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Self-Sufficient Modular Multi Sensor Platform for Remote Long Time Ocean Observations in Large Quantities

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Environmental and climate research is relying strongly on detailed measurement information especially from the ocean's surface. Recently the interest in small Drifter-Buoys is growing worldwide to increase the measurement resolution and monitoring capabilities. Manifold engineering challenges so far prevented a globally usable open-source platform. Commercially available drifters either only offer the possibility of position tracking or require high costs for the integration of special sensor technology. Custom developments are also expensive and require long development times. Considering this, the Institute of Mechatronics at TU-Hamburg is developing a self-sufficient modular multi sensor platform to collect different measurement data, considering a holistic design including energy-harvesting, cost- and performance optimized sensors, stability and drift-properties, and an electronic hardware architecture. The modular platform enables data acquisition and transmission for individually selected sensors and provides sufficient energy supply by energy harvesting methods. Inherent to the design, the presented concept targets for an open source platform enabling everyone interested to use the most important components for remote sensing, with an easy extension for individual needs.

The platform consists of a main board containing a GPS module, a MEMS-IMU, a temperature sensor, a satellite communication module and a power management circuit in addition to the processing unit. The motherboard alone enables a transmission of collected data according to user oriented settings. Onboard temperature sensor enables temperature monitoring of the device, GPS-module acquires an accurate position and the integrated IMU can measure the wave spectrum. Satellite communication is based on state of the art IOT-communication solutions. Additionally, an interface was developed to allow the extension of a sensor unit. According to a standardized protocol, any measurement data of the connected sensors can be processed. Special focus is put on the integration of e.g. water temperature and salinity sensors as a standard. To enable long time measurements, the self-sufficient module provides an energy supply for all components based on solar power and wave energy. The wave energy converter is a specially developed linear generator, gaining energy of the relative motion between buoy and drogue. The full hardware is designed based on low power electronics and stores the energy in non-toxic super capacitors.

A simple open source housing design provides a cost effective drifter solution, which can easily be manufactured by research groups all over the world. The modular system can be implemented in

different stages of complexity to always have the best trade-off between cost and needs. This also allows a cost effective deployment of a high quantities to enable drifter measurements with high space resolution like for submesoscale analysis. The housing is targeted to be manufactured completely from bio compatible materials to avoid water pollution.

A first proof of concept prototype was tested in the Baltic sea off the coast of the German island of Fehmarn. Two prototypes and two CARTHE drifter were successfully deployed and compared. The development finished its concept definition and functional-sample chapter, and is now going into a first prototype phase following the implementation in a V-model development structure.