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**GIB PORTABLE  
TRACKING SYSTEMS  
F.A.Q.**

**Frequently Asked Questions  
January 2003**

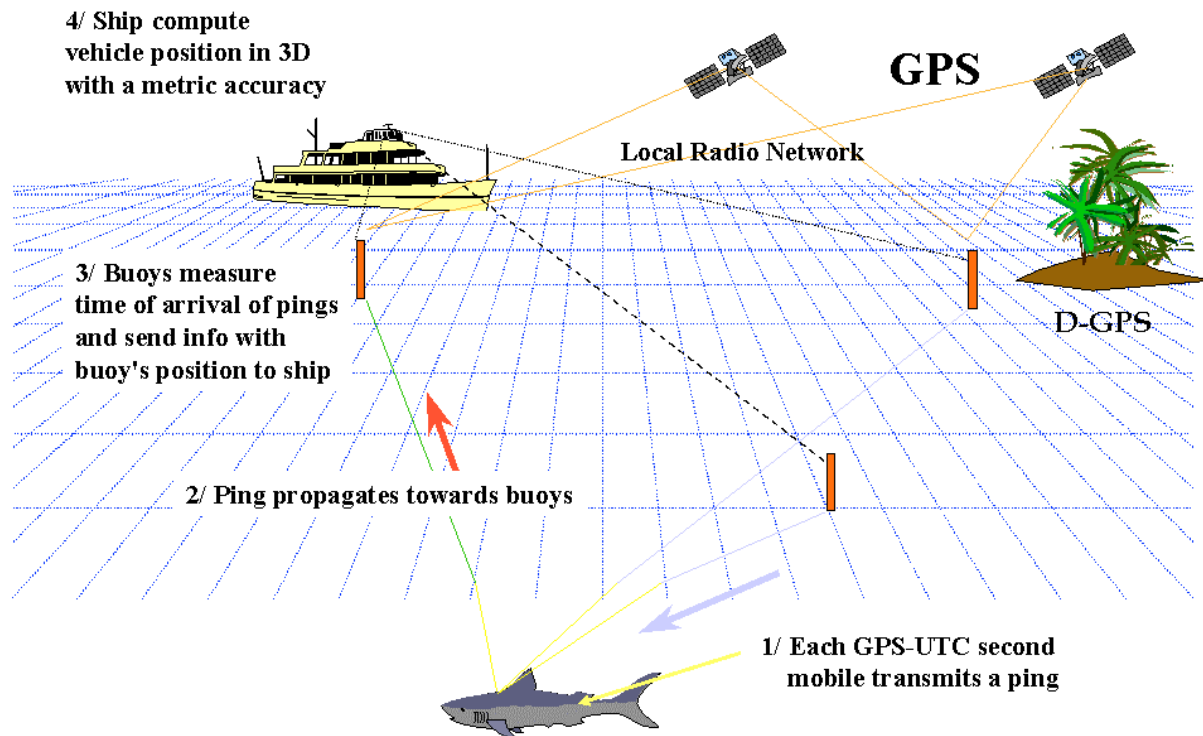


**French Navy "ERATO" equipped with a GIB 32 kHz pinger**

## QUESTIONS

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## GIB CONCEPT



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### **1. Is GIB a long baseline system ?**

In some way the GIB tracking range can be compared to a long baseline system. Some time we call it "drifting surface long baseline" as the reference points are buoys anchored or drifting on the surface.

GIB, as a long baseline, uses the principle of measuring the time of propagation of an acoustic pulse between a mobile and a receiver. When you want to use a long baseline to track a vehicle from the surface, that will require to acquire one position 6 successive acoustic paths :

- Ship interrogating the seabed transponders,
- Transponders replying to ship,
- Ship interrogating the underwater mobile,
- Mobile replying to ship's interrogation and interrogating transponders on the sea bed,
- Transponders transmitting to the ship.

That's a long and hazardous process !

GIB is a **one way technique** using a clock in the mobile that is synchronous with the GPS Satellites atomic clock.

This avoid errors in sound propagation (lost of signal or multi-path replies), this allows a much higher repetition rate (1 point every second, instead of one point every 5 or 10 seconds).

Generally long baseline systems uses 3 distances to calculate X-Y and Z of the mobile. The depth is very inaccurate when depth is small compared to distance between transponders. That is why we have integrated a pressure sensor in the mobile's pinger. The depth telemetry technique used is of an extreme accuracy.

Long baseline systems require a calibration step that's long and support-ship time consuming. Recovery of transponders is difficult (you don't know were they are).

GIB buoys do not require any calibration and are very easy to recover as their D-GPS position is continuously transmitted to the support ship.

To summarize, GIB technology is comparable to long base line, but offer many advantages. More easy to deploy, lower cost, higher repetition rates.

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### **2. How many buoys do I require ?**

Just as a long base line, the minimum required to calculate a 2 D position is two distances.

Any number of buoys from 2 to 12 can be used.

A 3 buoys system will allow to calculate for each fix a mean quadratic error so that tracking quality can be estimated.

### **3. Is the GIB system a new technology ?**

The history of the GIB development is the following.

Early in 1989 the idea arose to have a long base line system drifting on the surface with a radio link to a nearby control station arose. At that time the GPS technology was not ready yet: too heavy, too expensive and too much power requirement.

The idea to use GPS underwater was studied by James Youngberg of the US-AIR FORCE, patented in July 1991 and announced to the international community during the summer 1992.

In September 1994, H. THOMAS presented a paper at UNDERSEA DEFENCE TECHNOLOGY Conference, held in Brest on the subject :

*"New advanced underwater navigation techniques based on surface relay buoys"*

This paper presents a different way to use the GPS underwater, in fact exactly the opposite way of the US AIR Force's view : Acoustic signals flow the other way round - From the mobile to the buoys and not from the buoys to the mobiles !

A very different solution offering significant commercial and operational advantages.

With the support of the French Defence Agency, DGA, ACSA is created in January 1995 to develop a prototype of the GIB system and to analyse how those solutions can be used for various naval operations. ORCA is teamed to the project. The first very positive results are acquired during the summer 1995.

On September the 14th, 1995, a new paper is presented at ION-GPS conference in Palm Springs US on :

*" The Use Of GPS for Underwater Navigation - Sea Trials Results "*

In 1996, extensive tests are performed demonstrating at sea the GIB system performances in restricted shallow waters, as well as offshore. The performances are compared with DOD CEM / TREMAIL techniques on a CALAS target shot, showing GIB's micro-tracking capabilities.

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COMMERCIAL IN CONFIDENCE

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In July 1996, a licence for the manufacture and marketing of GIB buoys is signed with ORCA Instrumentation, GIB system enters production level and international sales.

Today, GIB systems have been sold to in France, Italy, Portugal, Germany, Canada and United States.

### **4. What performances can be achieved ?**

In D-GPS mode, GIB buoys are located with an accuracy varying from +/- 3 meters to +/- 1 meter depending of the D-GPS shore station and on the receiver board used.

The timing resolution of the time of arrival of an acoustic signal is of  $0.5 \cdot 10^{-5}$  second, the accuracy is close to  $10^{-4}$  second when working at 30 Khz, that means +/- 15 centimeters. Same accuracy is achieved using spread spectrum signals for military applications.

Give us your requirements and we will offer you a system well adapted at the best price.

### **5. Is it possible to compare GIB to Short Baseline Systems ?**

GIB, as a short baseline systems, offers a solution to track underwater vehicles.

#### **INSTALLATION**

A short baseline is difficult to install onboard a ship; Often it will require dry-docking as well as delicate calibrations: gyro's axis, short baseline transducer's axis and coordinates in ship's axis, roll and pitch sensors, GPS antenna, ... !

GIB is really a portable solution, very easy to install. No calibration at all is required.

#### **IN OPERATION**

A shore baseline requires the ship to be above the underwater mobile, that's a major constraint for the watch officer at the bridge, propeller noise will stop the system from working.

#### **ACCURACY**

Roll and pitch of the ship do affect a lot short base line accuracy. At a distance of 1 Km, the short baseline will present a dispersed cloud of points whereas the GIB will show a very smooth track.

In many circumstances, GIB tracking systems are 10 times more accurate than USBL.

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### **6. Can I use standard off the shelf pingers ?**

Yes, most pingers can be used together with GIB buoys. This requires a better knowledge of hyperbolic and circular systems. If the operator is a qualified surveyor, that will help ! We have different cases :

#### **Non synchronous pingers**

If at least three buoys are detecting the pinger's signals, the software will be able to calculate a position (hyperbolic mode). Positions might be unstable in noisy environment.

In order to get better tracking stability, it is preferable to know the pinger's repetition rate with a good level of accuracy (10-6). This just suppose that your pinger's clock is of fairly good quality. In such case pseudo-circular algorithms can be used to locate the mobile and to calculate the exact time at which the pinger is transmitting with respect to GPS-UTC absolute time base reference.

In such case 4 buoys must be used together.

#### **No pressure sensor**

If your pinger does not integrate a pressure sensor nor a depth telemetry option, you must know by any other mean at which depth the pinger is. This value is entered manually in the software for slant range corrections.

This can in many circumstances require a considerable effort from the operator's point of view !

### **7. Can I position black box using the GIB technology**

Yes, Back Box lost at sea can be positioned very quickly (few hours) using 1 to 5 GIB buoys. The buoys must be set on the proper frequency. This requires a special operational procedure and software package.

Accuracy in latitude and longitude is metric. This allows very fast recovery operations.

### **8. Will waves affect GIB systems accuracy ?**

Waves have two effects. First one will generate a circular motion at the buoys' level. Second one will affect pinger's depth measurement.

#### **Horizontal plan error**

For a 3 meters wave height (+/- 1.5 m), buoy's X&Y position might be affected of +/- 1 m noise. The hydrophone 10 m below the surface will have a heave movement of +/- 1.5 m. The GIB system being a long base, for a 750 m slant range and a vehicle navigating at a depth of 150 m, the projection of the slant range on the horizontal plane will only be affected by a 31 Cm error, as shown on the table below.

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	No vertical error	1,5 m vertical error
Slant range	750,00	750,00
Depth	150,00	151,50
Horizontal range	734,85	734,54
Range difference		0,31

**Depth error**

If the mobile to track is an ROV or an AUV, navigating at a depth of 150 m, the wave passing above the vehicle will not modify the pressure measurement (This is demonstrated by the equations of dynamic waves propagation, an exponential decreasing function of depth. Generally speaking, it is considered that at a depth equal to 50% of the wave length, the pressure will not be affected). Thus, the depth telemetry will still give an excellent Z value even with waves and swell.

**9. What can I track ?**

So far, GIB systems are used to track very efficiently AUVs, ROVs, sonars, divers, manned submarines, torpedoes, targets or to locate black boxes pingers, dummy mines on the sea bed, ...

Any think else you can think of, contact us, we will give you our point of view.

**10. Is it possible to have a demo ?**

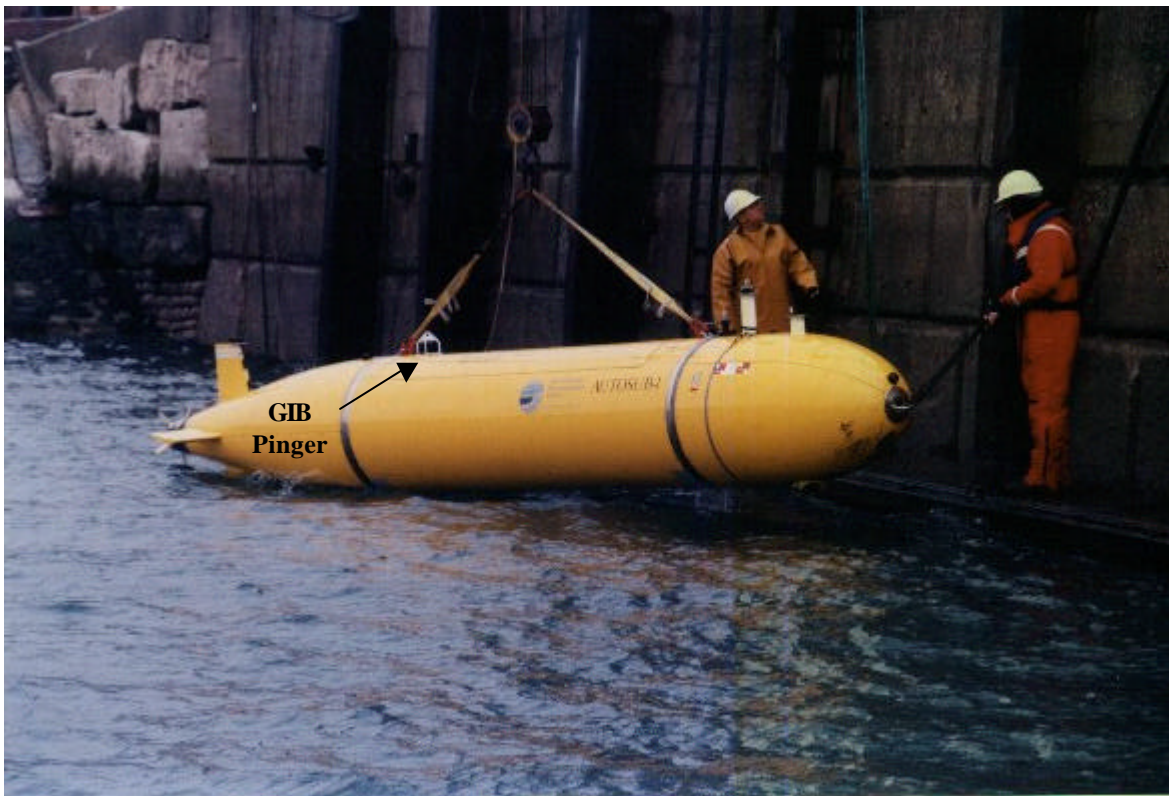
We organize on regular basis demonstrations abroad. We also have a demonstration base in the south of France. You are welcome anytime for a free demo. We publish GIB system at sea evaluations tests reports focused on different applications. Just ask, we will be pleased to mail them to you.

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**ISE semi-submersible MCM vehicle - GIB 10.5 kHz pinger**



**SOC UK AUTOSUB AUV – GIB 10.5 kHz pinger.**

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