Provor CTS5

New PROVOR float dedicated to challenging sensors and complex missions: opportunities for arctic deployments.

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Summary:

For more than a decade, the Argo program has proved its usefulness for physical measurements within the ocean. More recently, floats developed for this program have been used independently for a large number of other applications, from biogeochemical measurements to rainfall estimation. New programs, like remOcean and NAOS projects, have already succeeded in merging a significant number of sensors on the same float named ProvBioII (NKE). This float is perfectly suitable for a large range of "BioArgo" applications, and merging of sensors provides scientific benefits and cost reductions. Now new challenging sensors, such as imaging, chemical or acoustic sensors, are already planned to be implemented on floats. These new applications will need improved capacities of the float, in particular the electronic which manages sensors, and also increased flexibility of the float missions to accommodate all the potentials scientific applications. All these new capacities make this new float well adapted for arctic deployments, which require an avoidance of sea-ice and a large storage of data.

We present here a prototype version of a new NKE float which implements the so-called "double electronic boards" architecture. This scheme is based on one navigation board to drive the float and one acquisition board to drive sensors. This architecture is used to secure vital functions of the float and allows easier and safer integration of new challenging sensors. The new float prototype is equipped with a new navigation board developed by NKE, named APMT. This board allows script-based mission and is able to exchange data and receive navigation commands from an acquisition board. This allows retroactive programming of the float's mission based on scientific measurements, which could be extremely useful for a large number of applications including arctic deployments (avoidance of sea-ice) or adapted sampling of biogeochemical events. In addition, this new APMT board has large memory capacities as well as advanced remote control options. A new acquisition board developed by the LOV and OSEAN company has been interfaced with the float. This new low power acquisition board is able to accommodate a large range of sensors (including news sensor for sea-ice detection) and perform in real time complex processing of collected data (FFT, Wavelet decomposition or statistical identification).

New Provor CTS5:

The new Provor CTS5 uses the same mechanical (tube, ballast) features than the regular Provor. But it implements a new powerful electronic board :

APMT board

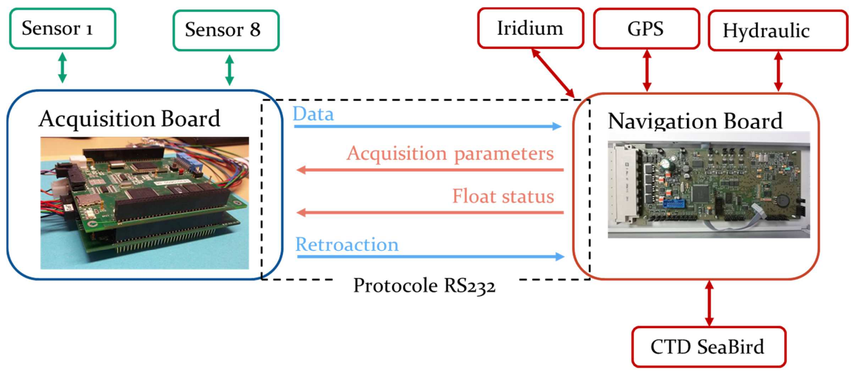
- Microcontroler 16-32 bits (48 Ko RAM, 1 Mo FLASH)
- 64 Ko de FRAM, 8 Mo de FLASH, micro-SD (32 Go)

Provor CTS5 main features

- ✓ Self-ballasted, navigation capabilities trough high density gradient
- ✓ Iridium RUDICS telemetry
- ✓ Highly flexible script based mission
- ✓ Large internal memory for data storage under ice
- ✓ Mission change without communication (base on date, useful for under-ice)
- ✓ Software simulator for easy validation of new configuration and training.
- ✓ Implement a communication protocol with science board with retroaction capabilities.

The LOV Multi-Application acquisition board :

The new PROVOR CTS5 could be equipped with a new and powerful acquisition board developed by the LOV and OSEAN company. It allows to interface quickly a wide range of sensors, to process data in real time and to send navigation commands to the APMT navigation board (retroaction)



LOV acquisition Board:

- CPU ARM32 bits
- RAM CMOS de 4 Mo
- Mass memory SD 8 Go

main features:

- ✓ up to 8 sensors
- ✓ low power high CPU capacity
- ✓ send retroactive commands to float
- ✓ easy implementation of new sensor
- ✓ data processing fully controlled by LOV
- ✓ future passive acoustic capacities

Retroaction of science onto float navigation:

The dialog between acquisition and navigations boards, and new capacities of the PROVOR CTS5, allow controlling the navigation of the float based on data measured by the acquisition board. This retroaction could be used by several applications

The ProVal Project:

The ProVal float have to profile, and then use energy, only when weather conditions are good enough for high quality satellite match-ups. We will use the retroaction to stop profiling when weather conditions are not optimal (Light irradiance and fluctuation, float tilt fluctuations or in the future passive acoustic may be used to monitor weather conditions).

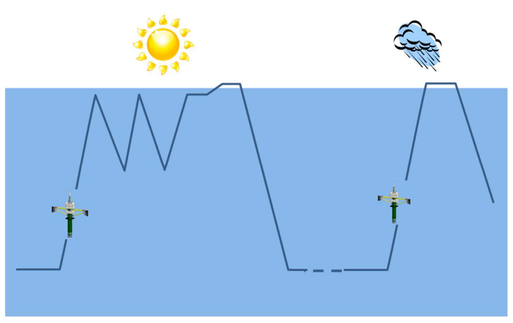
Arctic project within NAOS :

Retroaction features will be used to implement sea-ice avoidance.

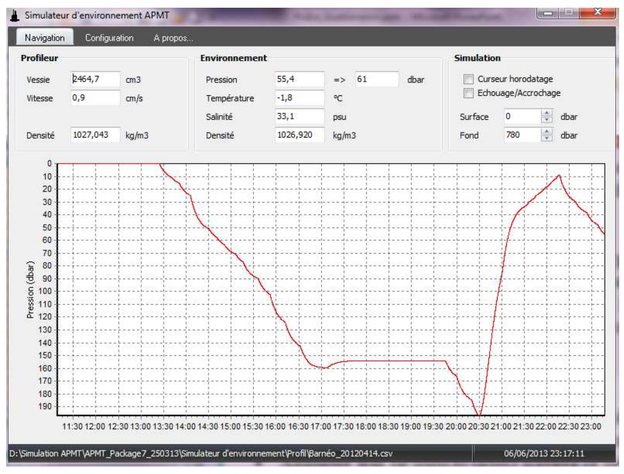
see poster : *The challenge of deploying biogeochemical ARGO floats at the Arctic ice-edge: the need for an efficient sea-ice detection system.*

Ready to be used:

- Ice Sensing Algorithm (T and S) are implemented and tested on hardware simulator.
- Altimeter will be used to detect iceberg or thick sea-ice



ProVal retroaction scheme



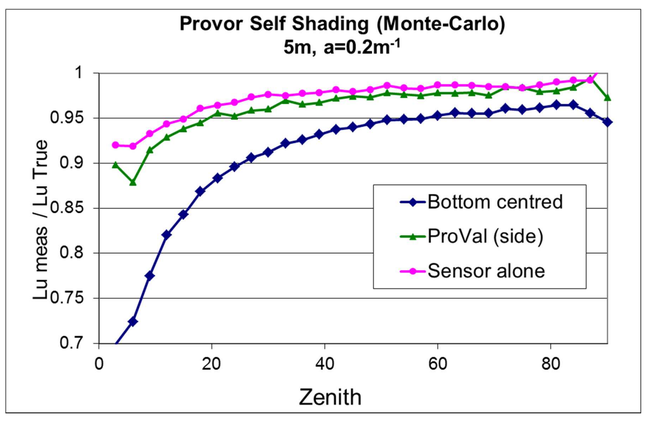
Sea-Ice avoidance simulation with a slow down at 50m and an abort at 9m

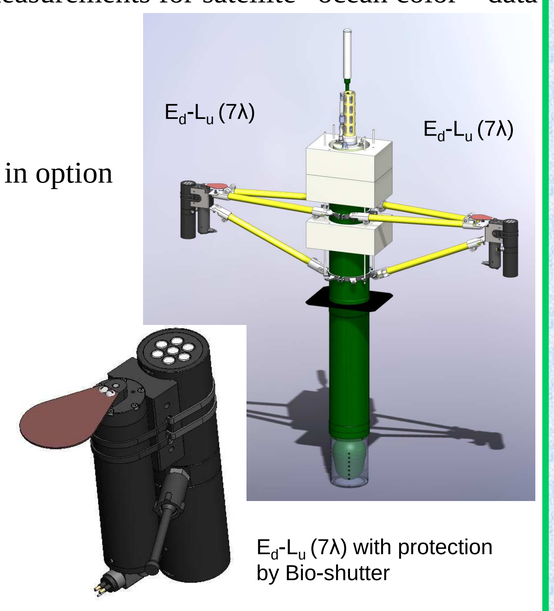
The ProVal float:

ProVal is a float dedicated to high quality radiometric measurements for satellite "ocean color " data validation.

ProVal is a PROVOR CTS5 instrumented with

- ✓ 2 E_d-L_u 7λ (400, 412, 443, 490, 510, 560, 665 nm)
- ✓ Compass and tilt
- ✓ Fluorimeter (Chla and CDOM) and backscattering in option





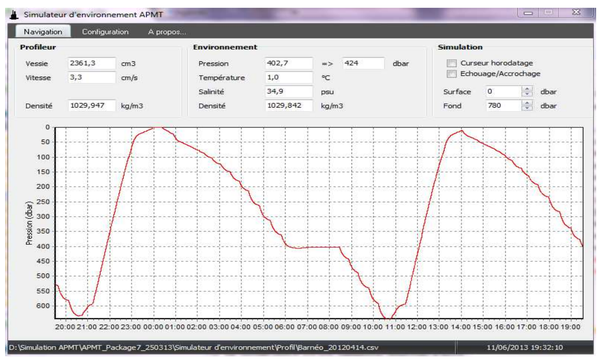
E_d-L_u (7λ) with protection by Bio-shutter

The ProVal float is specifically instrumented with two identical E_d-L_u combos deported on the side of the float. This configuration will minimize the self-shading and allows data inter-comparison between both sensors for long terms deployments.

Simulation and test capabilities at LOV

a)

b)

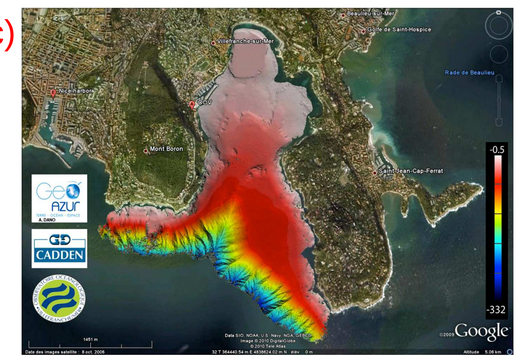


a) Hardware simulator for in-lab validation:

- Real electronics and software
- Real sensors
- Simulation of CTD values for navigation

b) Simulation of the environment (CTD values) for the Hardware simulator (with an abort @ 9m for the second profile).

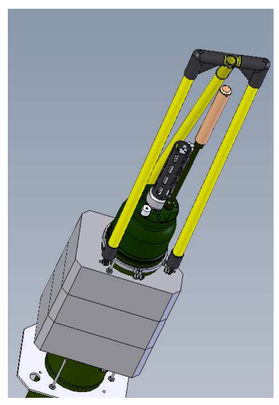
c)

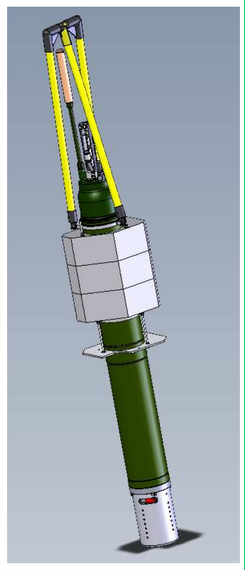


c) Bathymetry of the Villefranche Bay : Ideal for field testing

Arctic floats : Realized tasks and planning

- ✓ Electronic and software validation with hard simulator
- ✓ Validation of CTS5 in a 40m carrier (>200 profiles)
- ✓ Implementation of ISA logical function and validation on hardware simulator. But thresholds for arctic ocean (Baffin Bay) are not yet determined.
- ✓ Design of an hard protection of the antenna and CTD





Planning:

- ➢ Summer 2013 : Validation at sea of the CTS5
- ➢ End of 2013 : Validation at sea of retroaction functions
- ➢ Early 2014 : Validation in cold water
- ➢ Summer 2014 : First deployments in arctic

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