

Southstar™ ShipHull

Operator's Manual



Version 1.00

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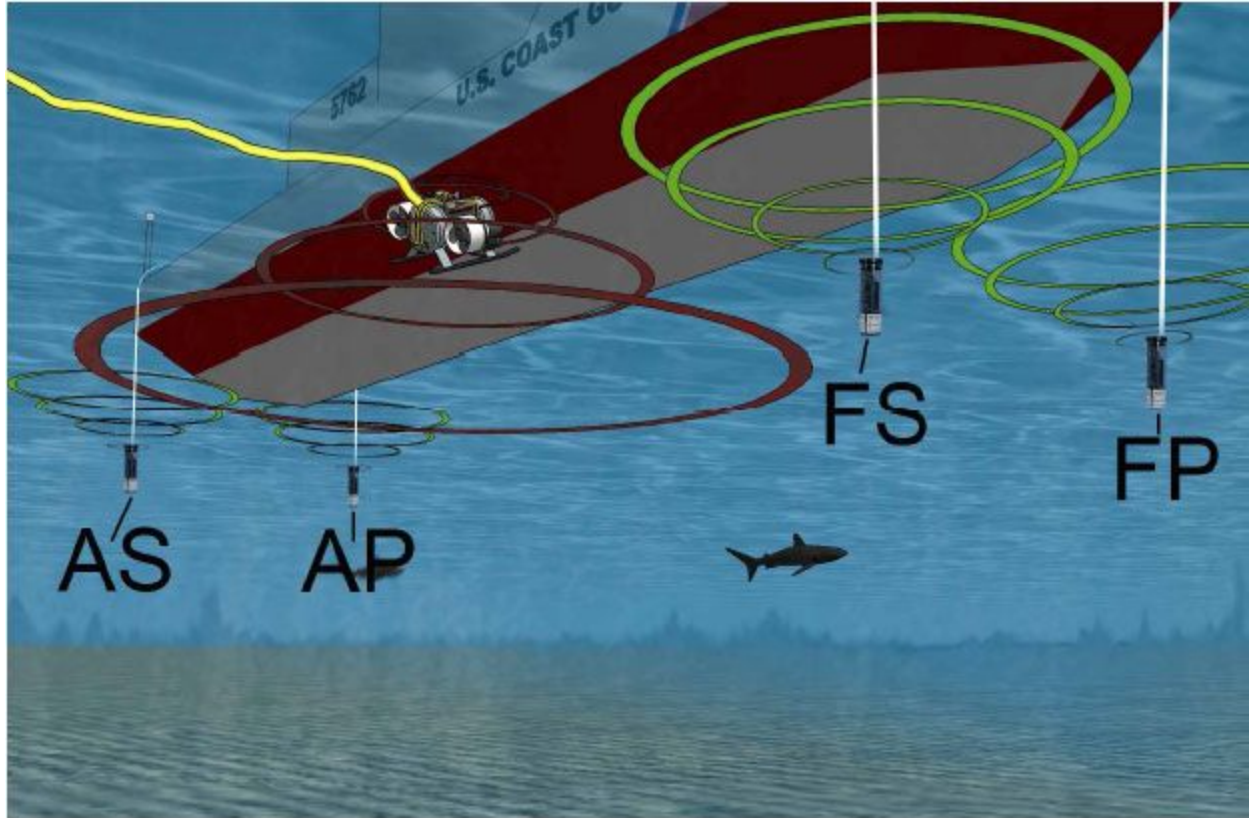
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Southstar™ Operators Manual

1. Introduction

The version of Southstar™ developed for Oceaneering is a dual-purpose system. Its primary function is to track the ROV during its hull inspection with precision, sub-meter, accuracy. The DiveBase ShipHull software paints a track of the ROV's path showing what areas of the hull have been inspected and which areas still need to be inspected.

1. The initial **full-hull inspection** utilizes an easy-to-use mode where the four baseline stations are simply hung off the side of the vessel. A transponder is placed on the ROV to communicate with the four baseline stations. Thereafter, the ROV can navigate on an overlay of the ship's plans, either on the side or the bottom view, port or starboard. The ShipHull system is used to quickly and accurately inspect the ship's hull to look for and annotate any problem areas. Full hull inspection generally offers an accuracy of 0.2 m to 1m depending on setup.
2. For a higher accuracy follow-up inspection of a select area, typically on the order of 10m x 10m, Southstar's **plate inspection mode** is used. This mode of operation is used to precisely navigate and annotate problem areas with an accuracy of better than 0.2m, and with appropriate setup down to a few cm. The four baseline stations are placed in the four corners of an essentially flat plate or area and should be mounted rigidly on tripods or towers so they cannot move. Using magnetic feet is one method to secure these structures to a hull.



Full-Hull Inspection Mode with four baseline stations hung off the side of the boat.

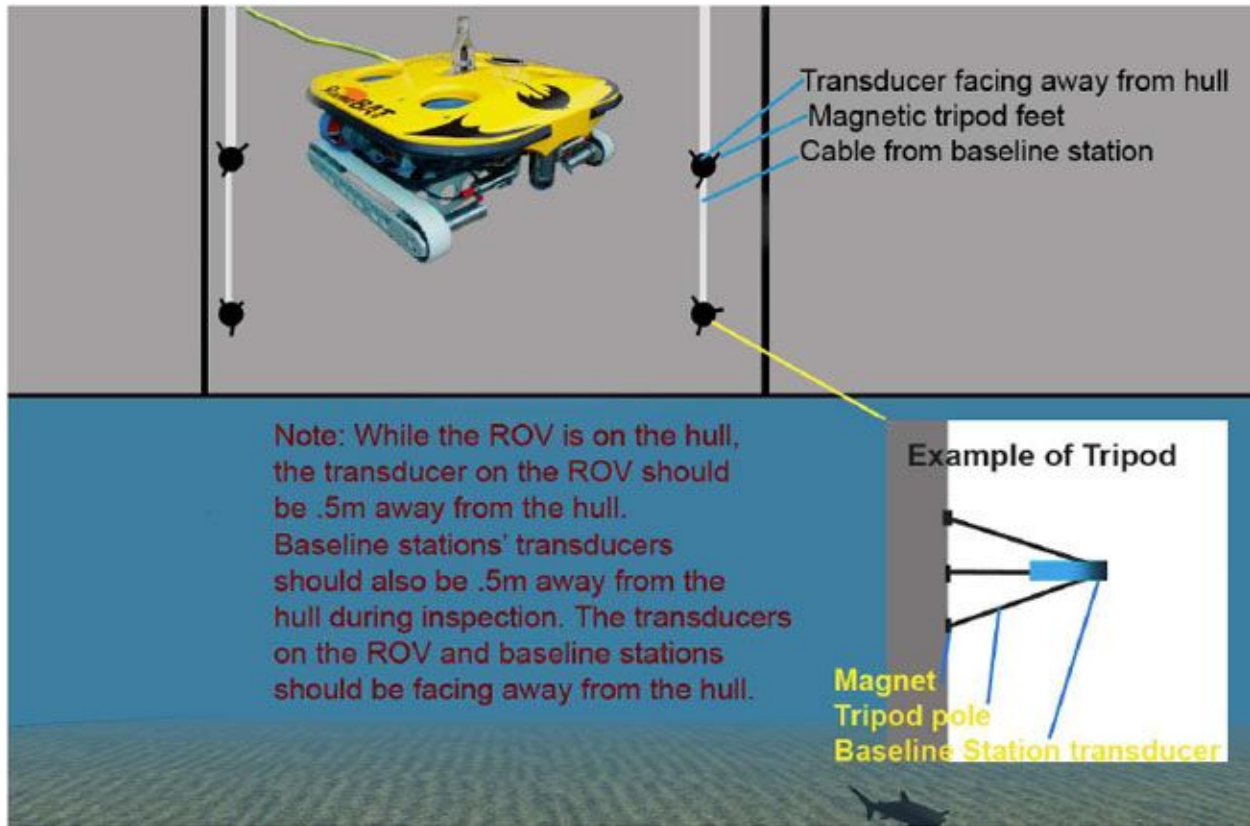


Plate Mode with all four stations hung in the corners of the plate. The configuration should roughly form a square, i.e. with the distance between adjacent baseline stations similar. The baseline stations are secured by magnetic clamps to ensure they do not move during the inspection.

Important Note On System Activation & Depth Sensor Calibration

When operating in full hull inspection mode, in particular along the side of a hull, accurate depth sensing by the TLT-32 or TLP-102 mobile station is important for positioning accuracy. The mobile stations will compensate for atmospheric pressure on power-up. For best accuracy, activate the pinger (switch power ON) while the mobile station is out of or just at the water surface, and its temperature is close to the water temperature. If the mobile station detects an initial pressure not compatible with atmospheric conditions, it will apply a default compensation which can result in an error of a fraction of 1 meter for the TLP-102 and potentially several meters for the TLT-32.

2. Southstar™ System Components

Southstar™ System Components

- Mobile Station(s): TLT-32 (general use) or TLP-102 (high depth sensing accuracy & transmit power)

- Baseline Stations: RBS-32
- Cables and Accessories
- Surface Station (Junction Box)
- Southstar™ software
- ‘DiveBase Seafloor™’ positioning software for plate inspections
- ‘DiveBase ShipHull™’ positioning software for full-hull inspections

Not included in the Southstar™ components, but required for use

- Windows PC running on Windows XP or newer with at least 256MB of RAM
- Additional mounting hardware (tripods, weights and floats)
- Virtual Serial Port software

Table 2: Southstar Components

3. Deploying the Baseline Stations & Operating Modes

Full-Hull Inspection Mode

Accuracy: Approx. 0.3m to 1m depending on setup

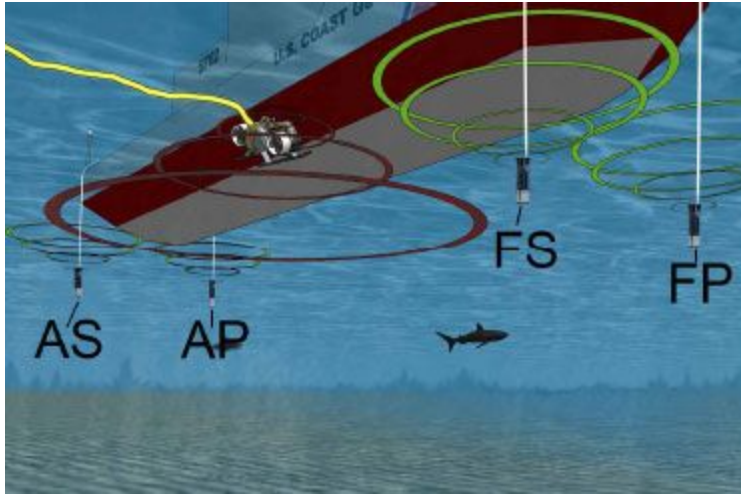
Coverage: The entire hull is covered in a single setup

In full hull mode, four baseline stations are hung off the side of the boat.

Deploy the baseline stations so that the transducer is facing down. Place two baseline stations at starboard and two at port; the two aft stations should be placed about $\frac{1}{4}$ ship length from the stern, the other two stations about $\frac{3}{4}$ ship length from the stern. Their depth should ideally be six feet below the keel.

Be aware that currents will drag the stations, causing an equivalent position error. To keep them stable, place appropriate weights on them and/or place a magnetic foot on the hull near the water line and route the line through the eyelet of the foot.

Please see the diagram below for a visual aid:



Full-Hull Inspection Mode

Plate Inspection Mode

Accuracy: Approx. 0.02m to 0.2m depending on setup

Coverage: An essentially flat plate or area of the hull, such as 10m x 10m

In Plate Mode, the four baseline stations are placed in the corners of the plate to-be-inspected. For best accuracy throughout the inspection area, the distances between each station should be about the same, creating a square.

Typically, plate inspection will be done with a crawler vehicle moving along the hull. To obtain high accuracy, the baseline stations should be mounted on rigid structures that prevent any motion. The baseline station distance from the hull should be at least 1/25th of the greatest station separation, or about 0.5 meters for a 10m x 10m grid with a 14m diagonal.

Deploy the RBS-32 baseline stations horizontally so that the transducer is facing away from the hull. The sonar transducer, which is the silver element in the bottom of the housing, must remain unobstructed.

The mobile station on the vehicle should be mounted above its top surface, i.e. facing away from the hull for a crawler vehicle. It should be mounted such that the transducer distance from the hull is the same as for the baseline stations, i.e. about 0.5m in the above example. That is important, because in plate inspection mode, all baseline stations and the mobile station are considered to be in a common plane. If deployed as such and water properties are properly accounted for, a positioning accuracy of a few cm can be achieved. As the diversion from the common plane increases due to hull curvature or mounting, so will the position error. For example, a vehicle operating in a 10m x 10m square and with its transducer 0.3m from the common plane of the baseline stations may see

an additional position error of about 1 cm when in the center of the square, but an error of as much as 30cm when operating near any of the baseline stations.

Please see the diagram below for a visual aid:

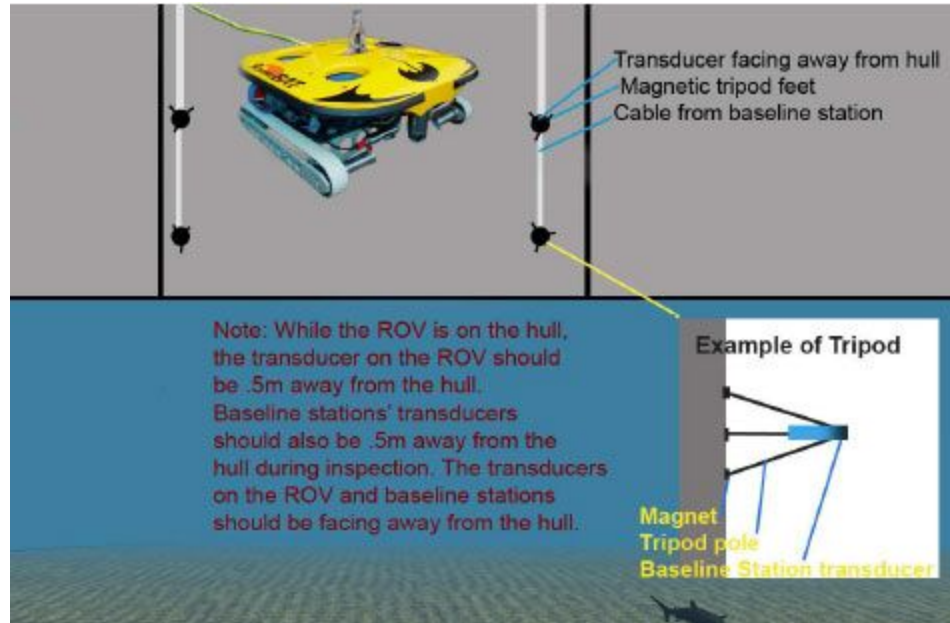


Plate Mode

4. Installing the Software

IMPORTANT: Southstar software runs on a Microsoft Windows XP or VISTA machine (tested at this time). Several software components are involved. For best system stability, Desert Star Systems strongly recommends that Southstar is run on a dedicated or configuration controlled machine. The machine should be configured and tested by Desert Star Systems support staff.

The following provides a general outline of the software installation procedure.

.NET Environment Installation

The Southstar software is built on Microsoft's .NET environment, which must be installed first. .NET is a free software package, the latest version of which should be downloaded directly from the Microsoft web site.

SouthStar

The Southstar software controls the positioning system's hardware. Install the software by copying the To install SouthStar, copy the SouthStar directory from the install CD to **C:\Program Files\Desert Star Systems\Southstar** on your machine.

DiveBase

DiveBase is the position computation and display software. Two versions of the software are installed and used:

- DiveBase ShipHull is the software used in the full-hull inspection mode. Offering a split screen of a side view (port or starboard switchable) plus a bottom view of the hull, it guides the vehicle and shows inspection coverage during the initial single-setup, full-hull inspection.
- DiveBase Seafloor is the software used in plate inspection mode. The software is very similar in its layout and user interface to DiveBase ShipHull, but offers only a single plan view of the inspection area. Its Seafloor name derives from its original use for seafloor inspections, a task that is methodologically similar to the inspection of a hull plate.

To install, run the DiveBase ShipHull installer. Then, copy the DiveBase Seafloor executable into the ShipHull folder.

Eltima Virtual Serial Port Driver

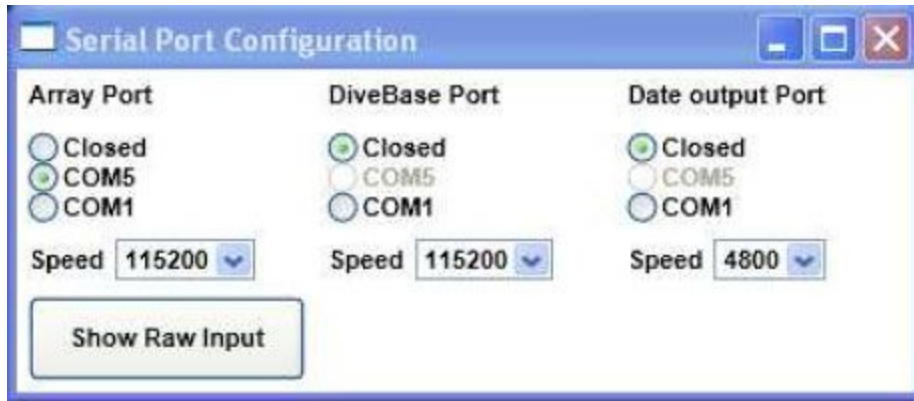
The Southstar software and the DiveBase software are typically run on the same machine. The Southstar software communicates with the Southstar hardware via a USB COM port. It thus obtains distance measurements, which must be passed on to DiveBase for position computation and display. This communication link between Southstar and DiveBase is also based on the use of COM ports. In order to allow the two applications on a single machine to communicate via COM ports, the Virtual Serial Port Driver from Eltima is installed. This software creates linked pairs of COM ports, one end of which is linked to Southstar and the other to DiveBase. Use the installer for the Eltima software, and then create a virtual COM port pair.

5. Using the SouthStar Software

Software Function & Connections

Southstar software controls the acoustic array, performs an acoustic baseline self-survey, obtains target range data and forwards it via a COM port to the DiveBase tracking software. Select an array COM port, DiveBase COM port and a data output port if you wish to have distances, depths, temperatures, and accelerometer data sent out.

DiveBase accepts the target range and depth data from Southstar. Baseline survey results must be hand-transferred from Soutstar prior to start of tracking. DiveBase computes, filters and displays target positions.



Typical COM port configuration

Note: You may have to reset the software after changing the Data Output or Divebase ports to ensure that data is sent to these ports.



Main SouthStar Window

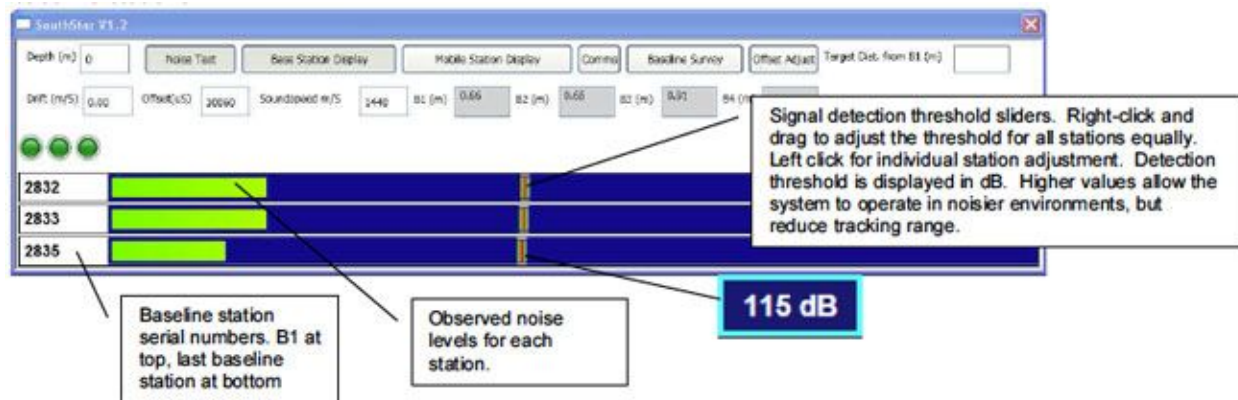
Southstar Function	Explanation
Depth	Depth display. Depth is received automatically from PC-PILOT and shown in this field. You can also hand-enter depth if automatic depth should fail.
Noise Test	Click to measure underwater noise levels and set the signal detection thresholds for the baseline stations (see section #3).

Base Station Display	Click to display/hide the signal strength display.
Mobile Station Display	Click to show mobile station management screen with distances and sensor data.
Comms	Click to set COM ports for data input from the array and output to DiveBase. Use 115200 baud for the array port, and 4800 baud for the RangeNav (DiveBase) port. The data output and DiveBase ports are optional and SouthStar will display raw distance and sensor data without them.
Baseline Survey	Click to self-survey the baseline station network prior to tracking
Target Distance from B1 display, Offset Adjust Button, Offset display	To synchronize the pinger to the array, place at a known distance from baseline station B1, enter that distance and click the Offset Adjust button. The ping time in microseconds from the start of a GPS second is now displayed.
Drift	Enter the pinger clock drift relative to the GPS standard based on an observation; to minimize position drift.
Status Lights	<p>Number of lights will be equivalent to the number of baseline stations defined in the Application_Settings.Config file. From left to right: B1, B2, B3, B4</p> <p>Red: Cannot talk to TLT-32 acoustic baseline station. Check link via antenna, FRF-2 pair and cabling. Make sure TLT-32 is blinking. NOTE: All station symbols remaining red can indicate a failed FRF-2 USB connection to the PC. Re-launch Southstar and re-connect the FRF-2 via USB.</p> <p>Yellow: Communication with acoustic baseline station OK, but station does not detect acoustic signals. Normal status when target pinger is not yet in the water, or is shielded or out of range.</p> <p>Green: Target pinger signal detected. Normal status when target pinger is in the water. If target pinger is out of the water, green means noise</p>

	triggers the receiver. If this happens frequently (once every five seconds or faster on a indicator), increase the detection threshold.
Sound speed	Enter the sound speed here. Accurate number required for accurate measurements. Default is 1440 meters/sec, for -2 deg C water with 35 ppm salinity (typical Antarctica condition).
Distance fields	Shows the target distance from the baseline stations.

6. Conducting a Noise Test

Prior to baseline surveying or tracking, conduct a noise test and set the signal detection threshold for the baseline stations.



Noise Test Procedure

1. Click **Noise Test** button
2. Observe noise bars for ten seconds or more
3. Right-click on detection threshold slider to adjust the thresholds for all stations to just above the prevalent noise levels. If infrequent (every five seconds or less) noise spikes occur, they can be ignored. If one baseline station sees more noise, its threshold can be individually adjusted. As the noise test tends to be more sensitive than the tracking mode, you can also adjust the detection threshold by up to about 6dB below the noise level. See the advise below for details.
4. Click on the **Noise Test** button to end the test and accept the new detection thresholds.
5. Software bug: Due to an apparent software bug in Southstar, you must now start and end Noise test once more (click the noise test button twice, with a 1 sec or more pause in between clicks). Otherwise, the new detection thresholds may not be accepted by the array.

Advise on setting detection thresholds

Noise rejection: Higher detection thresholds are required for noisier environments, but they also reduce the effective tracking range. If you experience too much signal loss, try reducing the detection thresholds even below the level indicated by the noise test. Next, watch the ranging displays and status lights. If no pinger is in the water, you are OK as long as the status lights stay normally yellow and the distance indicators remain at 0.00m. If a target pinger is active, you are OK as long as the indicated target distances for the most part steadily show the correct target distance. If the indicators jump a lot, then you are probably picking up noise and need to increase the detection threshold.

Echo rejection: Target pinger signals may bounce-off reflective surfaces such as the sea-floor, seasurface, rocks or ice bergs. Echoes may be the cause if you frequently see an obviously wrong but consistent distance indicator. You can increase the detection threshold which may reject an echo if it is weak. Using four baseline stations will also help in high-echo environments, as the software will reject an outlier range but still obtain positions.

Effective Tracking Range

The following are observation values for the Southstar system performance in Antarctica, 2009 (wireless system):

At Arrival Heights, in about 25m to 65m of water, reliable operation up to about 330m from baseline stations with 120 dB detection threshold, and no signal detects with 130 dB detection thresholds.

Near Tent Island in 300m of water or more. Pinger lowered to 300m, baseline station at 9m depth.

- No signal with 110 dB at 1000m
- Good signal with 105 dB at 850m
- Reliable detection at 475m with 110dB detection threshold and pinger at 30m and 60m depth.

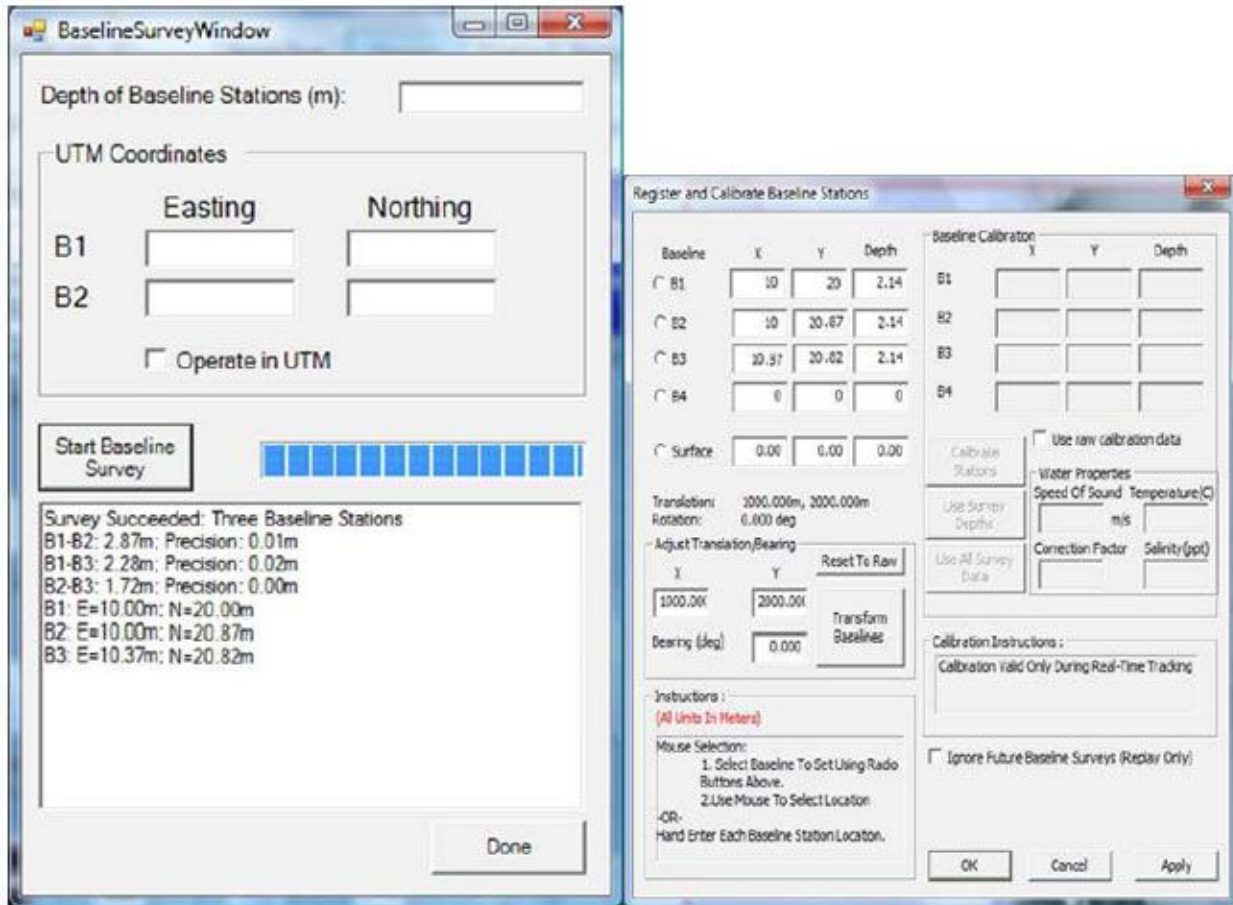
Bay of Sails Noise and Echo Evaluation at iceberg BS1 in 32m of water

- Noise around 95dB – 100dB
- Reliable signal detection at 100dB to 130 dB for a pinger lowered to the sea floor.
- Apparent echoes indicated by jump to approx. 118m for about 20% of the ranges. Seemed to get marginally better at higher detection thresholds.

7. Conducting a Baseline Survey

Do a baseline survey to establish the relative location of the baseline stations.

Procedure



1. Click the **Baseline Survey** button in SouthStar to call up the baseline survey window.
2. Enter the depth of your baseline stations in meters.
3. Click the **Start the Baseline Survey** button. The baseline survey can take up to 40 seconds, progress indicated by bar.
4. Read the results. Baseline station distances are indicated first. The Precision shows how much the measurement from station A to B varied from B to A. It should be a few centimeters or less. If precision is poor then the survey results are probably poor. If a distance measurement is not available, then a path blockage or excess baseline station range may be the problem.
5. Re-try a poor survey to see if it improves. If no improvement is available, move the baseline station closer, deeper or away from a suspected blockage.
6. Now manually transfer baseline survey results into DiveBase. In DiveBase, select **Action**→**Register and Calibrate Baseline Stations**.
 1. Enter the Easting coordinates of the baseline stations into the 'X' fields in Divebase.
 2. Enter the Northing coordinates of the baseline stations into the 'Y' fields in DiveBase

3. Enter the actual baseline station depths into the Depth field in DiveBase. (The Depth field in Navbridge is not currently used and can be left open).
4. Click the **OK** button in DiveBase
5. In DiveBase, select File→Save Current Record and select a name representative of the dive site such as **BayOfSailsIceberg1.shr**

8. Monitoring the Mobile Station

ID	Enabled	Primary	B1(m)	B2(m)	B3(m)	B4(m)	Depth(m)	Tilt(x)	Tilt(y)	Temp(c)	Description
2836	<input checked="" type="checkbox"/>	<input checked="" type="radio"/>	0.66	0.65	0.91	0.00	0.00	0	0	19.21	Diver #1(Marco)
2837	<input type="checkbox"/>	<input type="radio"/>	0.00	0.00	0.00	0.00	0.00	0	0	0.00	Diver #2(Matthew)
2838	<input type="checkbox"/>	<input type="radio"/>	0.00	0.00	0.00	0.00	0.00	0	0	0.00	Shark(Bruce)
2839	<input type="checkbox"/>	<input type="radio"/>	0.00	0.00	0.00	0.00	0.00	0	0	0.00	ROV #1(Nemo)
2840	<input type="checkbox"/>	<input type="radio"/>	0.00	0.00	0.00	0.00	0.00	0	0	0.00	ROV #2(Shelby)
2841	<input type="checkbox"/>	<input type="radio"/>	0.00	0.00	0.00	0.00	0.00	0	0	0.00	AUV #1(Tommy)
2842	<input type="checkbox"/>	<input type="radio"/>	0.00	0.00	0.00	0.00	0.00	0	0	0.00	AUV #2(Dunko)
2843	<input type="checkbox"/>	<input type="radio"/>	0.00	0.00	0.00	0.00	0.00	0	0	0.00	Tuna fish(Trevor)

Mobile Station Display Panel

Initial configuration

The Mobile Station display panel allows you to monitor and manage multiple mobile stations. The first step in setting up your mobile stations is to enter their mobile ID's in the far left boxes by double clicking an ID number to edit it and making sure to press enter after entering an ID number. If you own multiple mobile stations then you should enter all of their ID's at once and write in a description for each in the description box on the far right. When you're going to deploy the system you should uncheck the "Enabled" box for each of the mobile stations you're not going to be using. The more stations that are enabled the lower the refresh rate you're going to get for position and sensor data. One station may be set as the "Primary", which will cause its distance data to be displayed in the main window after the Mobile Station Display is hidden.

All of the data you enter for mobile stations(along with the rest of the application settings) are stored in the file "Application_settings.config" in your SouthStar program directory in a clean text format using xml.

During deployment

When the system is deployed and in the water you will see the distance data for enabled and connected mobile stations update along with the sensor data. The background behind the stations ID number will also change colors to indicate the status of the station. It will be green if all base stations are receiving it's pings, yellow if at least one station misses it's ping, and red if communication to the station can't be established or the station isn't enabled.

Data Output Format

If a "Data Output" port is selected in the Comms screen then the distance and sensor data for all enabled and connected mobile stations will be output during system operation. The data format is as follows: \$Mobile ID, temperature(Celsius), depth(Meters), rotation X, rotation Y, distance to base 1(meters), distance to base 2(meters), distance to base 3(meters), distance to base 4(meters), Speed of sound (meters/second)

Example output string using a mobile station without a depth sensor or accelerometer :
\$2836,19.30,0,0,0,0.65,0.61,0.74,0.50,1440

9. Mounting the Pinger



TLT-32 target pinger is mounted free & clear of the vehicle, minimizing acoustic shadowing. Horizontal orientation works, but vertical with transducer up is preferred, when practical, to align beam patterns.

While working on the hull, the pinger should be .5m off the hull or the same distance as the baseline stations are off the wall.

Mount the target pinger on the vehicle such as to minimize shadowing by components of the vehicle. An unobstructed line-of-sight to the baseline stations must be maintained. Ideally, the pinger should be mounted vertical, with transducer end up.

10. Ship Drawing Registration (prior to deployment)

These tasks should be done prior to deployment of the system.

Preparation Tasks

1. Scan a ship plan
2. Register the ship plan

Scan a Ship Plan

The first step is to acquire a scanned copy of the ship's plan or a digital picture of the ship's plan. Typically the plans are located on the ship somewhere so you can easily take a picture with a digital camera and load it into the registration software. If neither or these are available, the software

pre-installs several ship plans; you can use one of those. You still have to register the image as that is used to scale it to size.

Required format for ship plan images

1. Black and white, to minimize file size. Do not use grayscale or color.
2. The file must be BMP format.
3. The file size of each image file should be **1 MB or less** (a smaller file size increases the speed at which your computer handles the images while tracking the mobile station).
4. The physical size of each image should be the same, regarding size of pixels (ex: 800 x 600 pixels)

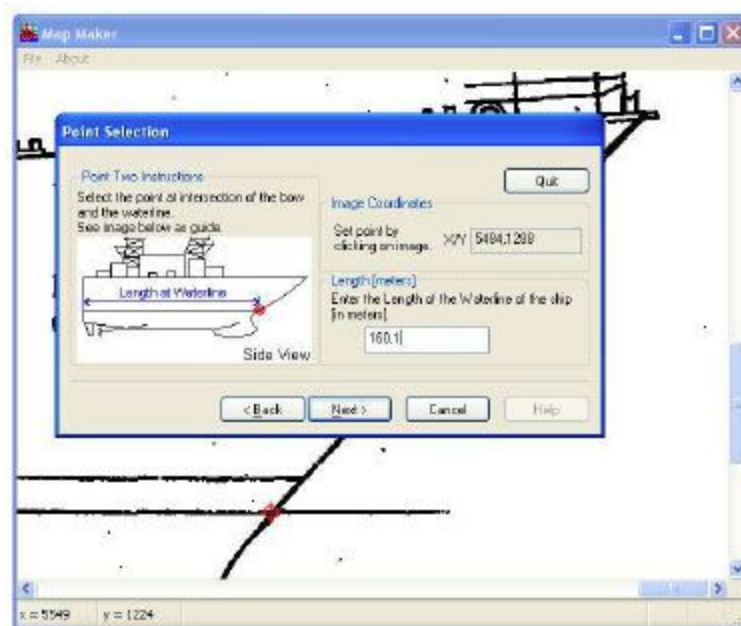


Figure 3.1: ShipHull Registration™ Wizard, defining lines and entering measurements.

Register the Ship Plan

Digital images of the top and side of the ship must be “registered” in order use them with AguaMap ShipHull. When you register your ship images you are telling the ShipHull software where certain points on the ship images are and the relative size of the ship. The software that will guide you through registering your ship image is called **ShipHull Registration™**.

Using the ShipHull Registration™ utility

Once you have digital images of both the top and the side of the ship you are ready to use ShipHull Registration™ to register those images. Open Chart Registration™ and then the ShipHull

Registration utility and it will guide you through each step of the process. It is located in the same folder as the ShipHull application.

You will need some ship measurement information before you get started. Those measurements are:

1. Length of waterline
2. Draft of ship (waterline to lowest point of ship)
3. Overall length of the ship
4. Width of the stern (widest part)

The ShipHull Registration™ Wizard will walk you through defining various lines on the ship image (using the mouse pointer) and entering their measurements.

Near the end of the process the wizard will tell you that the image is rotated (i.e. the horizontal axis is not perfectly horizontal, see Figure 3.2) and it will ask you if you want to correct this, choose “yes”.

To complete the process follow the on-screen instructions, select “Save Registration” and give your map file a name.

In the DiveBase ShipHull software you can now load the map file. This option is available under FILE in the software drop down boxes.

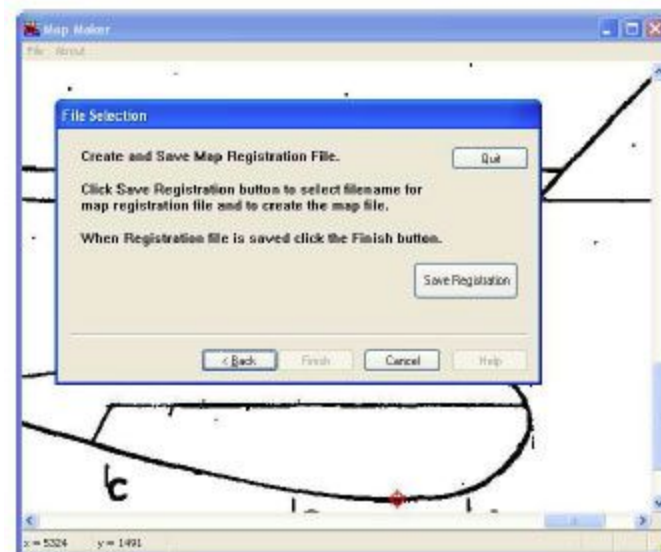


Figure 3.3: Saving the new map

11. Target Tracking: Full-Hull Inspection Mode

ShipHull mode is used for the general inspection of the ship's hull. This mode is used to find plates that need further inspection. Tracking and navigation are done using the DiveBase ShipHull software. Operate the software as described in the DiveBase manual, except that baseline surveys are done in Southstar rather than directly in DiveBase. The data from the baseline survey in Southstar is manually entered into the DiveBase software. Please take note of which stations are the Aft Port, Forward Port, Aft Starboard and Forward Starboard.

Here is some general guidance for DiveBase use:

- Use Item→Filter settings to set position filter or processing parameters as appropriate:
 - Set an averaging period of 3-10 seconds to smooth the trace. More averaging → smoother trace → more position lag.
 - Set the visibility rating to influence the width of the position trace. Set to camera or sensory range to visualize search coverage.
 - Set the **Maximum Error** range to remove poor quality position fixes. Any error higher than the threshold will not be plotted. This can be changed during replay as well.
 - Set the **Maximum Holiday** higher to show more severe position jumps in the ROV track, or lower to leave a gap when successive positions are too far apart.
- Set **Options**→**Acoustic Navigation Com** port to point to the data source from Southstar
- Define **Options**→**Serial Output Com Port**, **Options**→**Serial Output Baudrate** to pipe position data to another computer or application (such as Hyperterm) to export position data in real-time or replay operations. Can be captured with Hyperterm to generate a text file for use in ARCGIS. Recommended Options→Output Format is DSS (XYD)
- Use the Chart Registration utility in the DiveBase folder to register an image for use as a chart background in DiveBase.
- Watch the **Current Error** at the bottom of the tracking screen to QC the quality of positioning. A smaller error means the system is more precise.
- Watch the **Last Fix Time** up-counter to see how long it has been since the last position fix. There is a position fix opportunity once a second.

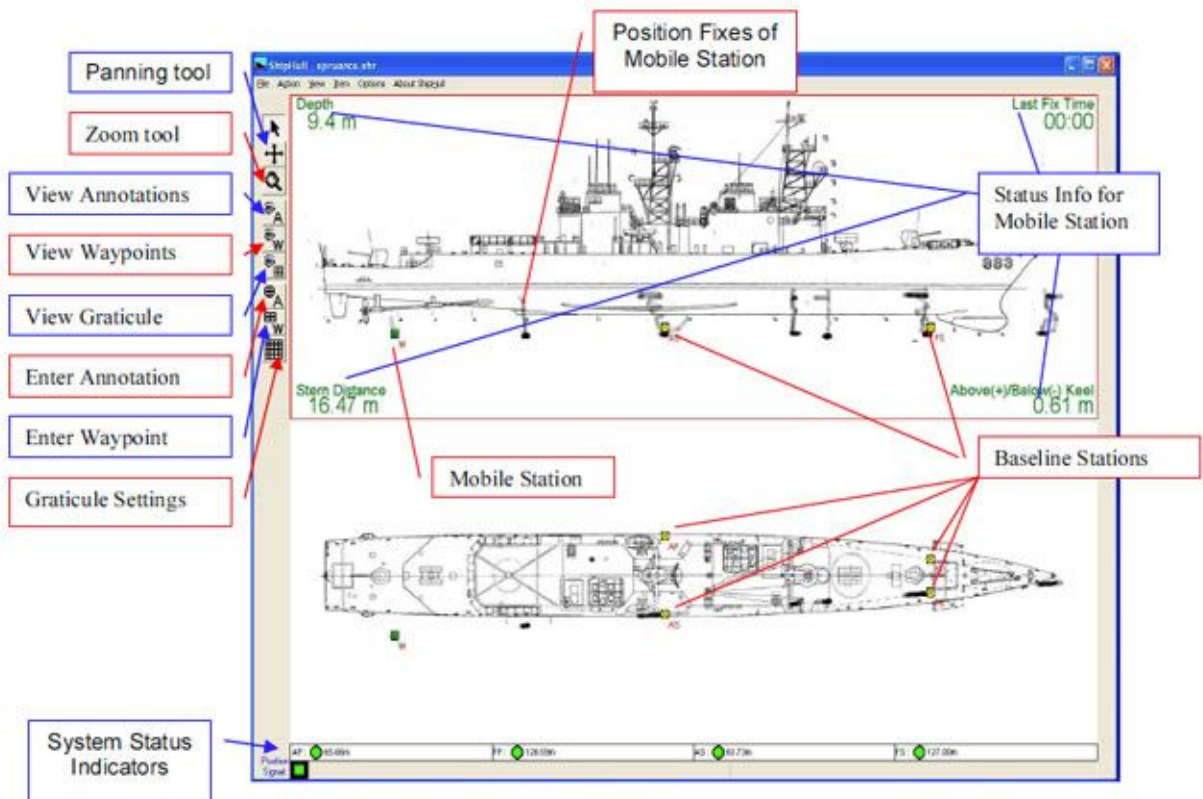
Diagnosing when DiveBase Does Not Track (no positions)

1. View the baseline status lights in Southstar and DiveBase. At least three green lights (available range measurements) are required to obtain a position fix, except when operating with two baseline stations and clicking Options→Allow 2 Range Position Fixes
2. View the Position Signal light in the lower left corner of the DiveBase screen. If red but enough ranges have been received, then the range data could not be converted into a position fix of sufficient quality:
 1. If the **Current Error** indicator is red, then the resulting position does not have an error exceeding the value set in **Items**→**Filter Settings, Maximum Error**. This can be the result of poor quality ranging data due to acoustic conditions (such as noise causing many outliers – raise the detection threshold). It will

also happen if a baseline station position is significantly incorrect, i.e by a few meters or more.

2. Well working navigation is indicated by current errors of $<0.5\text{m}$. $0.5\text{m}-1\text{m}$ is reasonable, above 1m is poor and above 3m should almost always be ignored.
3. It is also possible that a range is outside the boundaries specified by **Minimum Range** and **Maximum Range**. Verify these settings.

DiveBase ShipHull Display



12. Target Tracking: Plate Inspection Mode

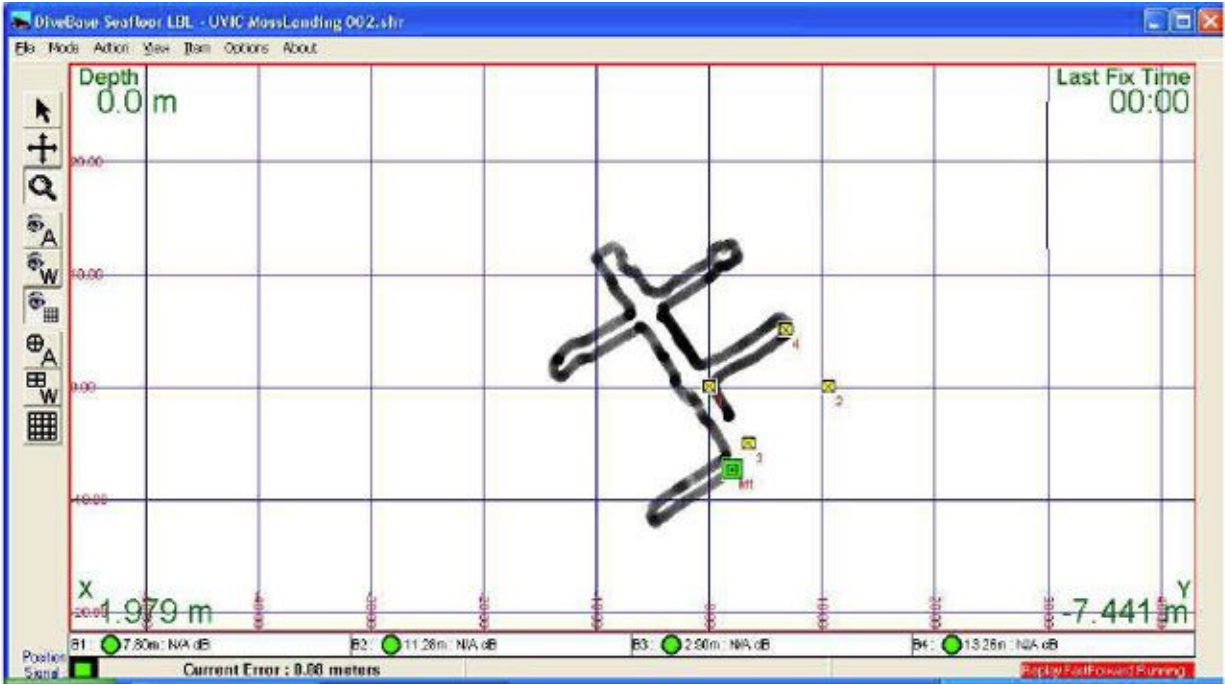


Plate mode is used after the initial ship hull survey is complete. Tracking and navigation are done by using the DiveBase SeaFloor software. Operate the software as described in the DiveBase SeaFloor manual, except that baseline surveys are done in Southstar rather than directly in DiveBase. The data from the baseline survey in Southstar is manually entered into the DiveBase software.

Here is some general guidance for tracking and DiveBase use:

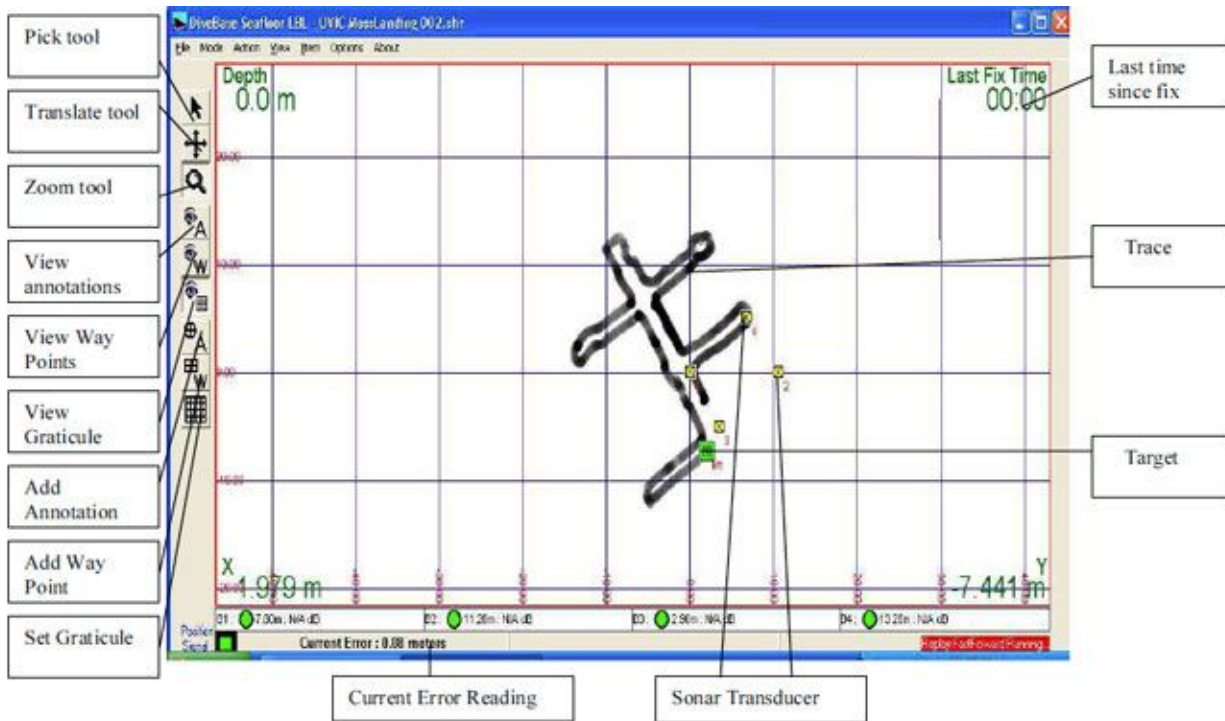
- Use Item→Filter settings to set position filter or processing parameters as appropriate:
 - Set an averaging period of 3-10 seconds to smooth the trace. More averaging → smoother trace → more position lag.
 - Set the visibility rating to influence the width of the position trace. Set to camera or sensory range to visualize search coverage.
 - Set the **Maximum Error** range to remove poor quality position fixes. Any error higher than the threshold will not be plotted. This can be changed during replay as well.
 - Set the **Maximum Holiday** higher to show more severe position jumps in the ROV track, or lower to leave a gap when successive positions are too far apart.
- Set **Options**→**Acoustic Navigation Com** port to point to the data source from Southstar
- Define **Options**→**Serial Output Com Port**, **Options**→**Serial Output Baudrate** to pipe position data to another computer or application (such as Hyperterm) to export position data in real-time or replay operations. Can be captured with Hyperterm to generate a text file for use in ARCGIS. Recommended Options→Output Format is DSS (XYD)
- Use the Chart Registration utility in the Seafloor folder to register an image for use as a chart background in DiveBase.

- Watch the **Current Error** at the bottom of the tracking screen to QC the quality of positioning. A smaller error means the system is more precise.
- Watch the **Last Fix Time** up-counter to see how long it has been since the last position fix. There is a position fix opportunity once a second.

Diagnosing when DiveBase Does Not Track (no positions)

1. View the baseline status lights in Southstar and DiveBase. At least three green lights (available range measurements) are required to obtain a position fix, except when operating with two baseline stations and clicking **Options**→**Allow 2 Range Position Fixes**
2. View the Position Signal light in the lower left corner of the DiveBase screen. If red but enough ranges have been received, then the range data could not be converted into a position fix of sufficient quality:
 1. If the **Current Error** indicator is red, then the resulting position does have an error exceeding the value set in **Items**→**Filter Settings, Maximum Error**. This can be the result of poor quality ranging data due to acoustic conditions (such as noise causing many outliers – raise the detection threshold). It will also happen if a baseline station position is significantly incorrect, i.e by a few meters or more.
 2. Well working navigation is indicated by current errors of <0.5m. 0.5m-1m is reasonable, above 1m is poor and above 3m should almost always be ignored.
 3. It is also possible that a range is outside the boundaries specified by **Minimum Range** and **Maximum Range**. Verify these settings.

DiveBase SeaFloor Display



13. Additional DiveBase Functions

Check and Enter Visibility

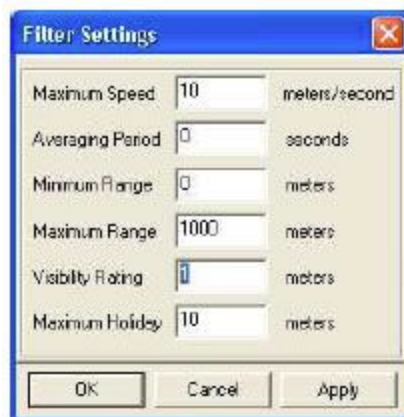


Figure 5: Entering Visibility Add Way

To take account of the **visibility** in the water at the time of the inspection you must enter it into the software. The visibility number determines the width of the trace. For example, for a 1-meter visibility the trace will be 2 meters wide (one meter to the left, one meter to the right). The trace is used to 'paint' the seafloor, i.e. show the ground you have covered. Good visibility (or an acoustic (sonar)

imaging system) will allow you to 'paint' a wider swath. Choose Filter **Settings** from the **Item** menu and enter the approximate visibility in the appropriate box.

Appendix B: Hot Keys (Keyboard Shortcuts, DiveBase)

Menu Command	Hot Key(s)	Function (if it's not self-explanatory)
<u>File</u>		
Load Record File	Ctrl+L	Loads a record
Load Annotations	Ctrl+A	Loads an annotation file
Load Waypoints	Ctrl+W	Loads a way point file
Save Screen Image		Saves currently selected screen image
Save Annotations		Saves the current annotation file
Save Waypoints		Saves the current way point file
Clear Data / Screen	Ctrl+C	Clear all stored data from screen
Close	Ctrl+Q	Closes Application
<u>Action</u>		
Start Real-Time Tracking	T	Starts tracking of the mobile station, a new record.

Register And Calibrate Baseline Stations Dialog	C	Launches baseline registration and calibration dialog
End Real-Time Tracking	E	Ends tracking of the mobile station, closes record
Replay A Record	R	
Generate Survey Report Image	Ctrl+S	Saves full DiveBase image currently selected loaded
Noise Test	N	Launch Noise Test Dialog
<u>View</u>		
Graticule	G	Toggles graticules (grid) on and off
Annotations	A	Toggles Annotations on and off
Status Info		Toggles Status Info on and off
Waypoints	W	Toggles Waypoints on and off
Replay Control		Displays Replay Control Bar
<u>Item</u>		
Graticule Settings	Ctrl+G	Allows changing of graticule (grid) settings
Filter Settings	Ctrl+F	Allows adjustment of Visibility and other settings

Add Annotation		
Remove Annotation	Delete Key	If An Annotation is selected Delete Key with remove it.
Remove All Annotations		
Add Way Point		
Remove Way Point	Delete Key	If A Waypoint is selected Delete Key with remove it.
Remove All Way Points		

Keystrokes (Listed by Functional Group)	Function
<u>Deployment</u>	
“T”	Start Realtime Tracking
“C”	Launch Baseline Register/Calibration Dialog
CTRL+F	Launch Filter Dialog (where you enter Visibility)
“N”	Launch Noise Test Dialog (only active during realtime tracking)
Up Arrow	Pan Up

Down Arrow	Pan Down
Right Arrow	Pan right
Left arrow	Pan left
“I”	ZOOM IN
“O”	ZOOM OUT
SPACE BAR	Add annotation at mobile station location, allows free text entering
F5	Add Quick Annotation (“1”)
F6	Add Quick Annotation (“2”)
F7	Add Quick Annotation (“3”)
F8	Add Quick Annotation (“4”)
DELETE KEY	DELETE Selected Annotation or WayPoint
“E”	END TRACKING
<u>Reporting</u>	
“R”	Replay Record
CTRL+R	Generate full report image (saves all items displayed)

Ctrl+C	CLEAR SCREEN
CTRL+A	LOAD ANNOTATIONS from file
CTRL+W	LOAD WAYPOINTS from file
CTRL+L	LOAD a RECORD
<u>Others</u>	
CTRL+ATL+Q	CLOSE/Quit APPLICATION
CTRL+G	Launch GRATICULE SETTINGS dialog
"G"	VIEW/Hide GRATICULE
"A"	VIEW/Hide ANNOTATIONS
"W"	VIEW/Hide WAYPOINTS

Appendix C: Toolbar Buttons (DiveBase)



Pointer: Allows selection of annotations and waypoints.



Translation/Panning Tool: Allows fine control over positioning of ship plan in display.

Click and drag to move image.



Zoom Tool: Allows fine control over zooming, click and drag a box to zoom to that box.

Right click = zoom in, left click = zoom out.



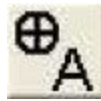
Shows annotations.



Shows Waypoints



Shows Graticule layer



Inserts Annotation



Inserts Waypoint



Graticule Setting Adjustment: Calls up Graticule Setting Dialog window for adjusting the values of the graticule.

Appendix D: Troubleshooting

Noise Problems

Acoustic or electric noise in the tracking environment will interfere with the signals used by the system. There are many sources of noise, including biological (snapping shrimp, etc...), ship engines, ROV motors, diver's regulators, AC power lines, low quality inverters, etc... The best way to locate controllable noise is to use the noise test feature in the tracking software to monitor noise levels as you turn on and off the possible sources of noise.

<u>ROV noise</u>	
Problem	Reason/Solution
Acoustic noise	Move transducer away from thrusters or hydraulics
Electrical noise (May be radio interference through the air/water or electrical interference through noise on power supply lines)	Test for power line noise by removing both the ROV transponder and the PC from AC power. Test for radio interference by shutting off all ROV systems. Use battery power, a good generator or a true sine wave inverter if power line noise is a problem. Move the ROV transponder away from the ROV to locate radio interference, then mount in a location where radio interference is minimized.

System Status Indicators

Problem	Reason/Solution
<u>Baseline Range Indicator</u>	

Constantly Displays Red Circle	<ul style="list-style-type: none"> • Possible loss of power to baseline station. Check power switch on baseline station.
	<ul style="list-style-type: none"> • During side surveys the hull may block the opposite side baseline stations. This will cause them to report red, but the position signal should still report good positions.
	<ul style="list-style-type: none"> • During bottom surveys indicator may change to red if the mobile station raises above the keel line creating another block in the line-of-site. Lower your depth so that all four baseline stations are in view of the mobile station.

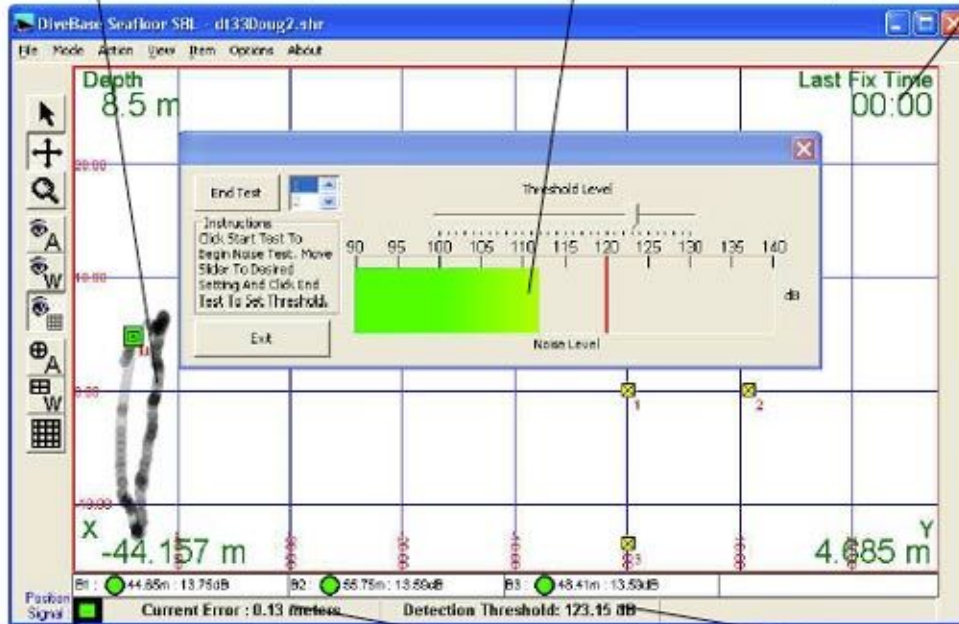
Position Indicator

Constantly Large Errors	<ul style="list-style-type: none"> • A persistently large error indicates that the baseline survey is incorrect.
	<ul style="list-style-type: none"> • If the number turns red, the system is not showing positions because the error exceeds the 'maximum error' defined in the filter settings.
Constantly Displays Red	<ul style="list-style-type: none"> • Communications problem. Cable has been disconnected on mobile station. Check cable connection to mobile station.
(Real-Time Only)	<ul style="list-style-type: none"> • Power loss. Mobile station has lost power. Check power connection (external power) or battery charge.
	<ul style="list-style-type: none"> • Transducer is out of range or in a shadowed area.
	<ul style="list-style-type: none"> • Transponder or Transducer has a dead battery.

Position Trace: The trace is painted only if the position fixes meet the quality standards defined in the position filter settings. If you see frequent gaps in the trace, then check your filter settings the other indicators on the screen to determine the cause.

Noise Test & Detection Threshold Slider:
Use this test to evaluate vehicle and environmental noise. More noise means less system range, so make changes to reduce any noise under your control and test again. Use the slider to set the detection threshold above the prevalent noise to avoid noise-induced errors.

Check the time since last position fix to make sure your data is up to date.



Green is OK, but a red light indicates that station is out of range, shielded from view or not operating. Are the lights almost consistently green? If not, reduce baseline station spacing and/or avoid obstructions to obtain better system reliability.

For good position quality, the error should be below 1 meter or even 0.5m. A persistently large error indicates that the baseline survey is incorrect, while changing errors indicate unstable baseline station mounting or obstructions in the water. If the number turns red, the system is not showing positions because the error exceeds the 'maximum error' you defined in the filter settings (quality control).

Signal strength above detection threshold: If you see only a few dB, you are near the limit of range. Check the numbers just after baseline station deployment to verify your array is not too large for conditions. Monitor them during ops to get an early warning of an approaching out-of-range condition. CAUTION: A persistently weak signal from one baseline station or sonar transducer may indicate the baseline station transmitter or surface station sonar transducer is not working properly. Replace it.