



**US Patent:**

Controlled Thruster Driven  
Profiler for Coastal Waters.

**Patent No:**

US 6,786,087 B2  
dated Sep. 7, 2004

**CURRENT USERS:**

- Space Applications Centre (SAC), Ahmedabad
- National Institute of Oceanography, Goa

**PROJECT FUNDED BY:**

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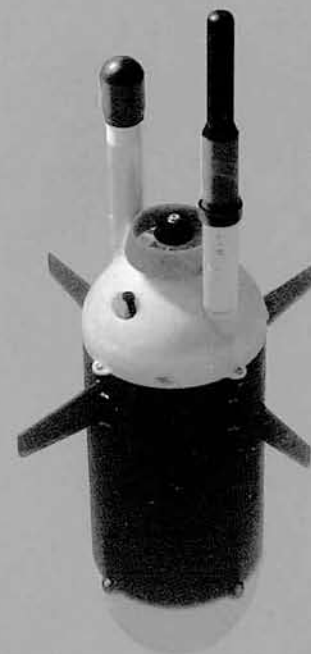


**NATIONAL INSTITUTE OF OCEANOGRAPHY**  
(COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH)

Dona Paula, Goa 403004 INDIA.

# AUTONOMOUS VERTICAL PROFILER

[ AVP ]

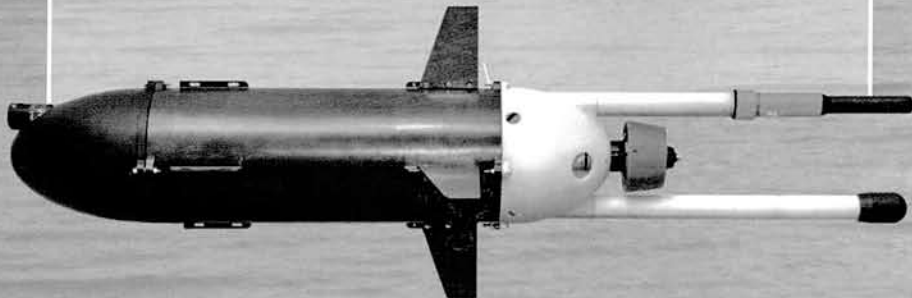


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## ABOUT THE AUTONOMOUS VERTICAL PROFILER (AVP)

A recent development of the Marine Instrumentation Division, N.I.O., Goa. It belongs to the class of propelled robot vehicles that traverse the water column vertically while sensing and storing the vertical structure of water column properties. The AVP can be programmed to descend at variable speeds to a given depth set by the user. It ramps down the motor thrust, reaching zero velocity at a desired depth layer above the sea bed. Being positively buoyant for safety purposes, it ascends relatively slowly to the sea surface without power. In order to locate the profiler after it breaks surface, the AVP transmits its GPS (Global Positioning System) coordinates via RF or through a satellite modem. A low frequency acoustic pinger is strapped to the hull as an extra safety device. These profilers fill a niche space as observing systems for the coastal seas. The AVP is usable without changes, in estuaries, fresh water reservoirs and dams for making rapid observations of water quality parameters.



## UNIQUE FEATURES OF THE AVP

- AVP is decoupled from external perturbation of the ship/boat providing a true vertical profile.
- Repetitive dives offer adequate statistics of the profile shape variability.
- Safety is ensured by use of an echo-sounder and pressure sensor so that it avoids crashing into the seabed.
- Control system on the AVP invests it with the capability to hover at any set depth.
- In a worst case scenario, the AVP can do 30 dives to a depth of 100m for 2.5 days.
- The AVP can morph into an autonomous profiling drifter in coastal and open ocean waters by reporting its GPS coordinates and a reduced data set through its satellite modem.
- Ease of operation and one man deployable.

## MULTIPLE APPLICATIONS ARE POSSIBLE!

- Observing Technology for coastal spaces – an important component of the Ocean Observing System.
- Rapid profiling of shallow waters – temperature, salinity, chlorophyll, and dissolved oxygen.
- Time series monitoring of biological blooms.
- Validation tool for Ocean Colour Satellites.
- Easily incorporated in a network of monitoring tools for the coastal zone.

## SPECIFICATIONS

Length	1.17 m
Diameter	0.18 m
Weight	~13-16 kg depending on the sensors
Rated Depth	200 m (max)
Hull	Aluminum alloy with acetal end cones
Propulsion	Single DC thruster
Electronics	8051 and ARM7
Communication	Radio Modem (2.4Ghz)/ Satellite transmission (Iridium)
GUI	Labview based
Energy source	Lithium ion polymer batteries(324Whr)
Battery banks	[1] 12V, 18 Ah, [2] 24V, 4.5 Ah
Speed	0-1 m/s
Endurance	~ 2.5 days with 12 dives/day to 100 m

## PAYLOADS



### Pressure Sensor

Range : 300Psi (211m)  
Accuracy : 0.1% of FS



### Echosounder

Range : 100m  
Beamwidth: 20° conical



### GPS

Accuracy : <8m



### DO Sensor

Range : 0-500µM  
Accuracy : <8 µM



### Fluorometer

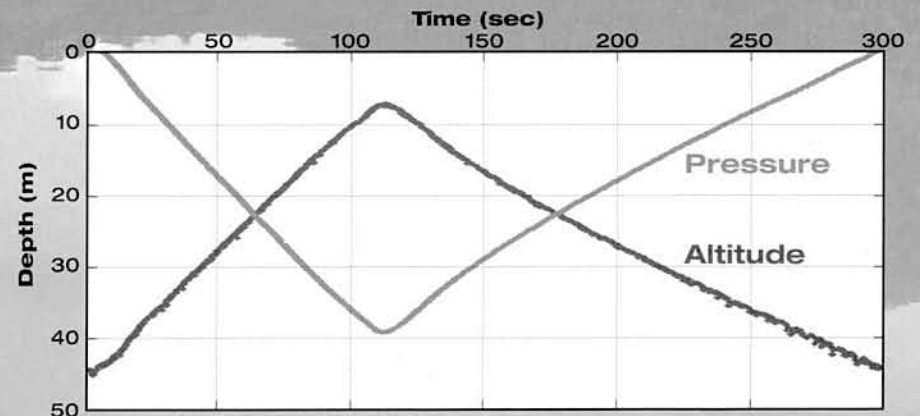
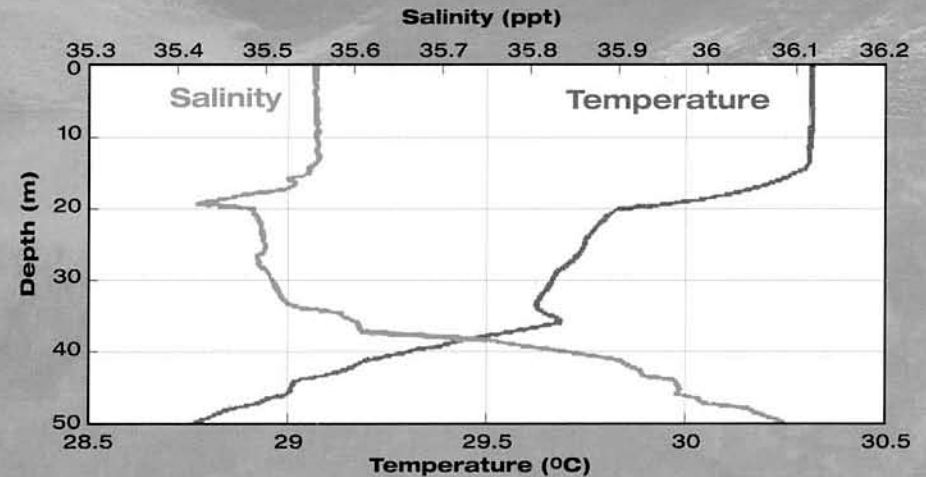
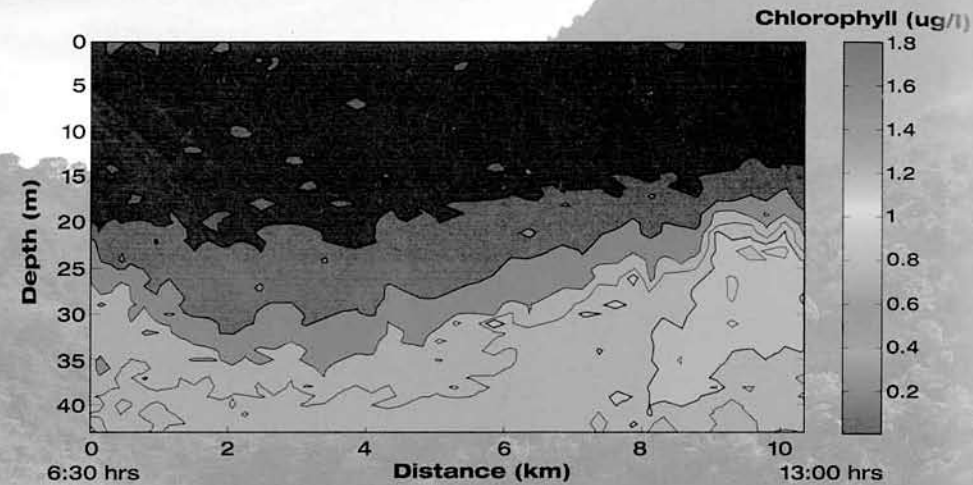
Range : 0.01-50 µg/l  
Sensitivity : 0.01µg/l



### CTD

(C) Range : 0-90mS/cm  
Accuracy : +/-0.002mS/cm  
(T) Range : -2 to 32deg  
Accuracy : +/- 0.002deg  
(D) Range : 500m  
Accuracy : +/- 0.02% of FS

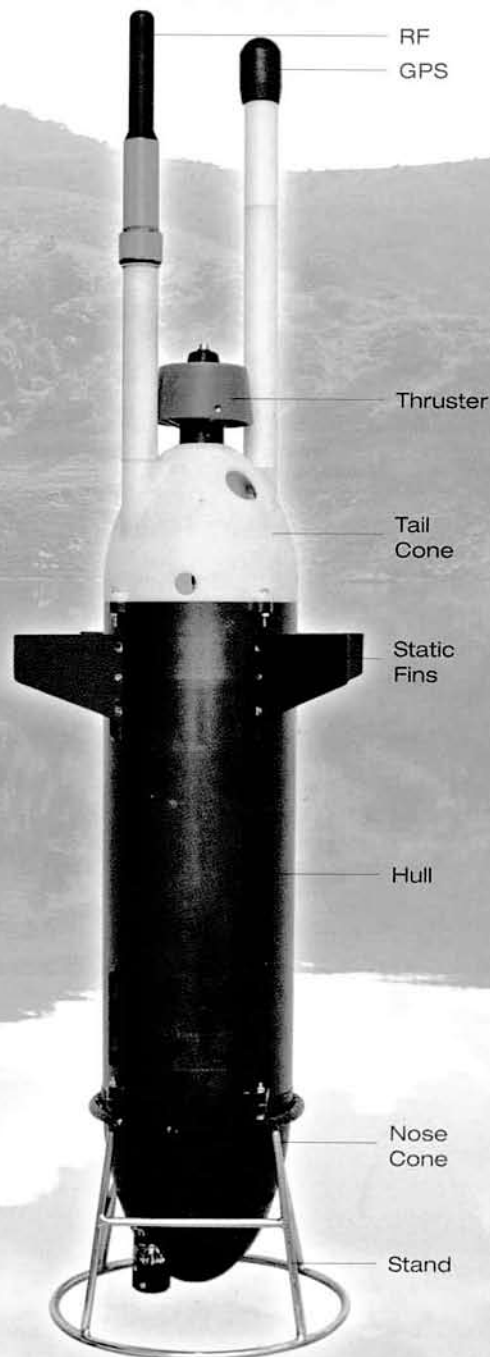
## VERTICAL PROFILES OBTAINED AT SEA OFF GOA



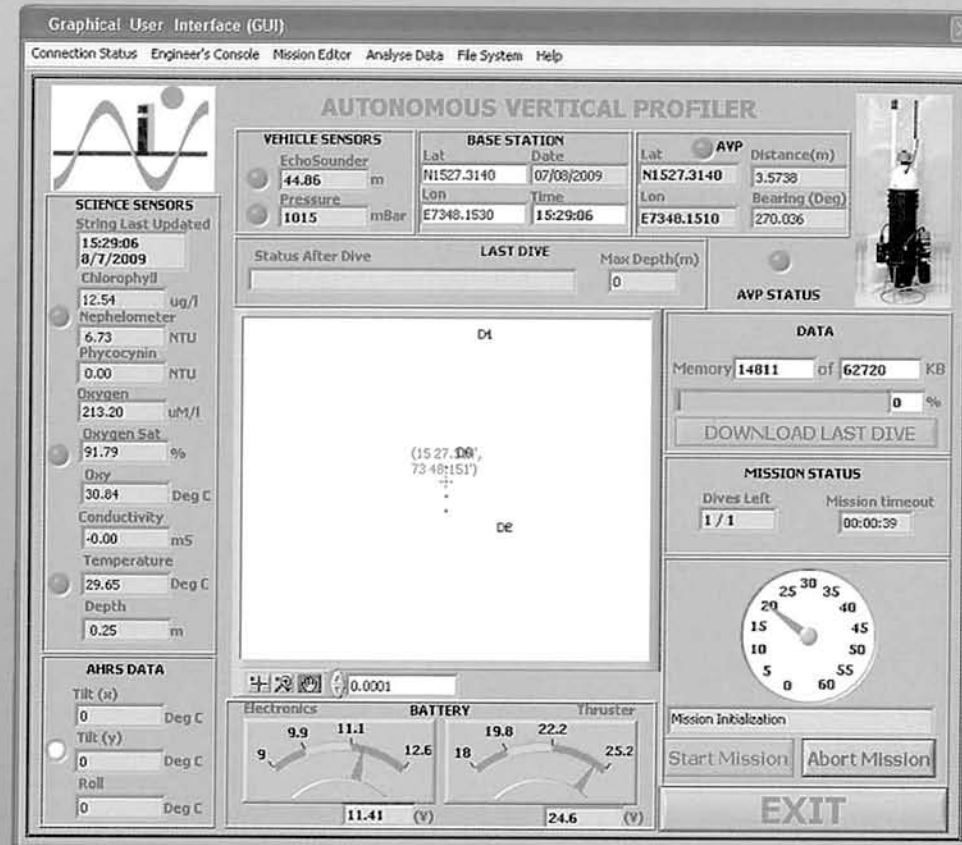
## SAFETY FEATURES

- Thruster cut-off enabled by either bottom detection from echosounder or depth overshoot by pressure sensor
- Reverse thrust in case of an emergency
- Small positive buoyancy
- Continuous battery monitoring
- Electronics failure detection
- Pinger for locating AVP in emergency

## AVP ASSEMBLED



## GRAPHICAL USER INTERFACE (GUI)



## FEATURES OF THE GUI

- Used to load a mission
- Provides profiler position
- Indicates Battery Voltage
- Shows status of last dive
- Can download and plot data
- Indicates status of the sensors
- Shows mission time remaining
- Conveys the drift of profiler on surface

## ELECTRONICS

