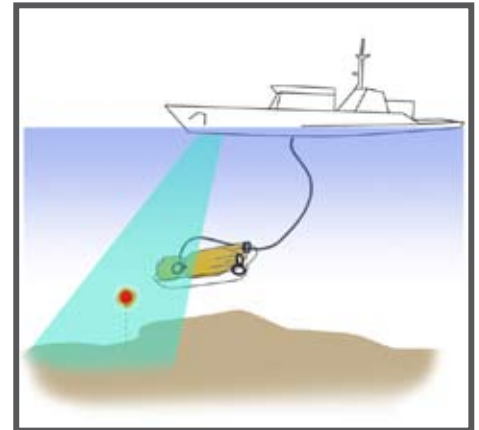


# MILITARY APPLICATION: enabling new operational scenarios in the mine warfare

## Mine identification and neutralization needs as a limit to full AUV operations

Most of the world's Navies are increasingly adopting light Autonomous Underwater Vehicles (AUV) to extend their counter-mine capabilities. A light AUV can indeed be easily shipped to remote operational areas and quickly deployed from any small boat. In this way, mine search capabilities are greatly extended far beyond the reach of any dedicated naval vessel and with a fraction of its costs.

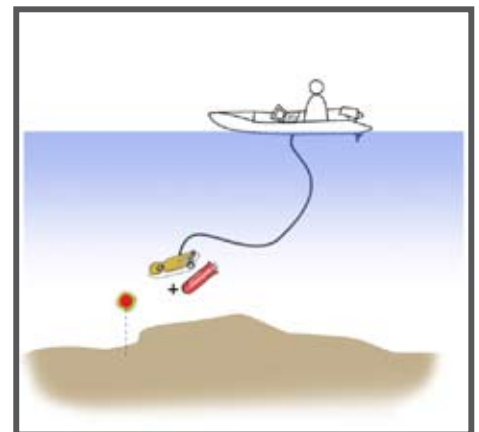
The weak point of this operational concept, however, is that the AUV only provides search capabilities. Once suspected targets are detected with the AUV, they still need to be identified and, if positively recognized as mines, properly neutralized. Currently, identification and neutralization operations are still conducted with dedicated naval vessels, whose transit time and costs limit the operational flexibility enabled by AUV.



## Removing the limit with the TRACKER

In order to take full advantage from the fast deployment capabilities of AUV, identification and neutralization operations should be carried out from the same small boat used for AUV operations. This could be done with a Remotely Operated Vehicle (ROV), but, to this end, the following minimum requirements would apply:

- The size and weight of the ROV should be such as to allow a deployment as easy as the launch/recovery of the AUV;
- In spite of its size, the ROV should be able to be precisely guided to the specific target positions identified in geographical coordinates (LAT, LON) by the AUV;
- The navigation system of the ROV should be fully independent from external guidance references (such as the mother ship's USBL or sonar systems).



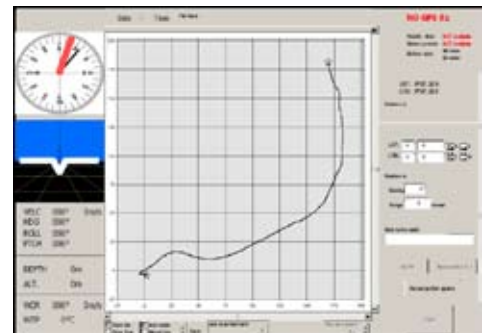
The ROV & Diver TRACKER provides an easy solution to all the above conflicting requirements, providing any ROV, even the smallest ones, with precise navigation capabilities, independent from any external reference.

## Fully independent navigation tool for the smallest ROV

The TRACKER is a self contained, small dimension and no weight (in water) navigation instrument that can be easily attached to any ROV or even carried underwater by a diver. The TRACKER does not require any external acoustic reference and autonomously communicates its own underwater position to a surface computer through the umbilical cable:

- The underwater unit is available in two configurations (with either vertical or horizontal shape) to better fit the installation requirements of any ROV. Whether configuration is chosen, the ROV only needs to provide a very small power supply and data transfer through its umbilical cable: no other requirement is asked to the ROV, other than the ability to carry out its usual mine detection/neutralization tasks.

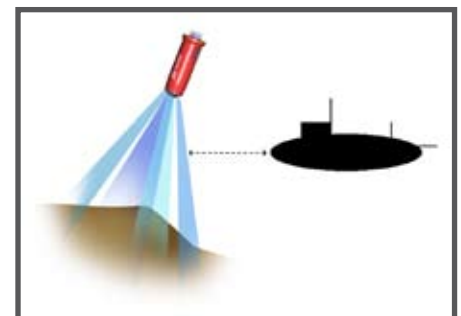
- The surface computer can be any Windows based laptop (even the same one used to run the mission of the AUV) and is used to display in real time the position of the ROV together with any other useful navigation information. Following the position of the ROV in the computer screen, the operator can easily drive the ROV to the suspected mine target, perform limited search operations, drop countermine charges and, in general, accomplish the same operations that he was used to carry out from onboard the mine hunting ship.



## Discreet navigation

The navigation principle that allows the ROV & Diver TRACKER to attain good position accuracy without any need for external acoustic references is the following:

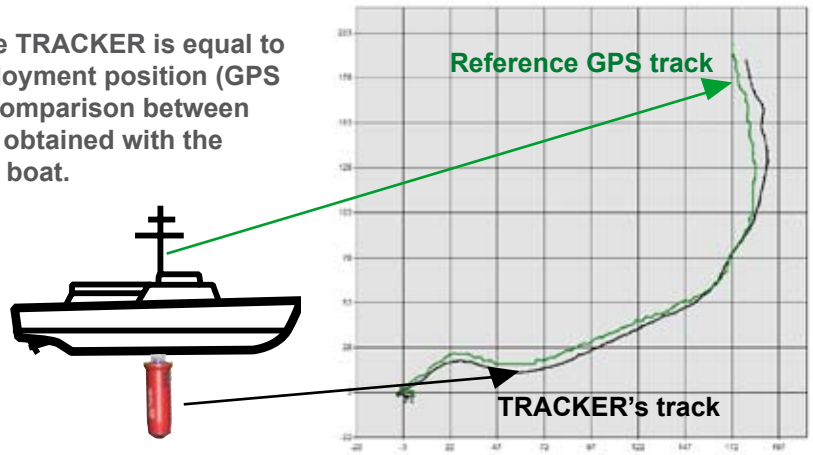
While still at the surface, the TRACKER autonomously acquires a GPS fix or, alternatively, receives a manual position entered by the surface operator. Known in this way its initial fix, once submerged, the TRACKER continuously updates its position by measuring the travel away from the starting point, referring its movements to the sea floor. For this purpose, the TRACKER uses a state of the art Doppler Velocity Log, that provides precise bottom track data for water altitudes ranging from 70 meters down to 25 centimeters. For altitudes higher than 70 meters the TRACKER references its motion to a wide water layer and automatically applies proper corrections to account for the effect of water currents if a previous bottom track is available.



The described navigation, independent from any external acoustic reference, ensures a pretty discreet navigation as the only emissions radiated by the TRACKER are the acoustic pulses of the DVL. Such pulses, however, are transmitted with an extremely low power (6 W) and at such a high frequency (600 KHz) that any acoustic emission is totally attenuated few meters away from the main beams. The TRACKER was also designed to have a minimal magnetic signature.

## Precision of navigation

The accuracy of the position data provided by the TRACKER is equal to  $\pm 1\%$  of the total distance run from the initial deployment position (GPS or operator fix). The following figure provides a comparison between the GPS track of a boat (green line) and the track obtained with the TRACKER submerged under the hull of the same boat.

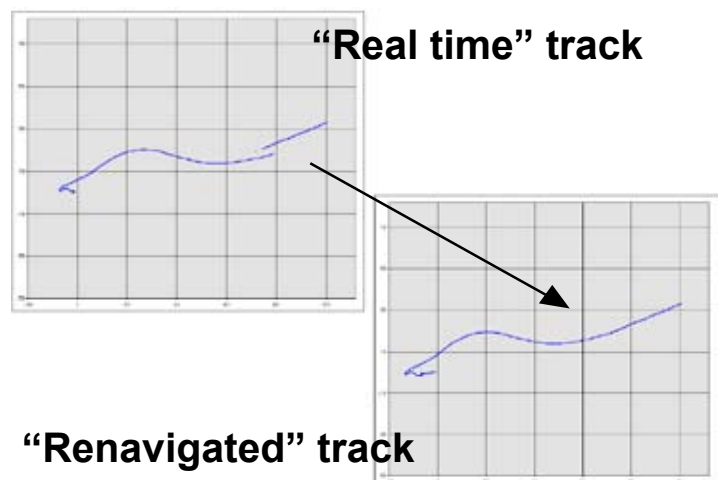


Since the value of the TRACKER position error increases with the distance traveled ( $\pm 1\%$  meter of error after 100 meters traveled,  $\pm 10\%$  meters after 1000 m. traveled, etc.), after a certain distance the real time error becomes unacceptable. The ROV operator has however the possibility of bringing back the real time navigation error to zero by applying anytime either one of the two following actions:

- Driving the ROV at the surface: as it surfaces, the TRACKER automatically acquires a new GPS fix and instantly resets its position; at this point the ROV can dive again and resume its mine clearance operations.
- Entering the position of a point of known location seen by the camera of the ROV (such as the location of a pre-surveyed target): also in this case the TRACKER, while still underwater, resets its position to the newer location and the underwater mission continues with no break.

Whether action is performed to reset the position of the TRACKER, a discontinuity in the recorded track is introduced. A typical example of discontinuity is displayed in the first part of the following figure. As shown in the second part of figure, however, the software of the TRACKER provides the ability of “renavigating” the track. The available “renavigation” tools allow all track’s fixes to be repositioned so as to take into account all the information that became available after the occurrence of any given position fix. The result is an accuracy of the track that is virtually unlimited.

This tool, besides providing the possibility of using the TRACKER for mapping purposes, allows the TRACKER to identify with extreme accuracy underwater references that can be later used for resetting the position of the TRACKER while still underwater. In this way, even in case of extended operations in an area where no underwater reference was previously known, very few rises to the surface are really required to always keep the precision of navigation within the required limits.

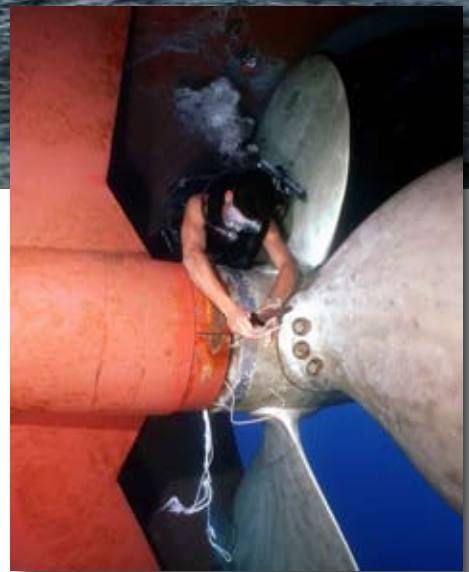


## Conclusions

The TRACKER enables virtually any size of ROV to be used for mine identification and clearance purposes, allowing a full and accurate guidance from the same small boat that the AUV is operated from. In this way, a complete and fully operational mine countermeasure unit can be quickly and easily deployed in any part of the world.

The above is just one of the many applications allowed by the unprecedented navigation flexibility provided by the TRACKER. Other applications include the whole range of military uses of ROV, such as:

- Harbor protection
- Inspection of ship's hulls
- Underwater works
- Support to any kind of underwater manned activity
- Search and rescue operations
- Divers' navigation



Photos USN courtesy

**Studio Ing. Banfi SAS**

Operations:

Viale Giulio Cesare 118/B

00192 Roma, ITALY

Tel. (+39) 349.53.35.920

Tel./fax. (+39) 06.37.22.929

mauriziobanfi@tiscali.it

www.rovtracker.com

**ROV  
& DIVER  
TRACKER**