are approximately one to two inches apart. An analysis of the first thirty days of deployment showed little statistical difference between the OWL and DDWM. Directions were much improved from the first deployment at 46022. However, the delta between systems was more than NDBC's ±10° system accuracy goal. There were some applied onboard direction parameters for the DDWM that are believed to be incorrect at the higher frequencies thus adding to the direction deltas. This can only be positively confirmed when the systems are recovered from the field.

6. Conclusions and Future Plans

NDBC is updating its wave observation system and initial field tests show good results. More test deployments in all areas where NDBC observes waves are planned and should be completed in 2020. Some of these test sites are planned to be near a Datawell Waverider for independent directional wave comparisons.