

A brief overview of State-of-the-art electronics in Physical Oceanographic Instrumentation

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Abstract -- A brief overview of the recent trends in physical oceanographic instrumentation in which recent developments in electronics technology play a crucial role has been given. The electronic instruments mainly utilized in the physical oceanographic studies in the laboratory and field works at sea are described. The meteorological instruments are also described that are useful in air-sea interaction studies and marine climate & environmental variability.

Key words: Electronics technology; Physical oceanography; Marine meteorology; Instruments & systems.

RECENT DEVELOPMENTS

THE recent advances in the electronics technology led the physical oceanographic instrumentation to attain compactness in size, low power consumption and portability in utilization. The advances in sensor technology, extensive utilization of micro-processors, VLSI and embedded systems resulted in powerful instrumentation.

The physical oceanographic & meteorological instrumentation has seen phenomenal growth from the classical electro-mechanical versions to sophisticated modern electronic gadgets.

The memory systems from EEPROMS, CMOS achieved high capacity CDs to cache memories, bio-chips & USB port versions. Opto-electronic instruments in the optical oceanography and underwater acoustic technology has led to development of CTDs, ADCPs & DVS systems. Portable CTDs, XBT, XCTD, TP data loggers are a reality now and being used for data collection at sea and in deep oceans for physical parameters, under water currents etc.. For WOCE (World Ocean Circulation Experiment) programme several moored (Eulerian) and Drifting buoys (Lagrangian) were developed, which coupled with GPS (Global positioning systems) sensors & ARGOS satellite technology global coverage of world Oceans resulted. The acoustic multi-beam sonar systems, sub-bottom profilers on board oceanographic research vessels have yielded high-resolution geophysical data including those of submarine sediments. The new millennium has seen the advent of the autonomous under water remotely operated instruments, in which robotic technology is used. In these AUVs the integration of CTDs, Fluorescence sensors, GPS, Sonars etc. led to unmanned tele-controlled & telecommanded submersibles and ocean profiling instruments. Similarly ARGO profilers led to automated ocean circulation studies. The usage of AWS

(automated weather systems) helped very much in air-sea interaction and climate variability studies. Telemetry systems used in radio-sonde and Vaisala radio-sonde measurements yielded extensive coverage of upper-air measurements over land as well as over oceans.

Specifically, the physical oceanographic instruments underwent drastic changes in electronics with time. The purely mechanical MBT (mechanical bathythermograph) was taken over by Digital Bathy thermograph (DBT) wherein temperature sensor was a thermistor and the logged data were transferred from the unit using optical couplers. The DBT was replaced by electronic version of XBT system, initially with electro-mechanical graphic recorders, & now with computerized data-acquisition types using electronic MK-21 deck units (in Sippican, U.S.A. makes) and that too deeper (1800metres) versions now available. The conductivity sensors initially inductive types gave way to 3-electrode conductivity sensors in CTD systems. The depth pressure sensors ranged from strain-gauge to piezo-electric quartz sensors. The salinometers evolved from inductive types to conductive types because of conductivity & temperature sensors ruggedness and the small sized compact salinometers are now available in the market field. The basic counting type direct-reading current (water) meters are replaced by Recording current meters (RCM), which initially was ¼" magnetic tape recording to present solid-state EEPROM data storage unit (DSU) types, which further shall be DSB pen stick drives and also the RCMs are of more precise vector-averaging types. The current sensors originally from mechanical propellers were taken over

by Acoustic sensors and that too by Acoustic Doppler current Profiler (ADCP) versions. In the moored buoys also inductive coupling data transfer from attached deep TP sensors to the buoy surface, were then satellite transmitted to shore earth stations.

The advances of materials technology and nano-technology will further compact the sizes of future generation oceanographic instrumentation. Remote sensing satellites and communication satellites facilitate global synoptic coverage & yield surface mapping of oceans especially temperatures (SST) and ocean wave fields & even salinity fields. Ocean colour measurements yields prediction of harmful Algal blooms (HAB), primary production measurements, oceanographic forecasting & potential fishing Zones (PFZ) and are also useful in Integrated coastal monitoring and management (ICMAM).

The electronic metrology and radar technology have also profound applications in (seismic) geophysical explorations & in gas hydrate, oil and natural gas prospecting energy sectors.

The displays were developed from classical CRTs (Cathode ray tubes) to the modern plasma flat screens & to low power solid-state displays. Signal processing circuitry also was miniaturized and now DSP chips are available in the instrumentation.

The availability of high speed computer networks and 3G mobile communication networks revolutionized the data transfer of scientific and other categories of data over long distances efficiently. Electronics technology coupled with ICT has many promises in future metrology

in Oceanography & so also in physical oceanographic instrumentation.

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