iBoat BS3 User Manual

Manual Revision

Revision Date	Revision Level	Description
Aug. 2020	2	iBoat BS3 User Manual 1.1 Version

Preface

Introduction

Thank you for using the Hi-Target iBoat BS3 USV system. This introduction describes how to use the iBoat BS3 USV system.

Experience Requirement

In order to make better use of Hi-Target iBoat BS3 USV system, Hi-Target recommends that you have certain GIS knowledge and read this manual carefully. If you have any questions, please check the official website of Hi-Target: *http://www.hi-target.com.cn.*

Tips for Safe Use

Notice: Please read the contents of the prompts carefully. They are generally about an important part of the device's operation, and you need to pay special attention to them.

Warning: The warning notices are generally very important prompts. If you do not follow the content, it will cause damage to the instrument, loss of data, a system crash, and even endanger your own personal safety.

Exclusions

Before using this product, please be sure to read the instruction manual carefully, which will help you to use this product better. Hi-Target shall not be liable for any loss caused by mishandling the product if you fail to operate it in accordance with the requirements of the instruction manual or fail to correctly understand the requirements of the instruction manual.

Hi-Target is committed to continuously improving product features and performance, improving service quality, and reserves the right to change the contents of the instruction manual without prior notice.

We have checked the consistency of the contents of the instruction manual and the hardware and software, but do not rule out the possibility of deviation. The pictures in the instruction manual are for reference only. If there is any inconsistency with the product, the product shall prevail.

Technical Support and Service

If you have any technical problems, you can call the technical center of each branch and the technical department of the headquarters. We will, in time, answer your questions.

Relevant Information

You can obtain this introduction by:

1. Purchasing Hi-Target products: you will find this manual in the instrument container to guide you on operating the instrument.
2. Logging onto the Hi-Target official website to download the electronic version introduction at *Partners → Partner center*.

Advice

If you have any comments and suggestions for this product, please email *info@hi-target.com.cn*. Your feedback will help us to improve the product and service.

Contents

The iBoat series intelligent USV can autopilot by setting waypoints with GNSS navigation. More sensor equipment can be loaded to perform various surveying tasks.

Accurate control of iBoat BS3 makes it easy to conduct ultra-shallow and nearshore hydrographic surveying, greatly improving the monitoring efficiency and accuracy, reducing the risk of monitoring staff working on the water; And lightweight easy to carry.

Professional hull design, high-performance sounding module, high-precision positioning system, USV control software and data processing software are independently designed and developed by Hi-Target. High integration, outstanding overall performance, coupled with a sound after-sales service system, can provide one-stop services.

Hardware Connection

The complete view after all things are installed well:

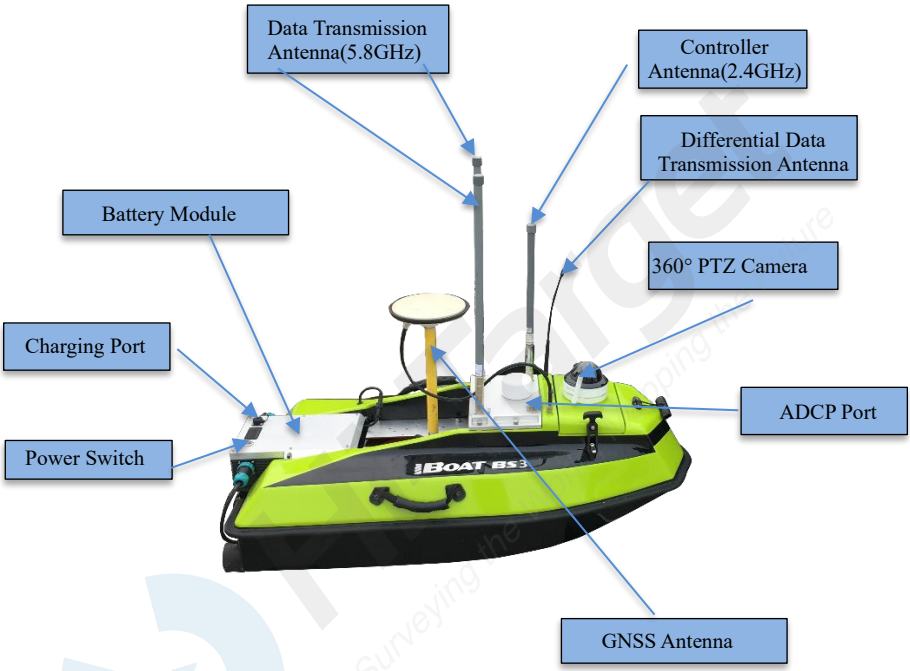


Figure 1-1 Complete view & antenna description

Description of ashore station

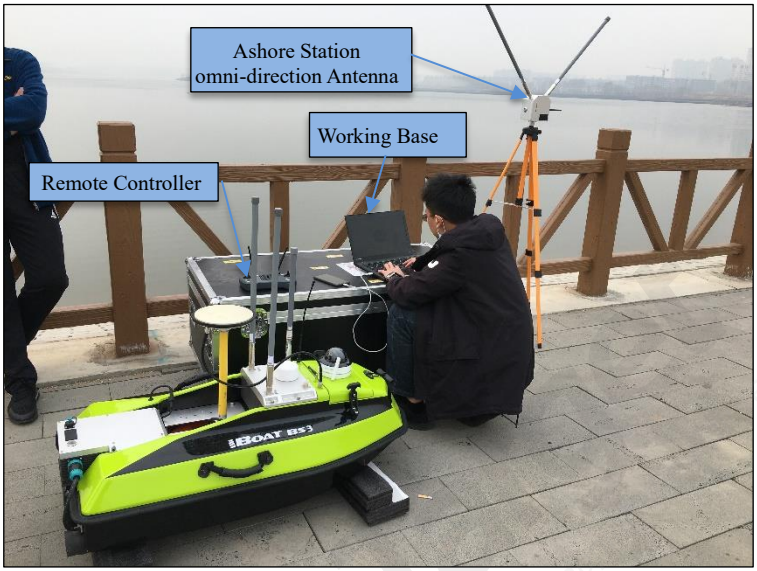


Figure 1-3 Ashore Base System

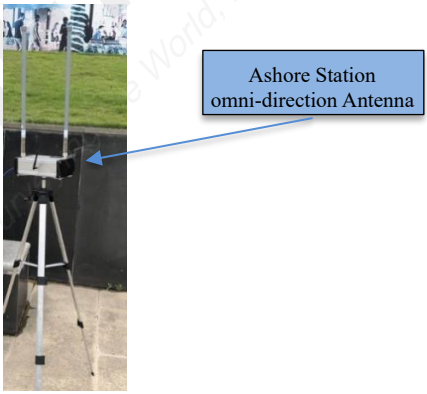


Figure 1-4 Wireless bridge connection

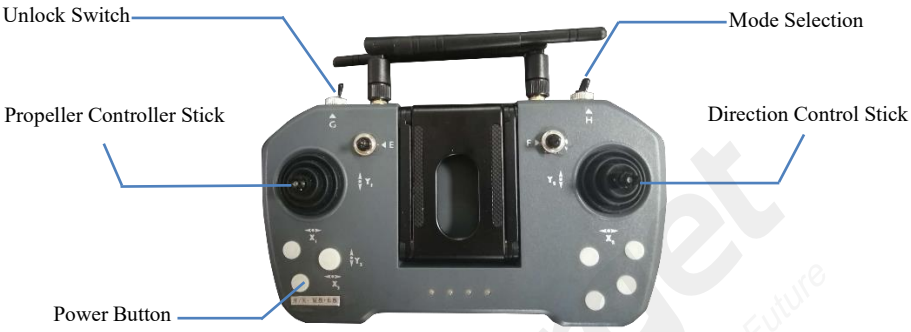
The laptop and the base station (LAN Port ↔ laptop ethernet port) can be connected by a network cable, which works as a LAN cable. Two 5.8 GHz data transmission antennas are equipped in the Ashore station to connect with the USV.

Figure 1-5 Base Battery and connection

Figure 1-6 Working state of the battery

Power on the black battery (don't forget it is a POE power supplier also), the screen indicates power and related information. The green grids indicate the power left in the battery. Users need to notice that the Power Switch button should be turned on when the battery charge or discharge.

Describing essential parts of the controller:



- ***Power Button:*** Click one time and long-press to power on or off the controller.
- ***Propeller Control Stick:*** Push the stick up to control the USV forward.
  Push the stick down to control the USV backward.
- ***Unlock Switch:*** The USV is locked when the stick is on the far left; it will immediately stop traveling. When the stick is on the far right, the USV is unlocked and able to be controlled by a controller or ground station to travel (the thruster emergency stop button in the controller is to lock the thruster during the test and can be used to lock the boat in the case of a boat emergency).
- ***Mode Selection:*** When the stick is on the far left, the USV is in auto-return mode and will return to the home point on its own. When the stick is in the middle position, the USV is in cruise mode and will move forward at the set speed uniformly. The operator can control the boat's forward direction with the direction stick. When the stick is on the far right, the USV is in manual mode and the operator needs to control it manually.
- ***Direction Control Stick:*** Control the USV to turn left or right.

Overall Operation Flow

2.1 Power on Controller

Click the button “1” one time and long-press the button “1” to power on or off the controller, and the bottom of the controller shows its percentage of power remaining.

2.2 Switch on USV

Switch on the USV and you will hear a “di di di” sound. When a long “di---” comes, the initialization is done (Please make sure the controller is powered on before turning on the USV). Use the right control stick to activate the propellers by turning it left and right, checking the USV

health of the engine system. This checking step can be done on the ground before deploying it into the water.

2.3 LAN IP Setting

Open the network configuration page of your laptop and set the local network IP (IPV4) to 192.168.1.88, the mask will set as 255.255.255.0 automatically. Keep others as default like the following figure and confirm the settings (If using a Wi-Fi connection, the Wi-Fi name is the router and the password is 12345678. In addition to changing the IP address and subnet mask, you need to change the default gateway to 192.168.1.1.), and then confirm the settings.

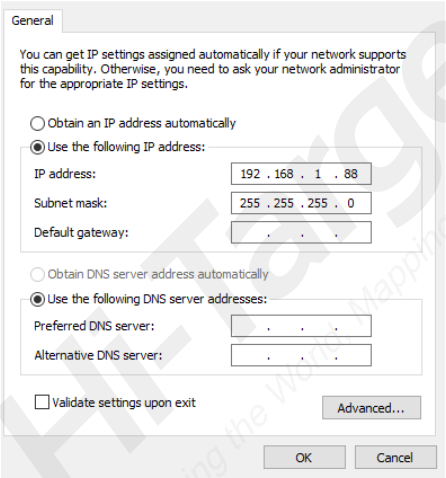


Figure 2-3-1 LAN IP setting

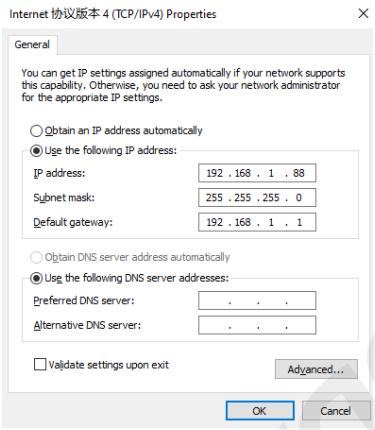


Figure 2-3-2 Wi-Fi IP setting

2.4 Run Virtual Serial Port Software

Run installer *USR-VCOM.exe* and then run the program immediately. Add a new virtual serial ports as below.

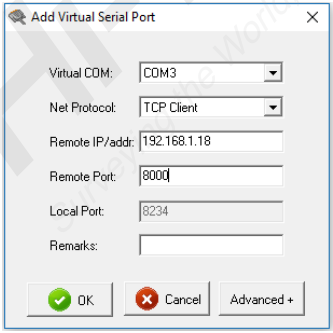


Figure2-4-1 Virtual serial port configuration

Three Virtual Serial Port configuration as follows:
Port Function: **Boat control**
Virtual COM: COM3(can be customized)
Net Protocol: TCP Client
Remote IP: 192.168.1.18
Remote Port: 7000

Port Function: **GNSS connection**
Virtual COM: COM4(can be customized)
Net Protocol: TCP Client
Remote IP: 192.168.1.18
Remote Port: 8000

Port Function: **ADCP connection**
Virtual COM: COM5(can be customized)
Net Protocol: TCP Client
Remote IP: 192.168.1.18
Remote Port: 9000

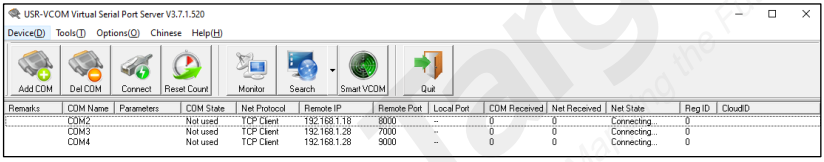


Figure2-4-2 Connecting status

When the ports set up, The *Connected* will be displayed and data income increase if everything goes well. Minimize it and keep the program running in the background.

2.5 Setup GNSS Receiver by Hi-MAX

Firstly, insert the Hi-MAX dongle (the orange color one) into the laptop, register if necessary.

Figure 2-5-1 Main interface of Hi-Max

2.5.1 New Project

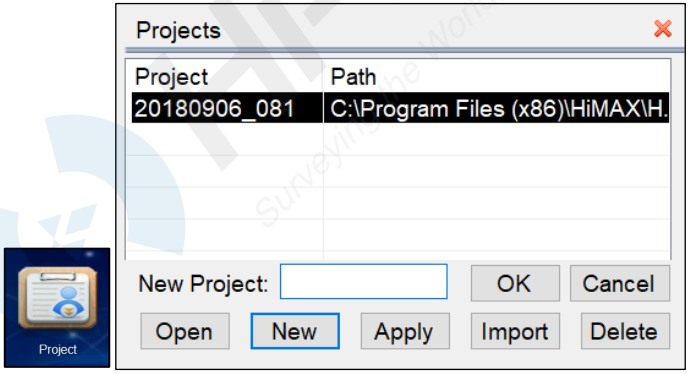


Figure 2-5-2 New project creating

The project name is at the top of the project list once it had been created.

2.5.2 Serial Port Debug

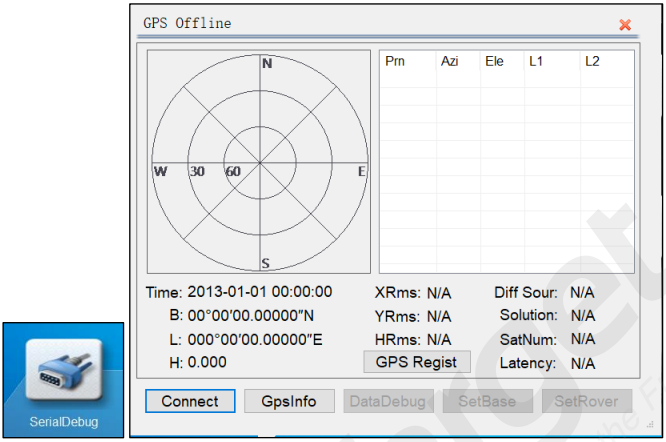


Figure 2-5-3 Serial port debug

Click *Connect GPS* button

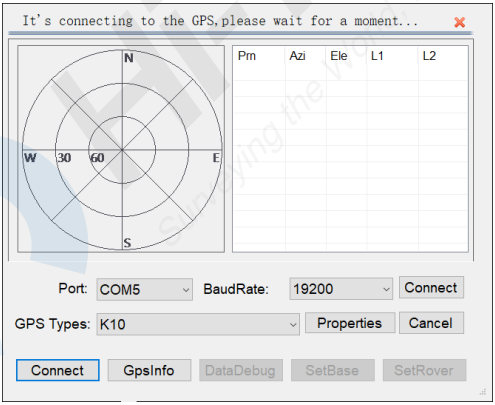


Figure 2-5-4 GPS connecting

Set the correct parameters and choose the right receiver type, click *Connect.*

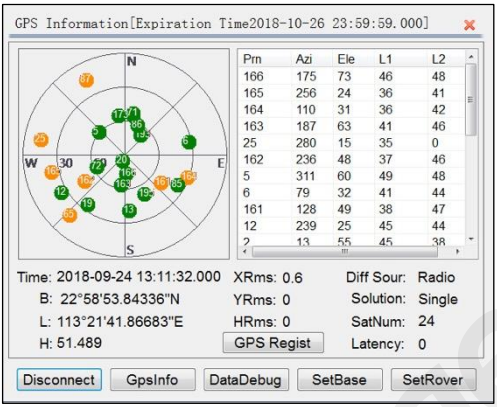


Figure 2-5-5 GPS information

On the top of the window shows the expiry date of the GNSS receiver. Restart the receiver if a license is applied. Click *SetRover* Button.

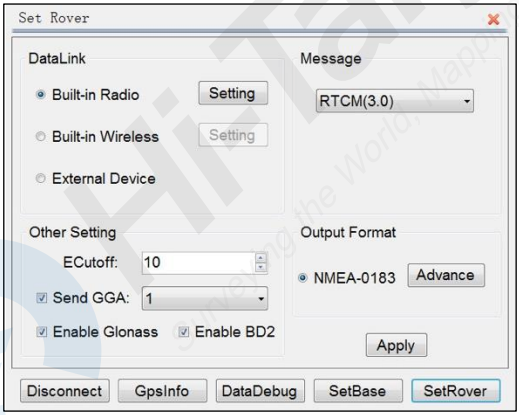


Figure 2-5-6 Rover setting

Select the *DataLink* format. If there is the base station, choose the *Built-in Radio* mode. Click *Setting* and enter the channel number in the pop-up *Radio Setting* window. Click *OK* for conforming.

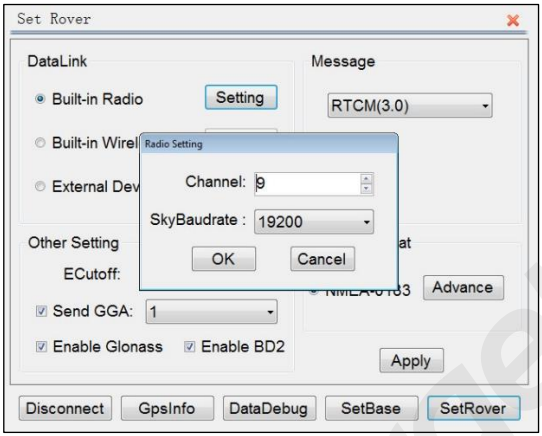


Figure 2-5-6 Radio setting

If use CORS, select the *Built-in Wireless* mode.

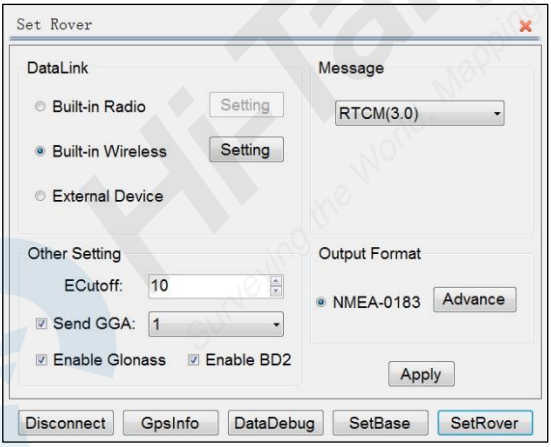


Figure 2-5-6 Built-in wireless

Click *Setting*.

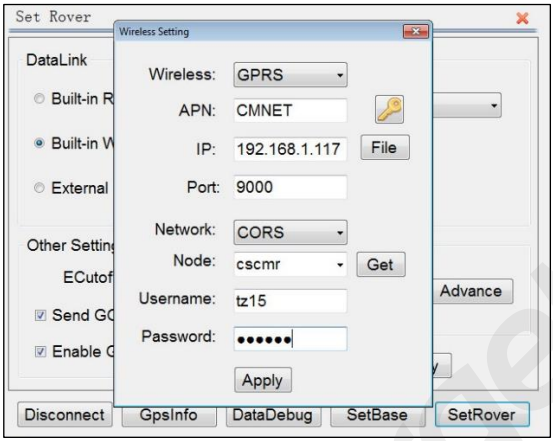


Figure 2-5-7 Wireless setting

Input corresponding IP address, port and so on, click *Apply*.

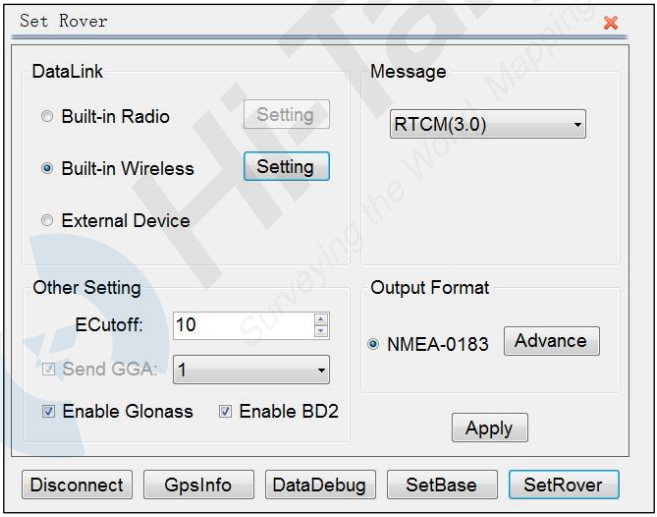


Figure 2-5-8 Message setting

The differential message selects RTCM3.0 and click *Apply*. The shipboard mobile station operation has been completed. The next step is data debug.

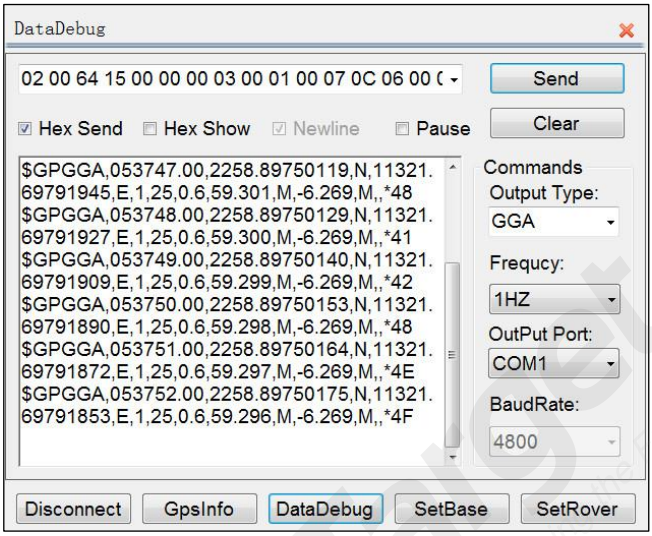


Figure 2-5-9 Data debug

In the Output Type option, select *OFF* and click the *Send* button; The data in the left window will stop updating. Then send *GGA* (position statement) *ZDA* (time statement) *RMC* (magnetic declination) *VTG* (for low speed) four commands respectively and set each command frequency as 5HZ. Close the window when you are done.

2.5.3 Equipment Connection

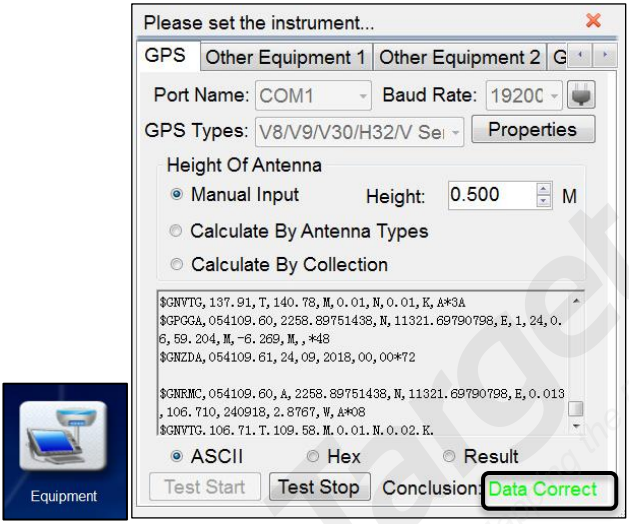


Figure 2-5-10 Equipment connection

Choose the correct COM port, for example, COM3(for GNSS connection), choose GPS type as K10, keep baud rate as 19200, antenna type is 0.45m(example) and test if the signal can come in and printed. The NMEA GGA, ZDA, RMC, VTG are necessary.

2.6 USV Ground Control Software (USV GCS)

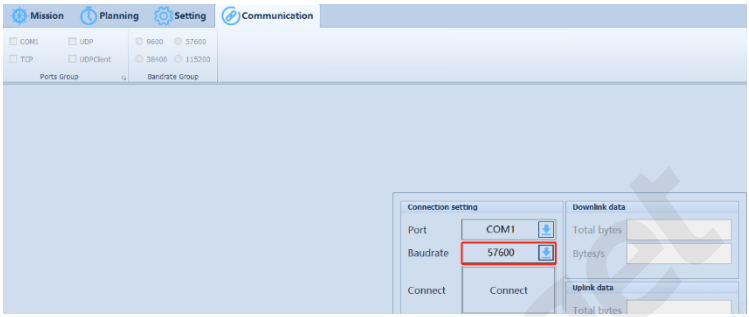


Figure 2-6-1 Communication interface

Enter the *Communication* interface, and select the serial port number 7000 like COM1. Then set the Baud rate as 57600 and click *Connect*.

When the connection is successful, enter the *Setting* interface.

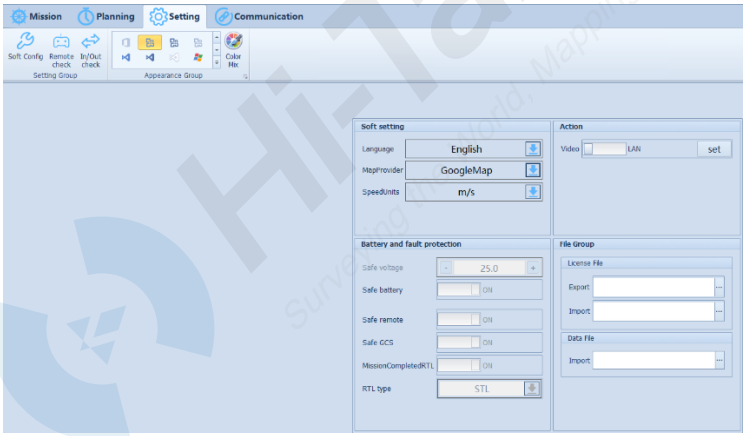


Figure 2-6-2 Setting interface

In the *Setting* interface, users can switch the language/ Map Provider/ Speed Units/ Safe voltage/ Safe remote/ Safe GCS, etc.

Figure 2-6-2 Setting interface

The *Setting* interface also supports setting video access (users can view the video in the USV GCS, HiMax Sounder software and on the web page).

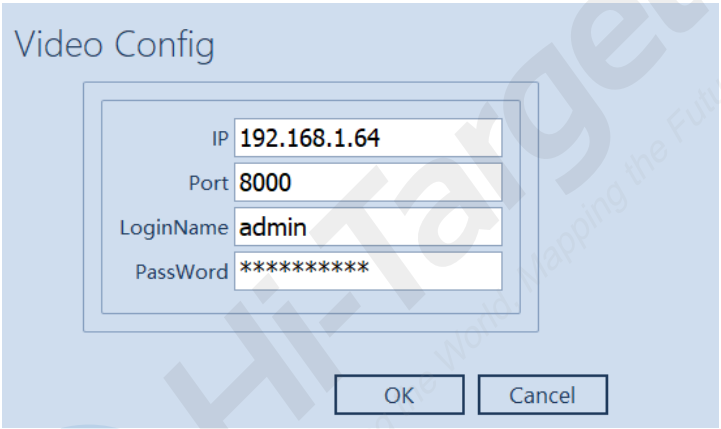
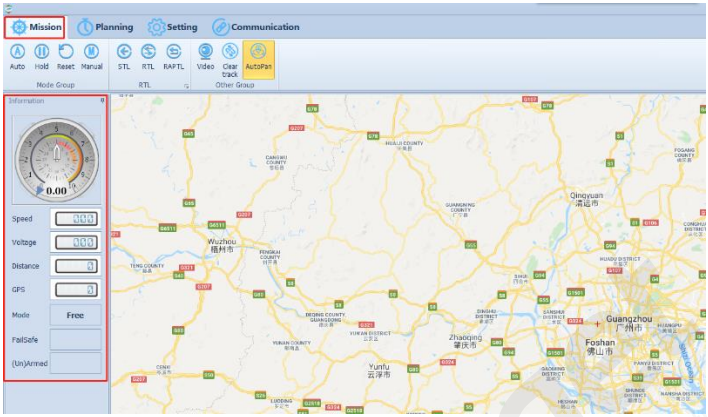


Figure 2-6-3 Video Config

When setting the video access:
IP should be set as 192.168.1.64;
Port should be set as 8000;
LoginName should be set as admin;
Password should be set as zhd123456;



When connected to the boat, enter the *Mission* interface. The left side of the mission interface shows some detailed information on the boat, like the speed of the boat and the current operation mode, etc.

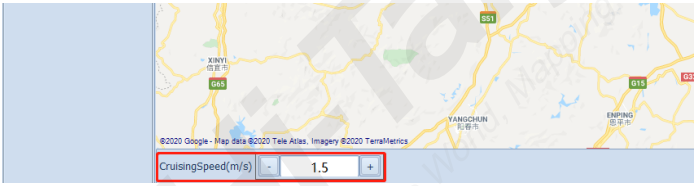


Figure 2-6-3 Cruising Speed description

The setting of fixed-speed cruising: In the *CruisingSpeed* tab set the value and click the *Write* button to change the speed of auto cruising. We recommend a speed value of 1.5m/s for automatically cruising. Every time the value is changed, you must click the *Write* button again so that the ship control system can receive the new speed command.

Notice: In any circumstances, users can switch between the automatic mode and manual mode by using the controller. It means that the manual control right can be obtained urgently, which is very important in the case of emergent situations like the boat is lost or suffer the collision.

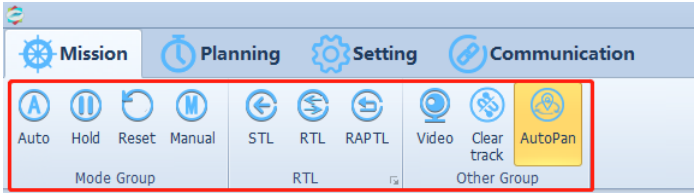


Figure 2-6-3 Operation mode

Descriptions about some key points:

- ***AUTO***: The current mode is an automatic cruise.
- ***HOLD***: The mission control system has no output commands, propellers and other related units will stop working
- ***MANUAL***: The boat under the manual control mode.
- ***RTL***: Return to the home point set automatically.
- ***Video***: View the video in real-time.

Planning Interface

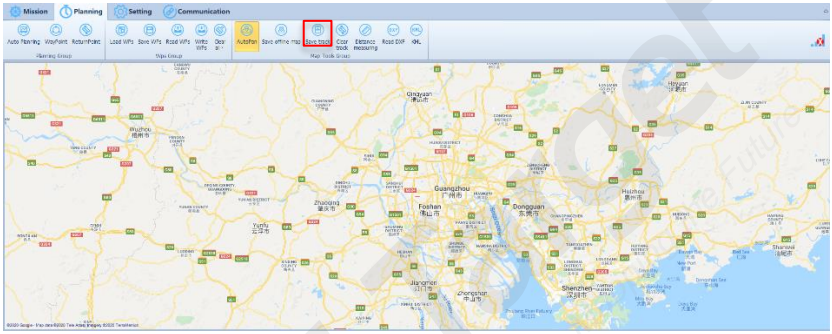


Figure 2-6-5 Planning interface

Firstly, enter the interface and select the *save track* button to get the current location of the USV.

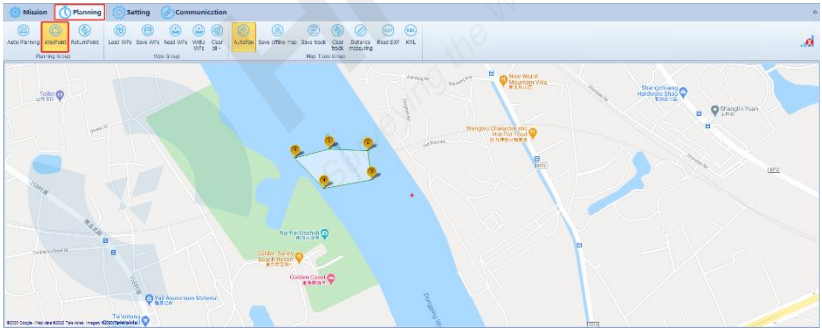


Figure 2-6-6 WayPoint setting

Label points can be added and edited by mouse, five label points are shown in the above figure, and then click the *Write WPs* and *Read WPs* in sequence from 1 to 5.

Back to the *Mission* interface and click the *Auto* button to make the USV sail automatically from 1 to 5.

Secondly, click the *Auto plan* button after you have planned the area where you want to survey. The software will automatically plan waypoints based on polygons. Then there will pop up a

dialog for you to set the parameters about the *angle, Span* of survey lines.

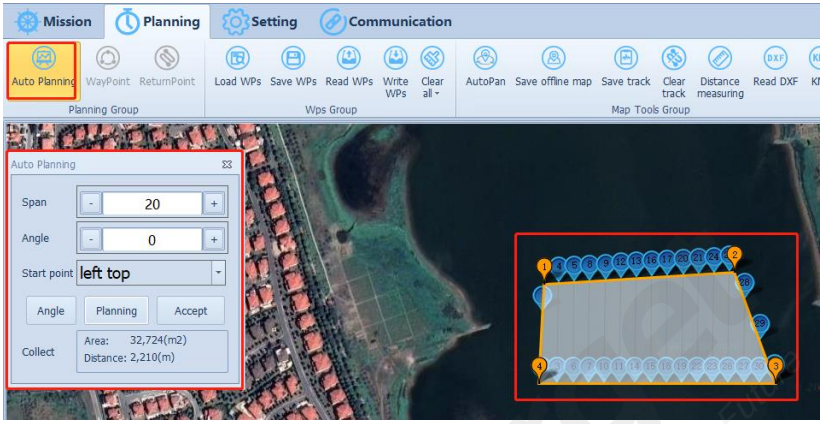


Figure 2-6-7 Survey lines parameters setting

Click *Write WPs* button → Then click *Read WPs* button (read the waypoint from the mission control system to ensure the operation of writing step is successful)

The route planning is completed to this step, back to the *Mission* interface, then click the *Auto* button , the boat will start cruise along the planned route automatically.

When the auto-pilot tasks along the planned route are completed, the boat status in the left of the main interface will show *HOLD*.

At this point, shake the mode switch button on the remote control, switch the mode to *Manual*, and control the boat manually to conduct guidance or other operations.

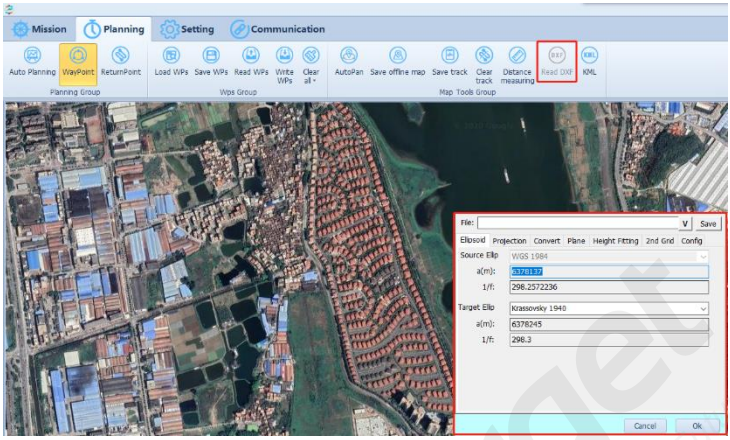


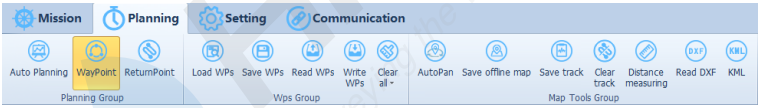
Figure 2-6-8 Auto cruising

In addition to this, there is a third route planning method: load the DXF file to generate the routes automatically.

Click the *Read DXF* button 

to import the DXF file and select the corresponding parameter conversion file or direct input. The route will be generated automatically.

Other Functions



- ***Load WPs***: Load the existing WayPoints file.
- ***Save WPs***: Save the planned WayPoints as a new file.
- ***Read WPs***: Read the saved WayPoints from the hardware.
- ***Write WPs***: Write the planned WayPoints to the hardware.
- ***Clear all***: Clear all of the WayPoints on the map.
- ***Save offline map***: Save the offline map of the WayPoints.

2.7 Preparation for Surveying

After planning the route, open the Hi-max software.

2.7.1 Coordinate Parameters Configuration

Input coordinate transformation parameters according to project requirements.

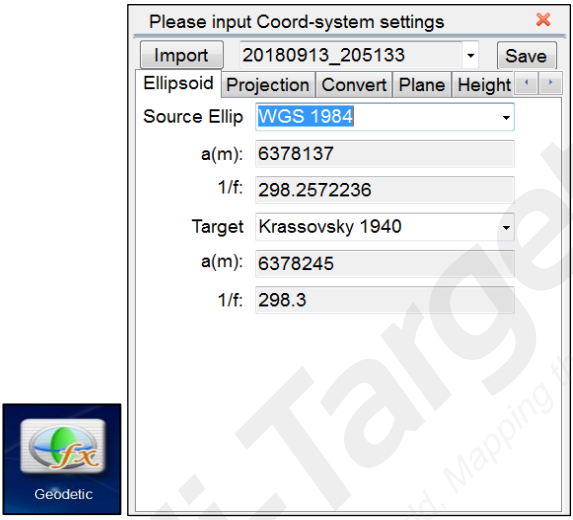


Figure 2-7-1 Coordinate parameters configuration

Configure the local ellipsoid coordinate system, projection and transformation parameters, etc.; then click the *Save* button and the set parameters will be saved in files. Then turn off the configuration window.

2.7.2 Boat Shape Design

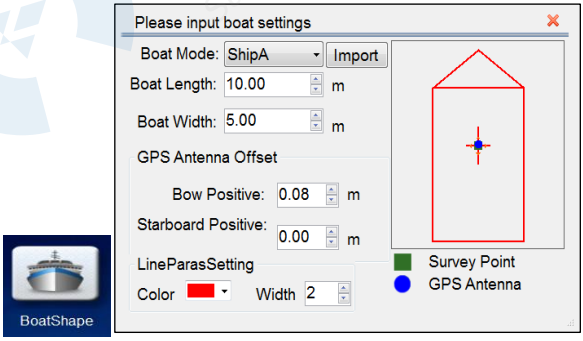


Figure 2-7-2 Boat shape design

GPS antenna of BS3 is 8 cm ahead of the transducer in horizontal position. Users need to input 0.08 in the *Bow Positive*. Since the antenna and the transducer are both on the boat's central axis, *Starboard Positive* value is 0.

2.7.3 Draft Setting

Open the *Survey* function in Hi-max. Click the *Sounder* button in the menu bar and pop up the configuration form about this surveying, as shown in figure 2-7-3.

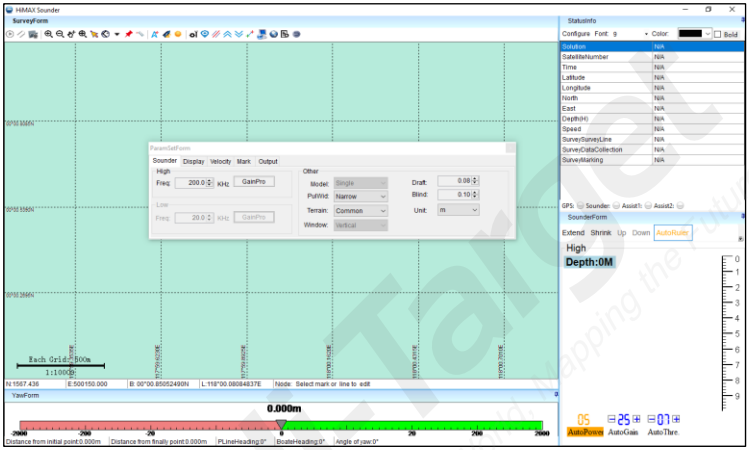


Figure 2-7-3 Sounder interface

The user needs to enter the draft value, and the recommended value is 0.08m for BS3.

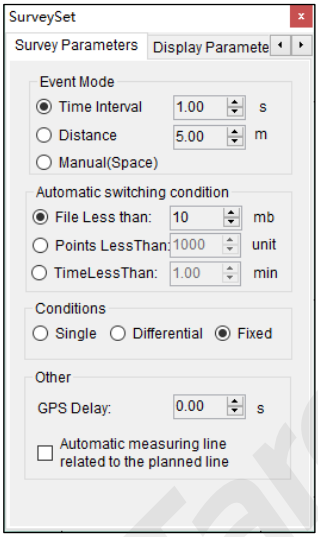


Figure 2-7-4 Survey setting

The RTK recording conditions can be selected in *Survey* on the title bar and the recording conditions are upward compatible. For example, if *Single* is selected, the single point solution and the above conditions (Differential and Fixed) are both recorded; when the Fixed is selected, only the data under the fixed solution status are recorded, and the differential and the single solution are not recorded.

2.8 Launch the Boat

Put the boat into the water at a suitable place, and then make the bow enter the water and then release the hull.

2.9 Surveying

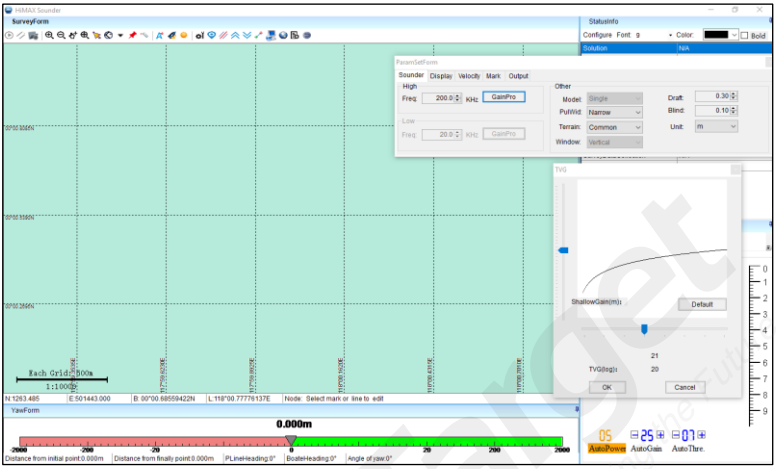


Figure 2-9-1 Survey configuration

Notice if the time, solution status, and water depth data in the *Statusinfo* bar are normal. The water depth data should be clean and no noisy wave in the display window. In most water conditions, there is no need to set *AutoPower*, *AutoGain* and *AutoThre*. When in special circumstances, such as in shallow areas, the user can adjust the gain and threshold manually. The higher the gain, the higher the echo amplification gain, the higher the threshold and the greater the filtering strength. For example, when the water depth is 0.6 meters, the gain value is recommended 25, and the threshold value is recommended 7.

After the above settings are complete, click the *Record* button in the upper left corner.

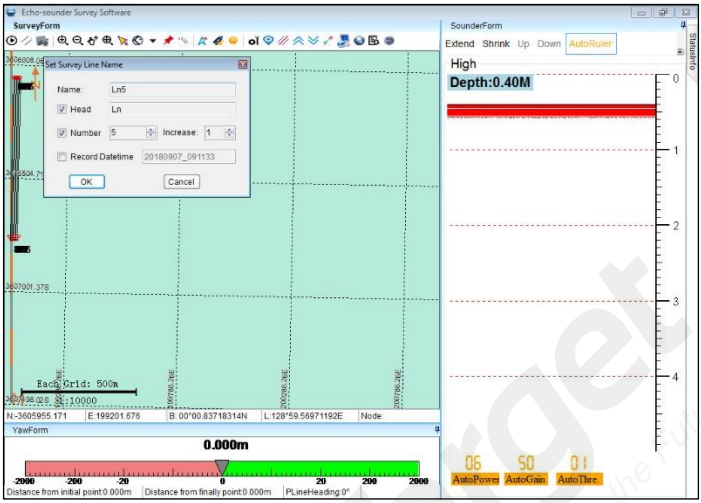


Figure 2-9-2 Survey Line setting

Enter the *Name* in *Set Survey Line Name* window and start data recording.

Open the iBoat GCS software, click *Start*, the boat starts to run and survey along planned routes, and the data are recorded simultaneously.

2.10 Stop the Recording

If users want to stop the measurements, just click the *Start* button again to stop recording.

2.11 Retrieve Boat

When retrieving the boat after surveying, drive the boat near the shore at a suitable place and turn off the power.

Note: First make the stern go ashore and then the bow. This is the opposite of the operation of launching the boat; finally, turn off the controller.

2.12 Data Post-processing

2.12.1 Sampling

Click the *Sampling* of Hi-max to get the operating interface, as shown in figure 2-12-1

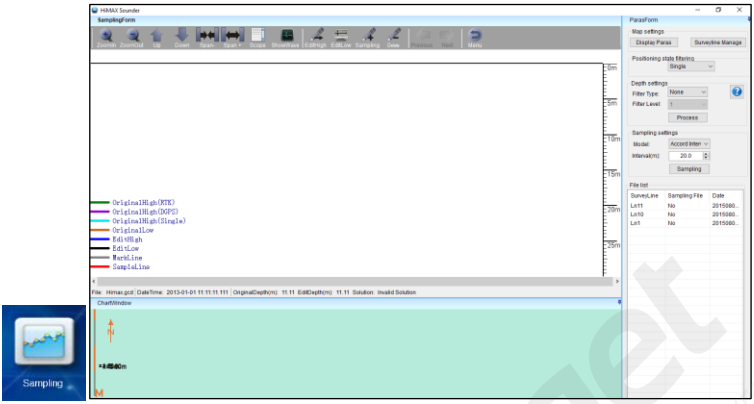


Figure 2-12-1 Sampling interface

Select surveyline in the *File list* bar and open it.

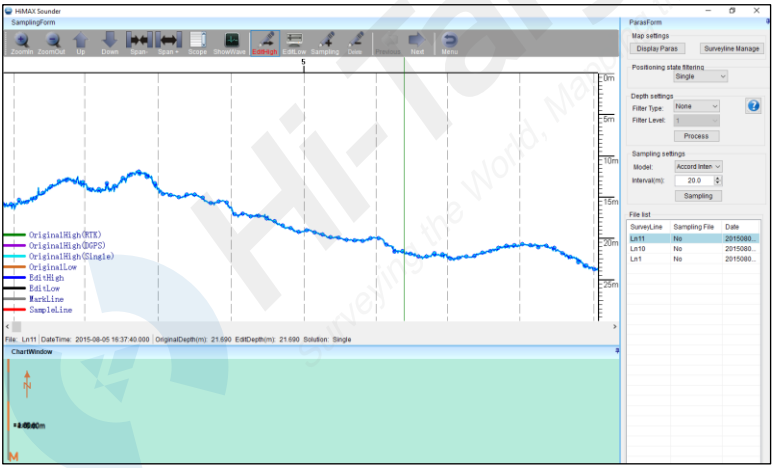


Figure 2-12-2 Sampling

This chart is a depth map without simulative echo signals. To judge whether the water depth is true or false, users need to click on the *ShowWave* button and then combine digital and simulative echo signals to assist judgment.

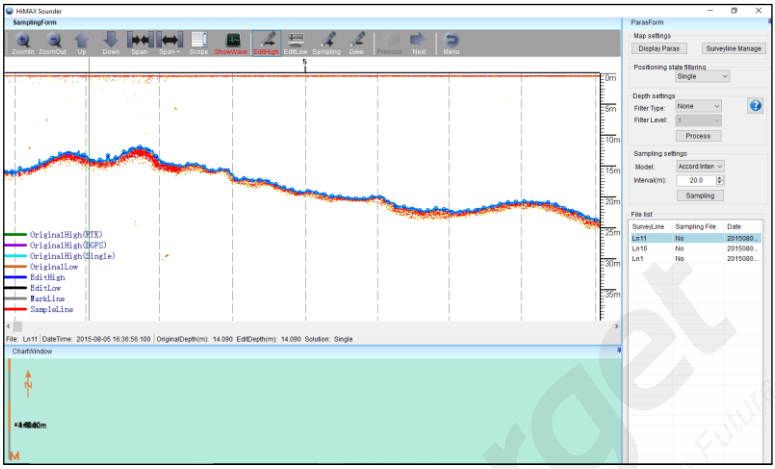


Figure 2-12-3 True or false depth judging

The red line is simulative echo signals, and the blue one is the digital water depth point. If these two match, the water depth is true and accurate. Then conduct the filtering. Hi-Max software provides three filtering methods. Users can choose anyone up to their needs. Experience tells us that the *Filter Level* is generally set below "3". Then click *Process* to finish this step. After filtering, most of the fake water depth has been processed, and then drag the progress bar below the wave display window to check the place where the blue line does not match the red line. If there is no match, users need to hold down and drag the blue line with the left mouse button to match the red one manually.

The next step is a sampling. There are two sampling methods for users to choose in *Sampling Settings*. If users choose the model, just enter a proper interval according to needs and then click *Sampling* to complete it. If there is a feature point between two sampling points that need to be extracted, click the *Sampling* on the menu bar; Users can use the mouse to extract this point manually.

2.12.2 Data Correction

Click the *Correct* button at the main interface of Hi-MAX and enter the following page.

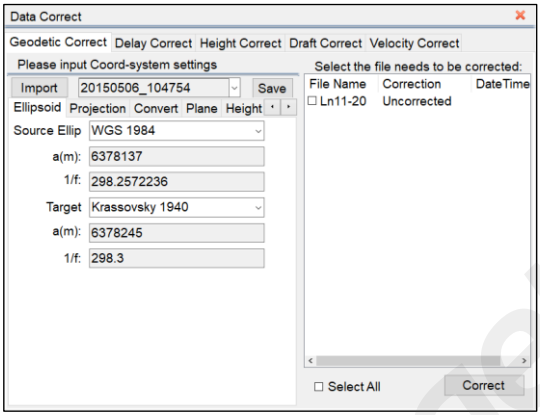


Figure 2-12-4 Correct interface

With this function, it can be corrected even if the parameters configuration in earlier measurement are not correct. Among them, the *Height Correct* is more significant.

- Delay correction

The *Delay Correct* is a correction for GPS resolution and data transmission delay. The impact of time delay on bathymetric data can be reduced by *Delay Correction*. The time delay value for the same set of sounding systems is fixed (sensors of the bathymetric system are unchanged), and the time delays vary from one sounding system to another.

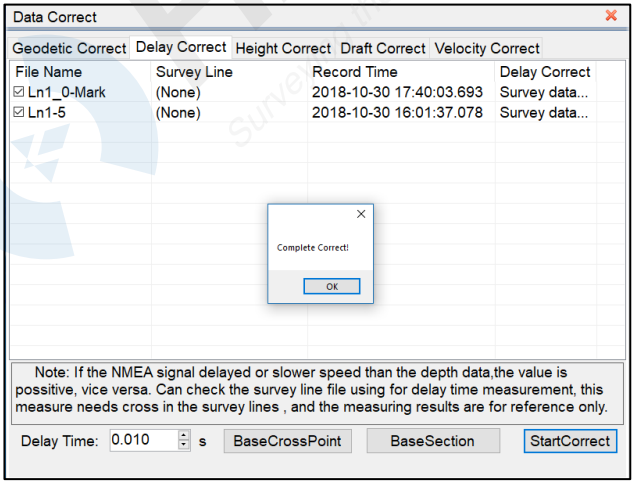


Figure 2-12-5 Correct interface

Enter the known *Delay Time* value or calculate the delay time by the *BaseCrossPoint* method and *BaseSection* method. Check the sampling file and select the corresponding line name. Click *Apply* to correct the file.

Acquisition of the time delay value:

1. If the time delay value is known, enter it directly in the text box.

2. If the time delay is unknown, users must test the delay value of this bathymetric system before or after construction.

- Height Correction

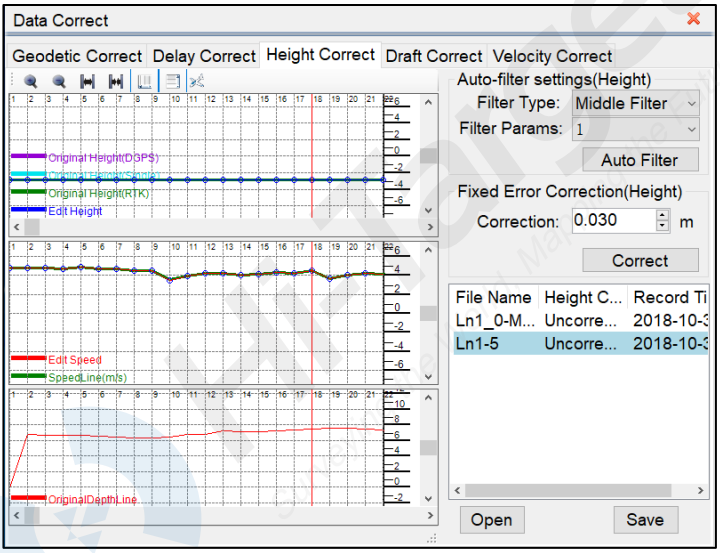


Figure 2-12-6 Height correct

Open a survey line and filter it. Similar to the *Sampling* operation, the blue line in the left frame is the water surface height. Because the water surface height changes are slight, especially in lakes, the water surface height is basically unchanged. The blue line fluctuates significantly, indicating that the data is inaccurate and the line needs to be flattened with the mouse. After the processing is completed, click *Save* and the processing is completed.

The *Height Correct* has three windows, namely the height line window, the velocity line window and the water depth line window. The height line and the velocity line both include the original line and the editing line. To facilitate user identification, the editing line has a solid circle filled

with different colors for the non-fixed solution, and the fixed solution is a hollow circle. The original line is represented by a different color for different solution states.

Velocity editing is used to solve the GPS slip problem. When the velocity is skipped, the user only needs to manually adjust the velocity editing line. The software will judge for any sign of cycle slip, and edit for it automatically. The GPS slip is generally caused by the satellite loss of the receiver or the abnormality of the network communication, and the obtained positioning state are the single, DGPS or other solution status. If the slip happened, there will be a sudden change in the velocity line. The software determines whether it is a slip point by the sudden change of the velocity and the solution state of the current point.

- Draft correction

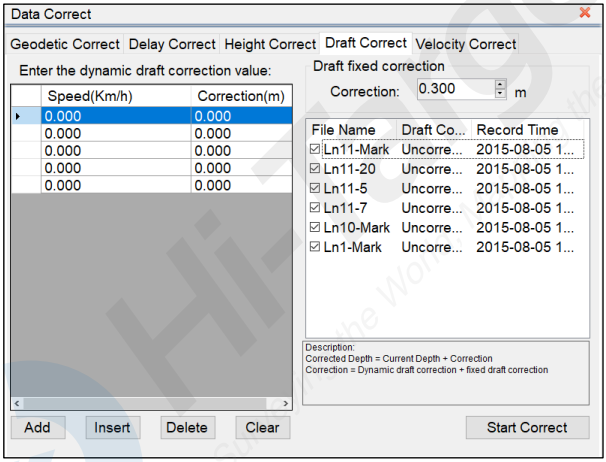


Figure 2-12-7 Draft correction

First, set the correction value, click *Add* to add a row of data, input the speed and the corresponding correction value; click *Insert* to add a row of data, click *Delete* to delete a row of data, click *Empty* to clear data. If users choose Draft fixed correction method, you can enter the value to correct the draft.

- Sound velocity correction

There are two ways to correct the sound speed: *Depth + Correction Value*, *Depth + Velocity*. Take the second method as an example:

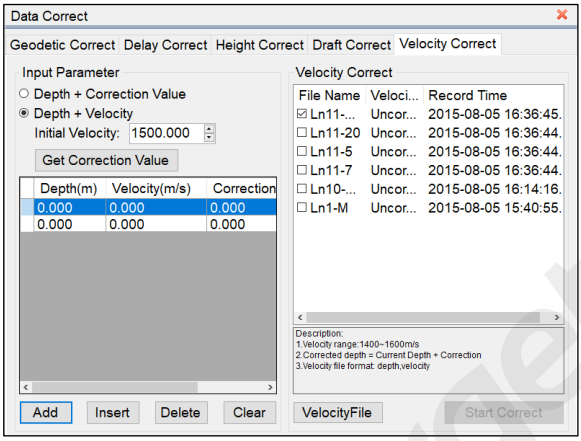


Figure 2-12-8 Depth+Velocity method

Specific steps are as follows:

(1) Import the velocity file, the file format is as follows:

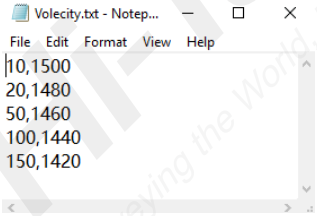


Figure 2-12-9 Velocity file

The first column is depth, and the second column represents the sound velocity.

(2) The imported file will appear in the list:

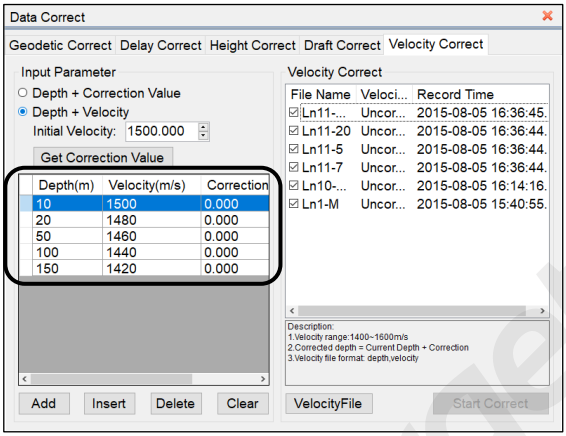


Figure 2-12-10 Import velocity file

(3) Input the *Initial Velocity* set during measurement, and click *Get Correction Value* to calculate the correction value of different sections according to the velocity of different depths:

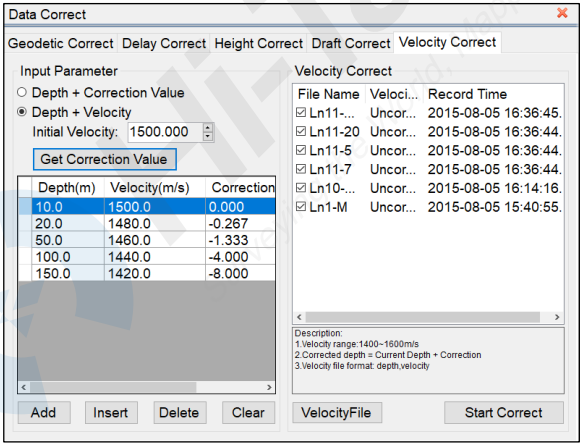


Figure 2-12-11 Get the correction value

(4) Check the files to be corrected, and click *Start Correct.*

2.12.3 Results View

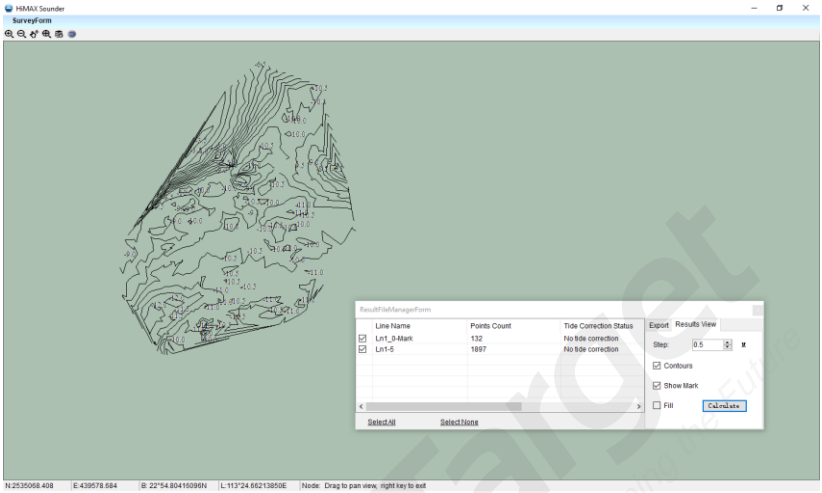


Figure 2-12-12 Export line

Select one survey line, click *Export* to export the data format users need.

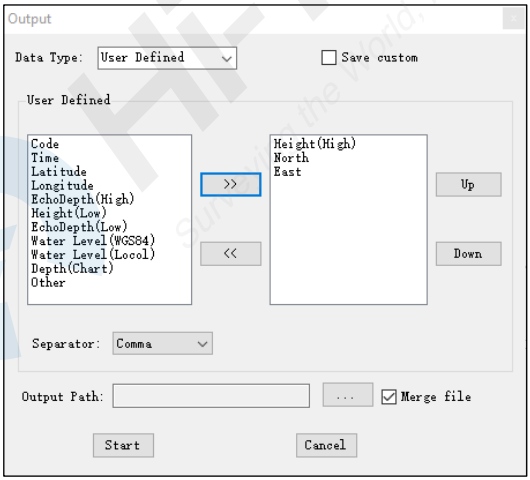


Figure 2-12-13 Export format choosing

Hi-MAX supports a variety of data format outputs, if users want to customize results, select one item in the left column, click the arrow sign pointing to the right, and this item will show up in the right column, it will be exported after. Likewise, select the items in the right column, click

the left arrow sign pointing to lift to delete. Then select the export path, after confirming, click *Export* or choose *ResultView*

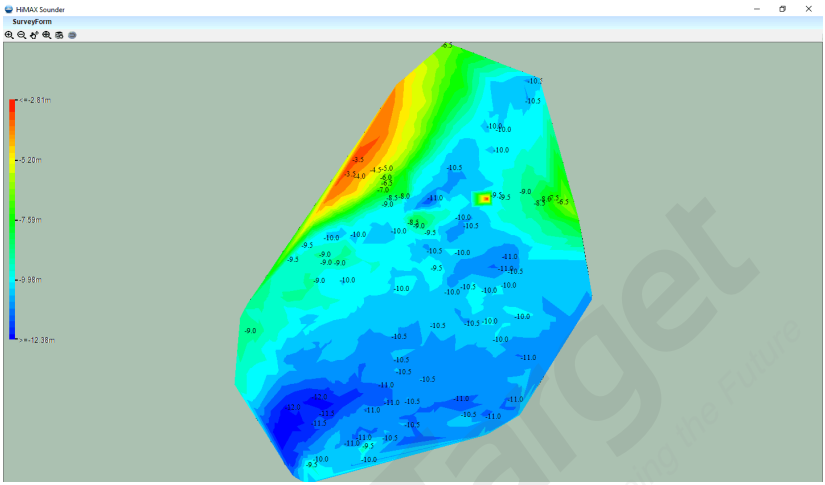


Figure 2-12-14 Result View

Select a proper interval for the contour map. Select the contents that need to be displayed and the underwater topographic map above can be generated.

Appendix 1

Table1 iBoat BS3 Item List

NO.	Item	PCS	Description
Boat-borne System	BS3 Hull	1	
	Propeller System	2	
	Power Supply System	1	Including charger & External charger
	Boat-borne Receiving Antenna	3	Including two 5.8GHz and one 2.4GHz transmitting antenna
Software Dongle	Ground Control System(GCS)	1	
	Hi-MAX Echo Sounder	1	
Ashore Base System	Intelligent Controller	1	Including 1 internal battery and charger
	IBoat GCS Software	1	
	Ashore Wireless Bridge Base	1	
	Base Battery	1	Including charger
	Ashore Station Antenna	1	5.8GHz transmitting antenna
	Network Cable	2	Including one cable
Professional USV Echo Sounder	HD-510 USV Echo Sounder	1	
	High-frequency Transducer	1	

Positioning Device	V90Plus GNSS Mainframe	1	
	GNSS Antenna Cable	1	
	Differential Antenna	1	
	Extendable Pole	1	
Case	Controller case	1	
	Hull Packaging Aviation Case	1	