



RELEASE NOTES

NAVISUITE KUDA CORE 4.6.2

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1 Release notes NaviSuite Kuda Core 4.6.2

The NaviSuite Kuda Core software version 4.6.2 is a minor release of the NaviSuite Kuda software which mainly consists of the acquisition part of EIVA's high-end solution for hydrographic survey acquisition and processing.

NaviSuite Kuda Core 4.6.2 includes some new features for utilising the **NaviSuite Kuda Autopilot** - this is highlighted in section 6

1.1 Formatting convention

Items formatted in bold are properties, buttons or other elements in the **NaviSuite Kuda Core** software.

2 Configuration

The setup of the instrumentation is done in the application named **NaviSuite Kuda Core Config**.

The setup is limited to a single object operation with all sensors mounted on a vessel where the position comes from the final positioning system, and there is no support for relative positioning systems. The setup is thus suited for single manned vessel and USV operations.

The setup is furthermore limited to navigational input and MBE/Laser data as well as control of standard autopilots.

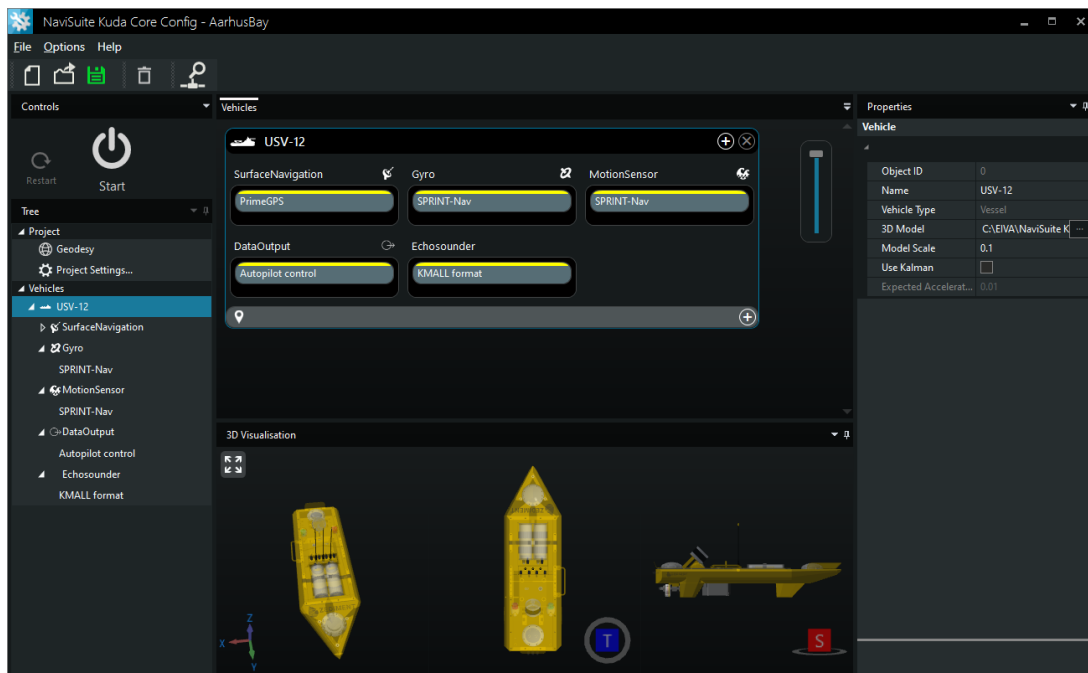


Figure 1 NaviSuite Kuda Core Config

The configuration program is based on the same framework as NaviPac 4 and consists of 5 views:

- The vehicle view
Show the content (instrument listing) of the setup in a grouped map listing – Use single click to select an item or right click to act on it
- The tree views
Show the content (instrument listing) of the setup in a hierarchy tree listing – Use single click to select an item or right click to act on it
- The properties view
Shows a series of parameters to define/edit for selected item
- The 3D visualization view
Shows a 3D drawing of the vessel with markings for each instrument – Drawings can be used via 3DS file format
- The operation control
Start/stop survey operation

2.1 Instruments & drivers

To add new instrument to the listing please press the Plus button in the Vehicle view:



Figure 2 Add new instrument

- Surface navigation
Base position of the vehicle by e.g., GNSS, GPS, SPRINT-NAV, Phins and similar solutions giving final position as XY or latitude/longitude
- Gyro & motion sensor
Vehicle orientation and heave
- Bathy
Height of vehicle from e.g., GPS or similar
- Echosounder
Multi-beam echosounder like Teledyne Reason, R2Sonic, Kongsberg, Norbit and many others
- Laser scanner
Above water LiDAR from eg Velodyne, Ouster, Quanergy-M8 and Dynascan

- Sidescan
MBE backscatter
- Data output
Output to autopilot, IxBlue USV status, nadir depth information and similar

The other samples in above image are not supported in **NaviSuite Kuda Core**.

Details for the various instruments are defined in the properties window, where you among others define IO Settings, offsets, calibration and mounting information.

2.2 Geodesy

NaviSuite Kuda Core is working in grid coordinates (Easting/Northing), so it is important to define the geodesy and datum. This is done from the Tree view, where you can click the **Geodesy** globe icon and then edit settings in the property list:

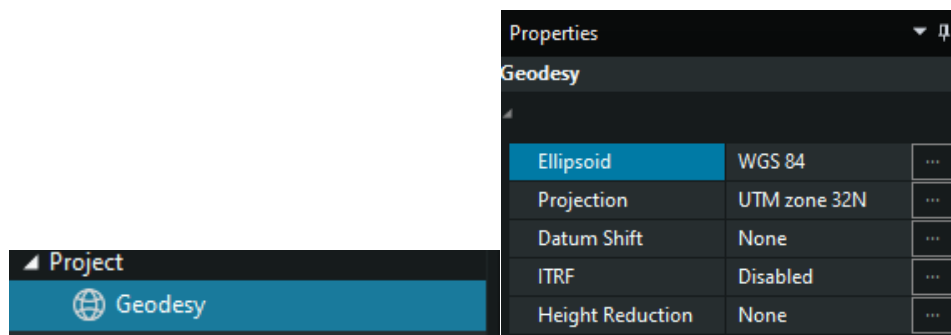


Figure 3 Geodetic settings

Projection and ellipsoid (the datum) can be defined either using EPSG look-up or entering definitions manually:

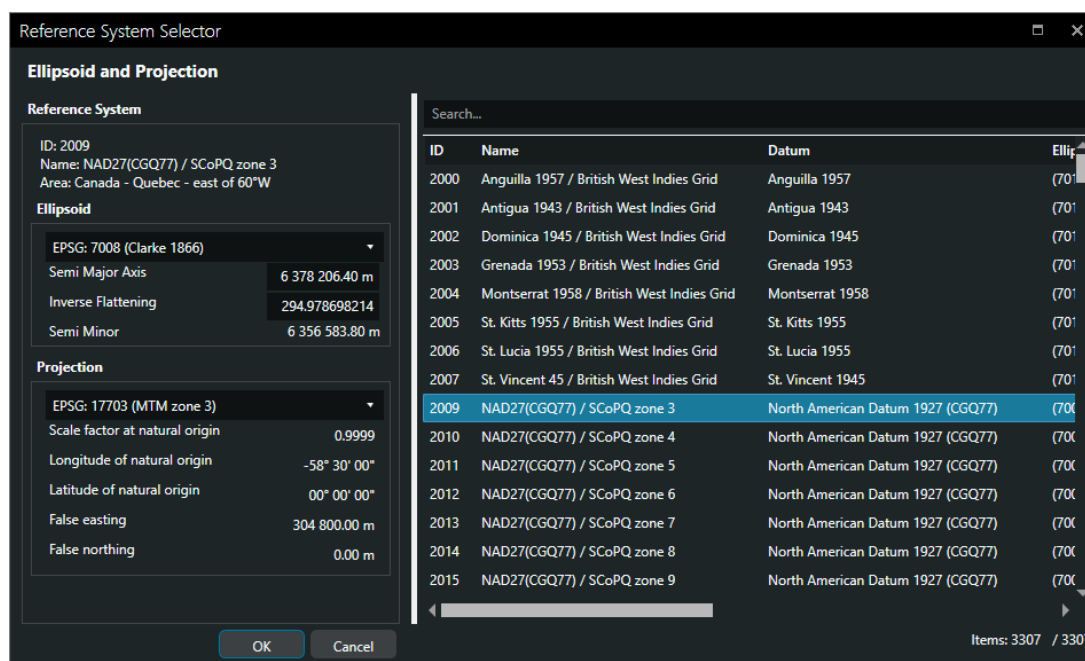


Figure 4 Geodesy setup using EPSG database

For further information please refer to the EIVA help page: [Geodesy : EIVA Support \(freshdesk.com\)](https://freshdesk.com/Geodesy-EIVA-Support)

2.3 Project settings

Besides the detailed instrument settings, there are some project related settings you need to address. This is done via the **Project Settings** item in the Tree view.

The **Project Settings** are grouped into some different tabs, please note especially the **Logging** part and the **System Parameters**.

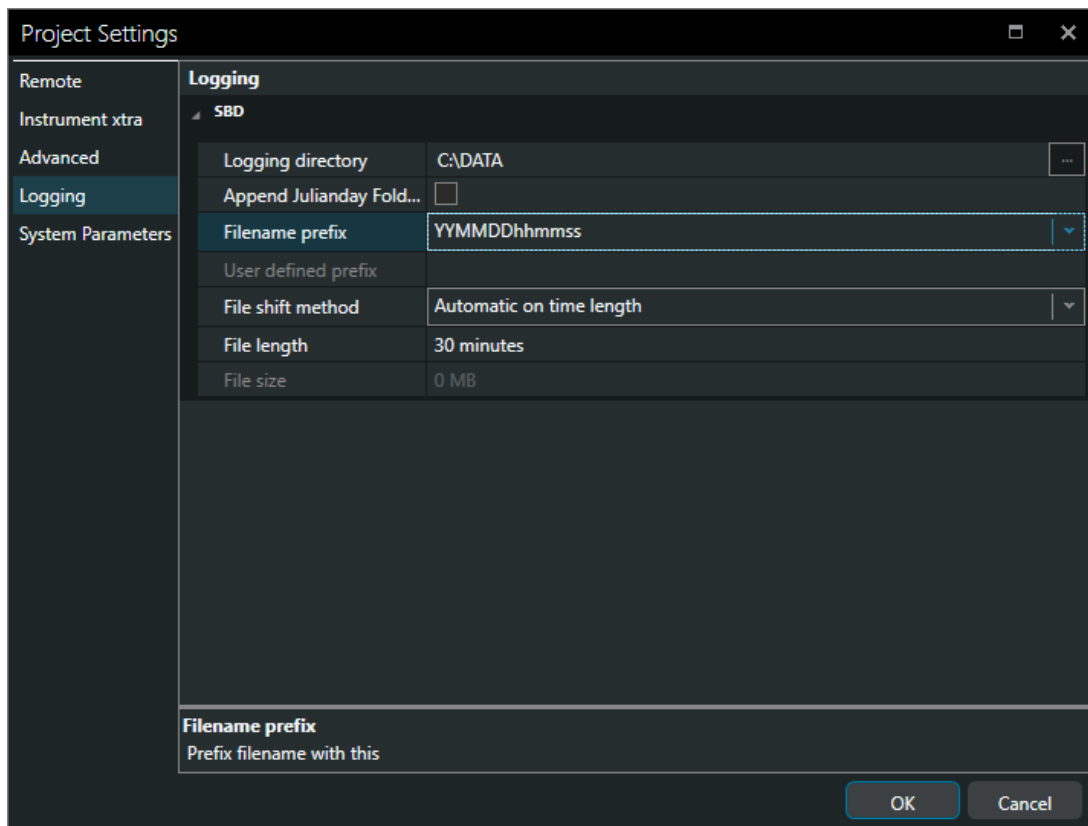


Figure 5 General project settings

2.4 Configuration file

The configuration is saved in a single file called <name>.NSP. The file is ASCII XML and you can save them wherever you want. A copy of an NSP will include the entire setup.

2.5 Starting the survey

You can start the survey operation either by using the **Start** button in the configuration program or by starting the Kuda Core application.

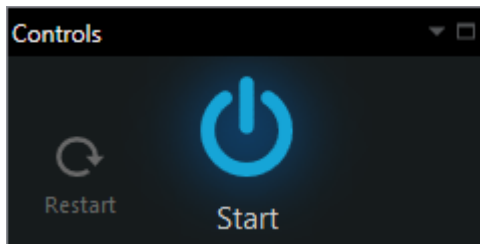


Figure 6 Starting/stopping a survey

3 The Kuda Core application

NaviSuite Kuda version 4.6 is built upon the same framework as NaviModel and NaviPac Helmsman's Display, so you will recognise the general behaviour from those modules.

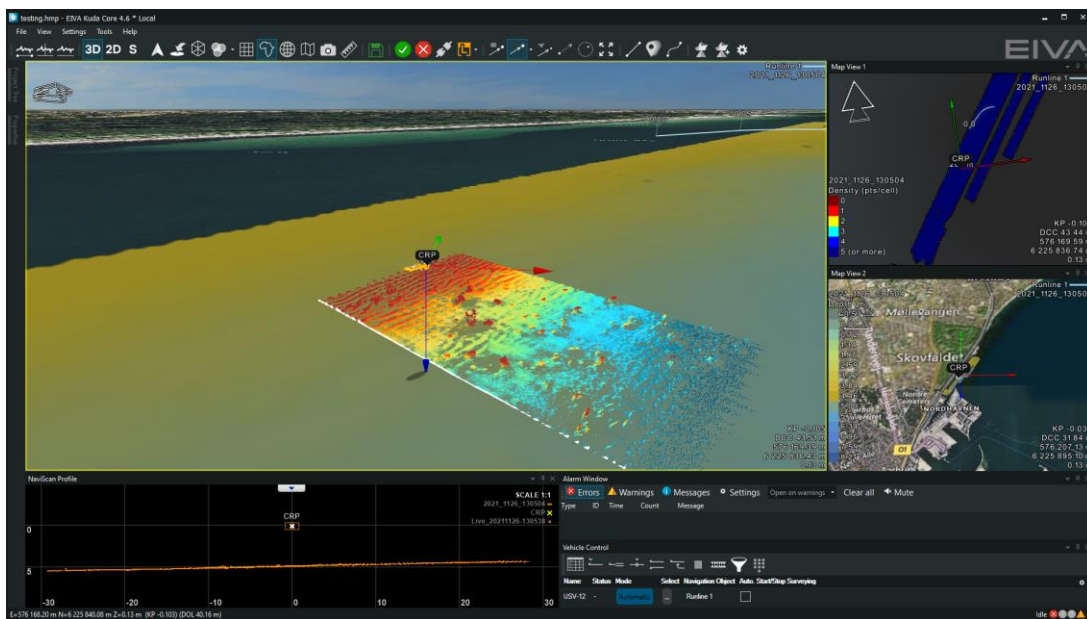


Figure 7 Sample NaviSuite Kuda display

The NaviSuite Kuda application receives data from the interfacing and recording module (NaviScan service) and enables you to monitor data as well as controlling the data recording and some sonar settings.

3.1 Views & data

The NaviSuite Kuda application includes a series of data views. Some are opened by default when starting the program for the first time and others will need to be opened from the **View** menu.

Data will be received from the recording application as sensor data (position, gyro, roll, pitch, heave, height) and multi-beam data (XYZ data points and Laser XYZ data points).

Multi-beam data and laser data can be display as point cloud data (just showing the raw data points) and this can be shown on one or more map views. Point clouds are typically colour coded by depth information or data intensity (for laser only) and for practical usage only a few million points are shown live.

Data from multi-beam can furthermore be saved as a terrain model (DTM) as known from ie NaviModel. DTMs can be as big as you require, you simply specify cell size and what you want to include in the model (average depth, min/max, density, standard deviation etc); typically the most important quality indicators.

The primary data views for sonar and laser data are the map views.

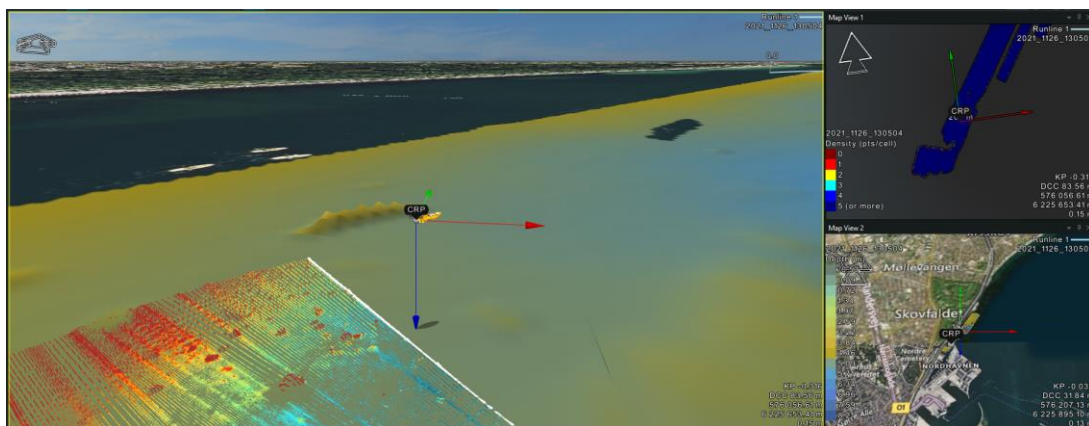


Figure 8 Map views

You can use multiple maps as illustrated above where we have one showing point clouds and depth DTM (left), another one giving data density (upper right) and finally an overview with background information from Bing and a DTM together (lower right).

You can use a 2D or 3D drawing of your vehicle showing real scale information as you go. For example, 3DS, STEP, OBJ files can be used:

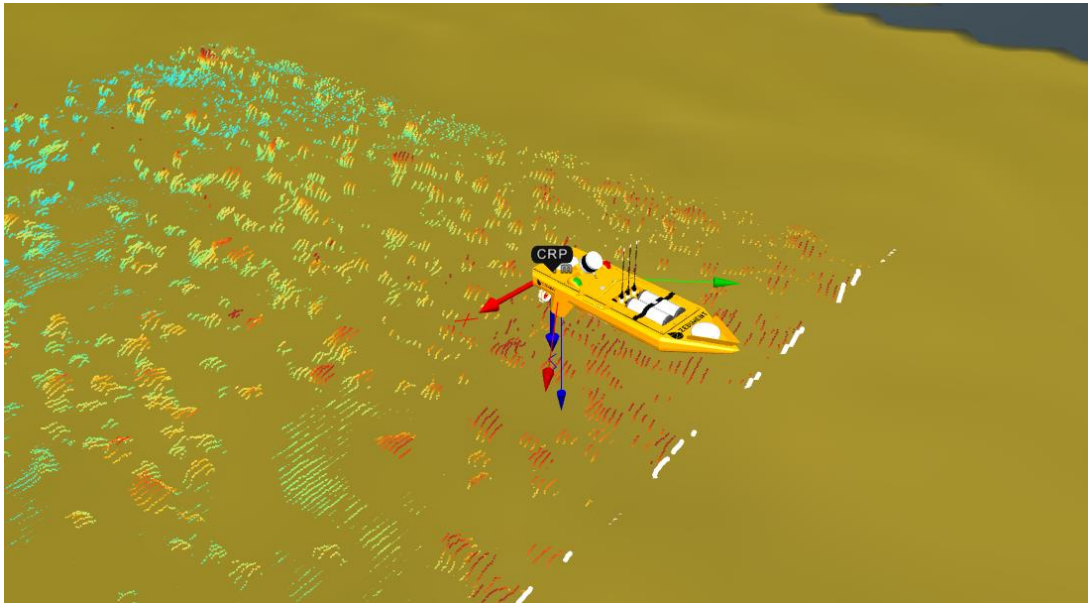


Figure 9 Map views – point cloud and DTM

The software also includes a profile view, where the most recent raw sonar/laser data scan will be shown, this is named NaviScan Profile. Aside from showing the raw scan it is also possible to display historical data from DTM in case you are passing over an already surveyed area. This provides a very good overview and quality control of your data. Enabling/disabling data in the view is done by right clicking your mouse.

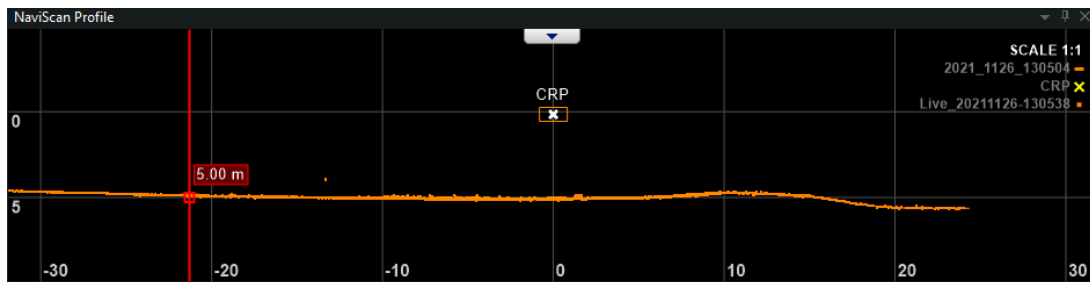


Figure 10 NaviScan profile

The main purpose of the Kuda Core setup is to provide data recording. This can be done in two ways: either manually using the toolbar Start/Stop and file-change buttons:



Figure 11 Kuda logging control

... Or, it can be done using runlines and waypoints – see also [Runlines & waypoints](#). For this use the main window is the Vehicle Control where you assign runlines or waypoints to the vehicle.

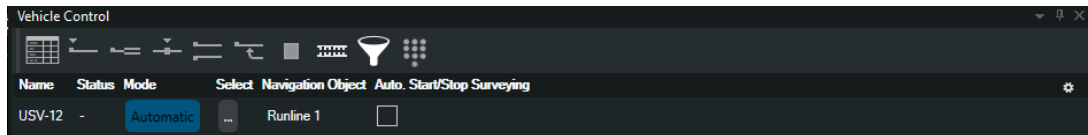


Figure 12 Vehicle control

Another useful view is the alarm window – where system and sensor quality alarms and messages will be displayed.

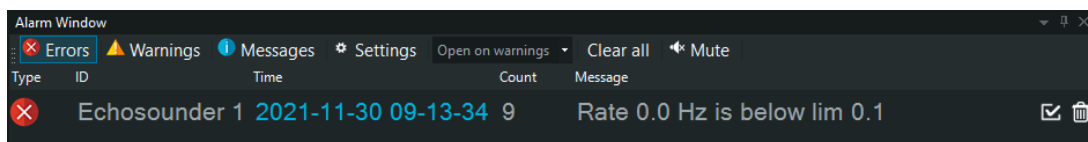


Figure 13 Alarms and messages

Finally, there are two data views available – displaying incoming sensor and navigational data as ASCII values as well as data graphs.

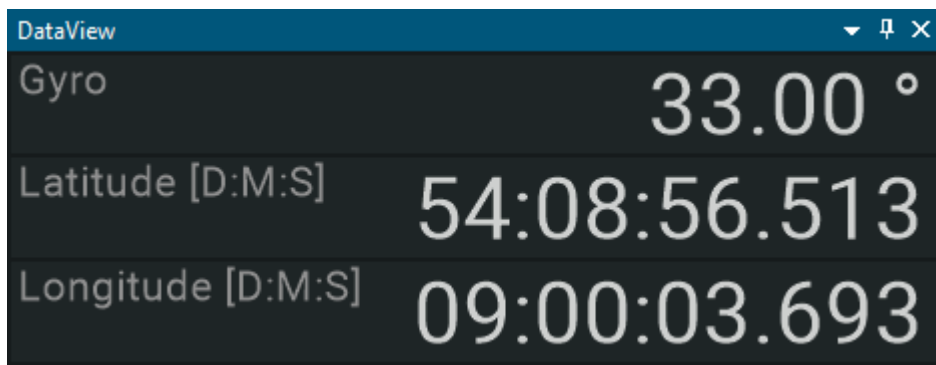


Figure 14 ASCII data view

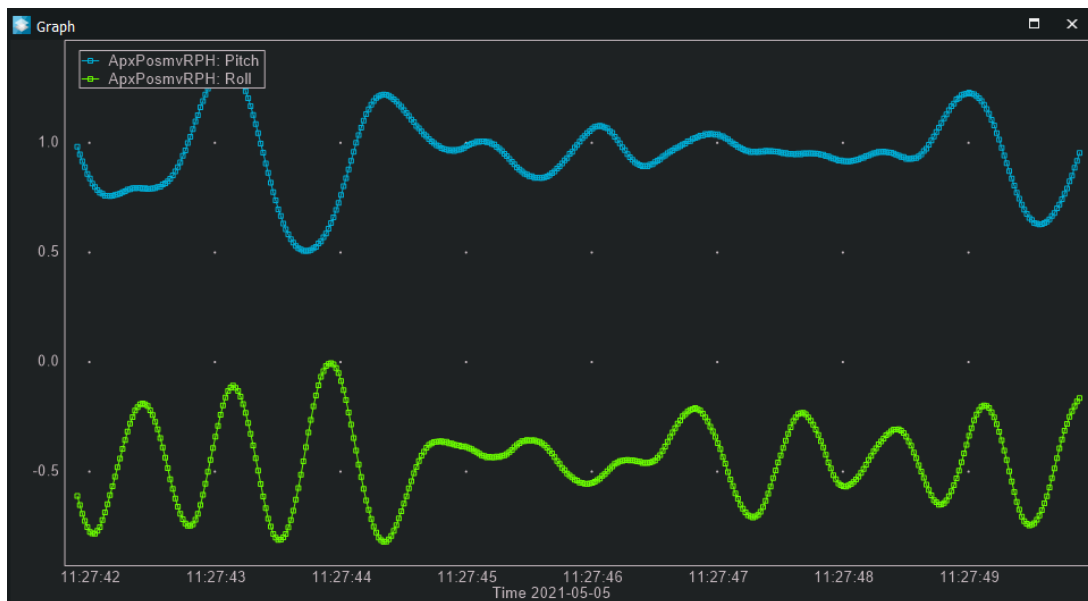


Figure 15 Graphical time series view

3.2 Real time data cleaning

Besides generation of a DTM based on the raw MBE data, it is also possible to perform real-time data cleaning using the EC-3D tool.

As in NaviModel, it is possible to define one or more cleaning sets from the EC-3D tool-box. In Kuda Core it acts as a sequential cleaning operation as illustrated in the below illustration, where three different tools are used in combination.

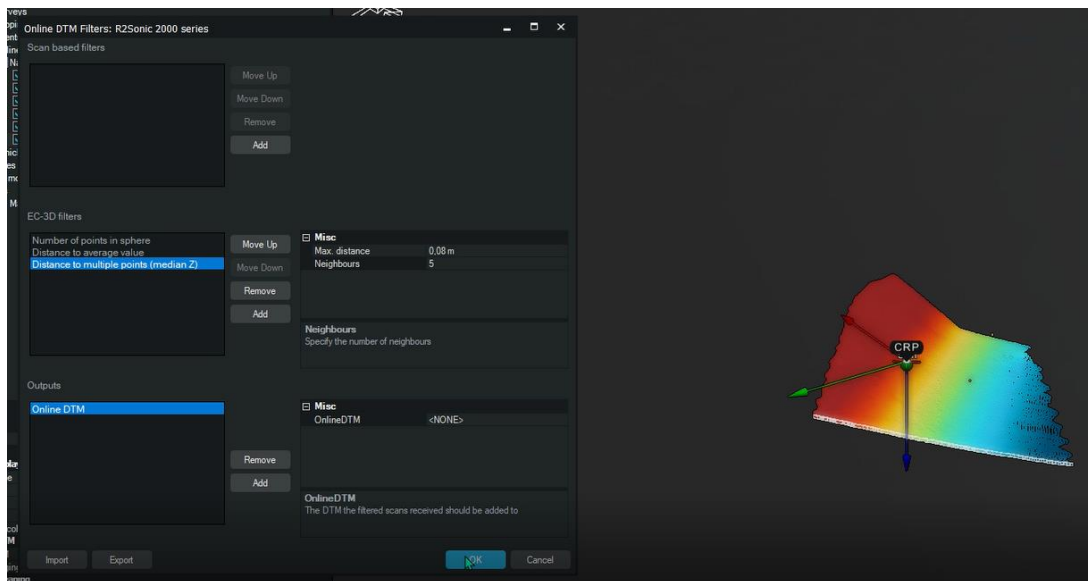


Figure 16 Defining a set of EC-3D cleaning rules

The result will be saved in the terrain model shown on the Kuda Core map view. It is important to remember the flexibility in the EIVA DTM handling, as it allows you to see the DTM in different ways (colour modes). This means that you can see both cleaned and uncleaned surfaces simultaneously.

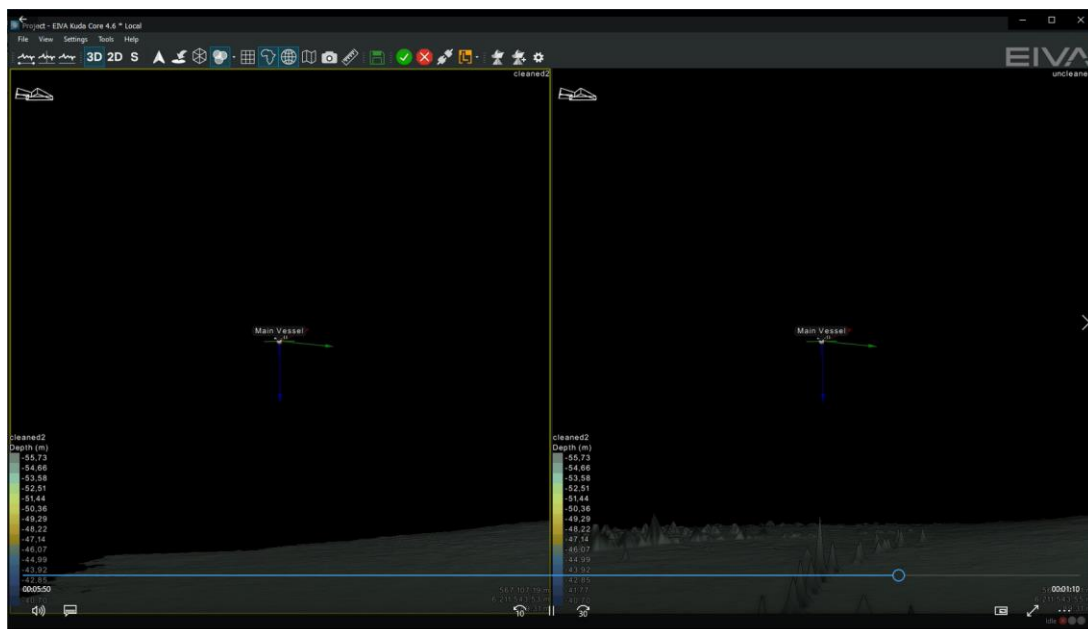


Figure 17 Cleaned (left) and raw (right) data view

Please note that the terrain model generated in NaviSuite Kuda can be directly used in NaviModel and the cleaning result can be re-used during processing in NaviEdit/NaviModel.

The data cleaning will also help improve the automatic runline planning (Coverage Assist) discussed in the next section.

3.3 Coverage Assist, runlines & waypoints

The first option to manage survey control is by using waypoints or runlines. They can either be imported from ASCII files or defined by using the **Create** toolbar:

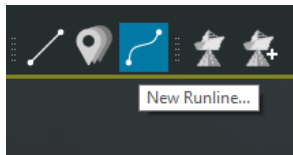


Figure 18 Runline and waypoint creator

Waypoints are simply defined by clicking on the map where points need to be created – one by one. Runlines are defined by drawing lines and curves on the map. Input you can control by inputting an arc radius defined by how fast you expect the vessel to be able to turn.

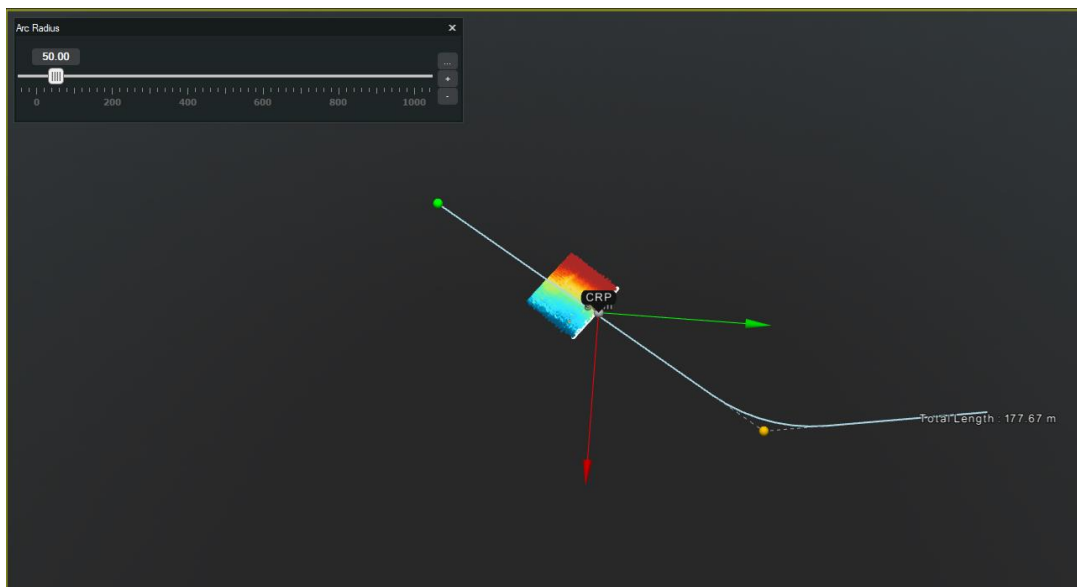


Figure 19 Creating runline

You can also define cross lines, parallel lines etc. Please refer to software FAQ [Support : EIVA Support \(freshdesk.com\)](#) or [eLearning](#) for details.

Having created or loaded the line, next step is to use it. A line can be active in two levels:

- Navigating
The runline is selected and NaviSuite Kuda calculates distance to the line (DCC) and can send the information across to an autopilot – but no data recording takes place
- Surveying
The runline is now active and data will be recorded

To start navigating you select the line or waypoint in the **Vehicle control** either by using the small selector button (...) or by using the map view.

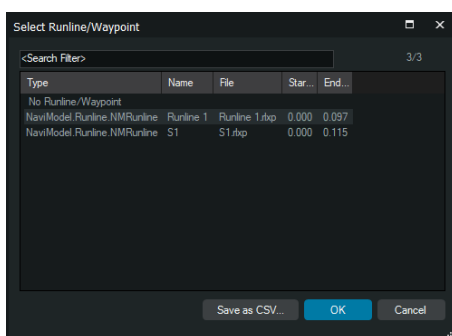


Figure 20 Runline selector list

The selector list can be rather big if you have several lines, cross and parallel variants, in which case it is preferable to use the map view where you can single click on the runline on the map. The name will now automatically be copied to the selector button in the Vehicle control. Then simply press the name.

The runline will now change status to navigating.

Next step is to start the survey. It can either be set up automatically when entering the line (vessel reaching start of line) or manually by simply using the **Start line** button:

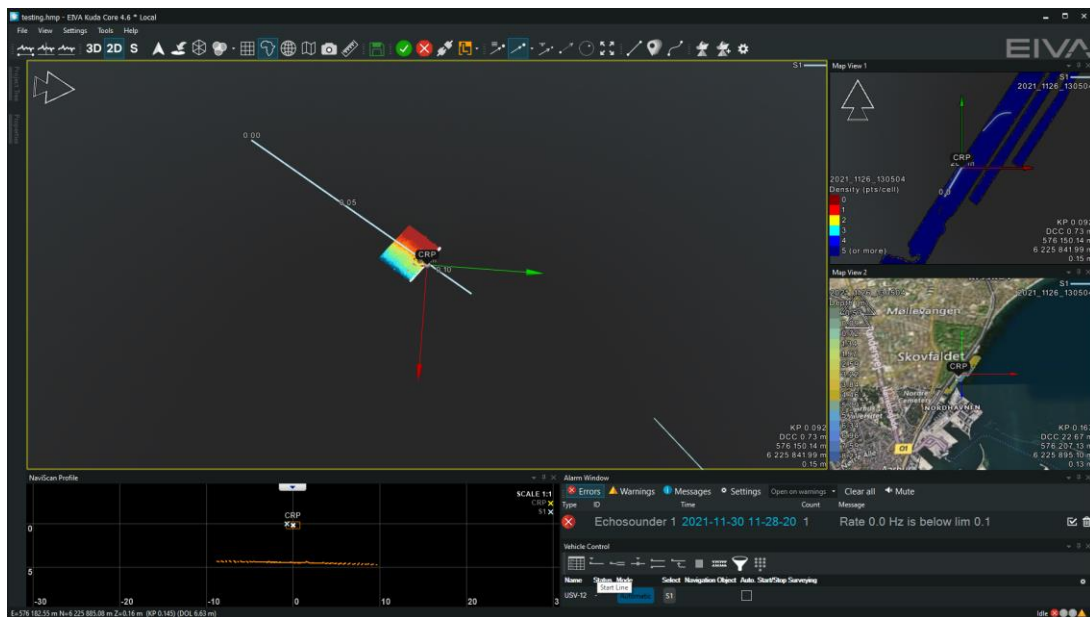


Figure 21 Starting a line

Kuda Core also supports the use of high-level lawn mower pattern planning tools. To use this, create a survey boundary using digitized line or similar, right click on the line and choose **Lawn Mower**.

Create Lawn Mower Pattern in Area57

Name: Lawn Mower Pattern

Distance between lines: 4 m

Angle: 0

Turn radius: 50 m

Turn Inside Boundary: ☒

Speed: 1 m/s

Output: Digitized ... **Runline**

Split: ☐

Runline

Start KP: 0 KP

End KP: 1.3 KP

Exclusion Zones

Offset for Exclusion Zones: 0 m

Result

Total Distance: 1301.45301322095 m

Total Straights: 45

Total Time: 0:21:41.453

OK Reset Cancel

Figure 22 Defining Lawn Mower pattern

For the pattern you must define line spacing, line direction and turn radius (how fast can the vessel turn) – and the result can be delivered as runline or a simple digitised line.

Lines can be defined using inner or outer turns and the result can be given as 1 continuous line or split into lines operated one by one.

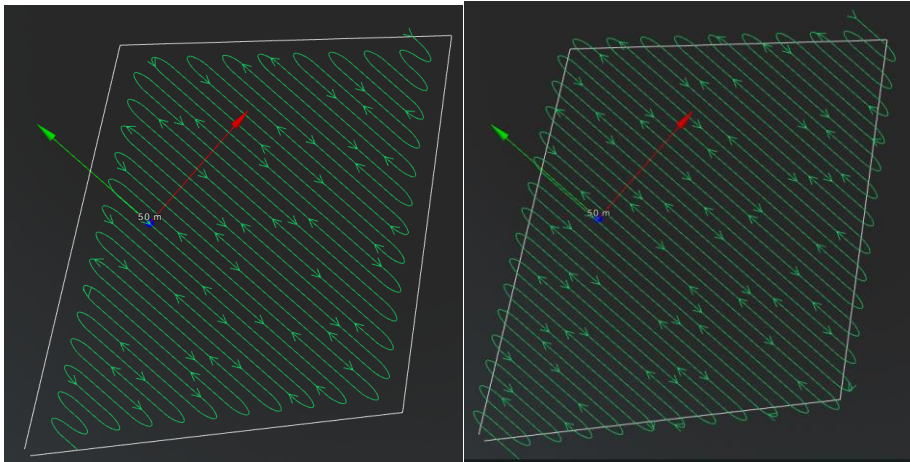


Figure 23 Continuous line with inner and outer turns

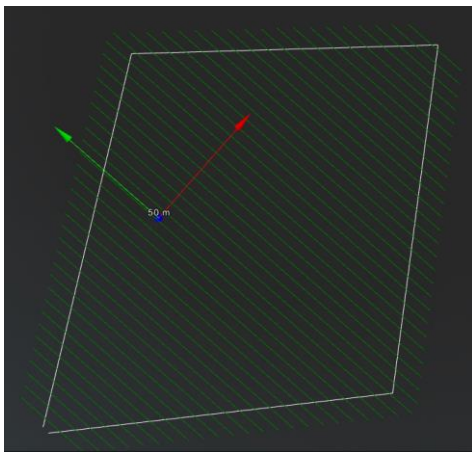


Figure 24 Segmented line (split) with outer turns

You may also create exclusion zones in the lawn mower pattern by defining inner areas as exclusion zones (right click and define attributes).

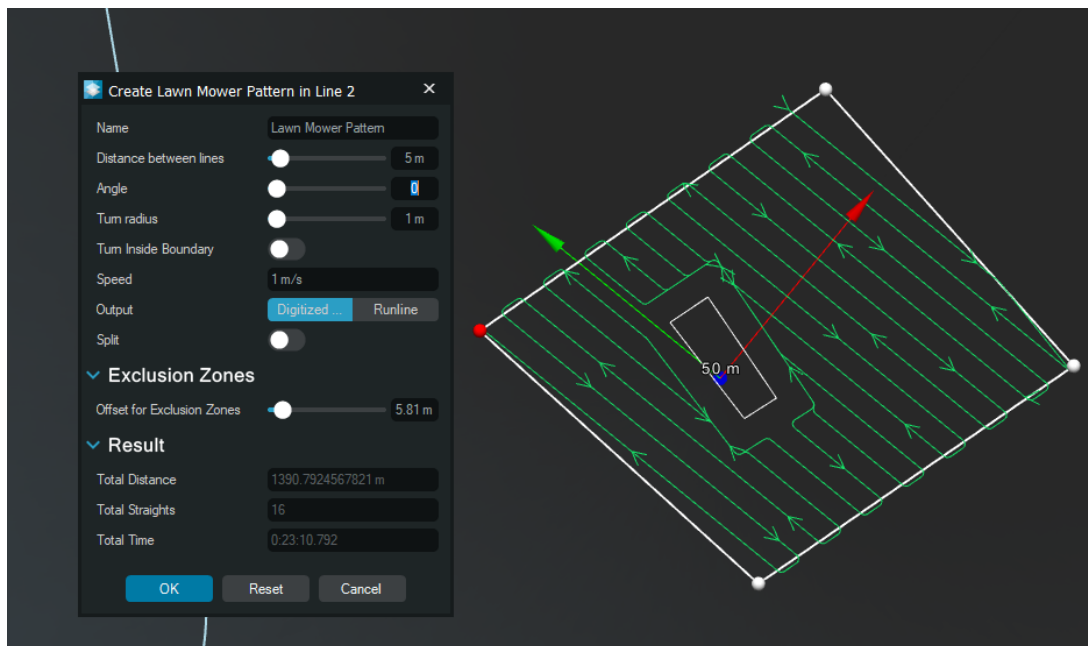


Figure 25 Pattern with exclusion zone

This is the traditional survey by planning method, but we will in many cases recommend the use of the automatic route planning (Coverage Assist). With Coverage Assist, NaviSuite Kuda Core uses the collected data to automatically define the optimal next line as well as run-in routes.

This is all controlled via the Coverage Assist toolbar.



Figure 26 Coverage Assist toolbar

The Coverage Assist tool has a number of parameters to help generate runlines according to different situations.

The sampling detail describes how closely related to the DTM edge it must be, low detail means it is much smoother than the actual edge, and high is very closely related.

The edge can then be smoothed further by smoothing the line. The number defined in the **Smooth line** category is the number of times the line is smoothed.

The suggested line, shown as a green line, is where Coverage Assist is preparing to place the new runline, and it is determined by the opening angle of the sonar, the overlap wanted, and how many times the line should be smoothed.

Coverage Assist can avoid exclusion zones, but to not cut corners, it is wise to give the coverage assist an offset from the exclusion zone.

The **Creating runline** section gives Coverage Assist some details on how to create the lines, using the **Vessel turn radius** and how much the new lines should **Extend runline outside boundary**. By extending, you give Coverage Assist some time to create the new runlines and it is recommended to improve the results.

Properties	
General	
Visible	True
Name	CoverageAssist
Information	
GUID	1b845256-9efe-4cec-84c3-019de29f64bf
Coverage Assist	
Vessel	simulatedNaviScan Vessel
Boundary	Line 1
End Point	<NONE>
Update interval	20 sec
Creating runline	
Connect Runlines with Arcs	True
Extend runline outside boundary	0.00 m
Vessel turn radius	10.00 m
Edge line	
Sampling detail	Low
Smooth line	
Smooth	20
Suggested line	
Sonar Z offset	0.00 m
Opening angle	90 deg
Overlap	0.00 m
Smooth	10
Exclusion Zone Strategy	Edges
Offset From Exclusion Zones	10.00 m

Figure 27 Defining Coverage Assist

NaviSuite Kuda will then use the MBE data (DTM) to calculate a smooth boundary of the current survey (yellow line below) and based on overlap requirements, it will generate the next line (green line). This will give the optimal survey pattern and decrease risk of not achieving the desired coverage..

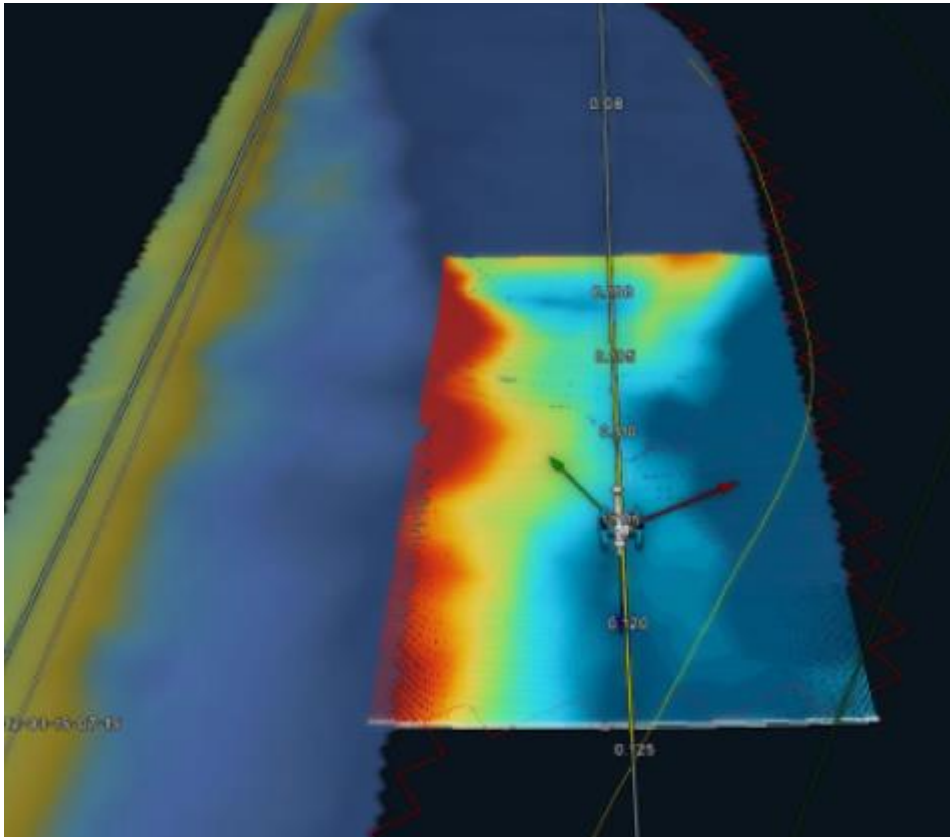


Figure 28 NaviSuite Kuda Core Coverage Assist

When using lines and waypoints actively (manually or automatically with Coverage Assist), the operator may use two new windows, a left/right indicator giving a graphical view on how to steer the vehicle (showing same information as we send to the autopilot) and some status information on the line being tracked (time to end of line, distance to end etc).

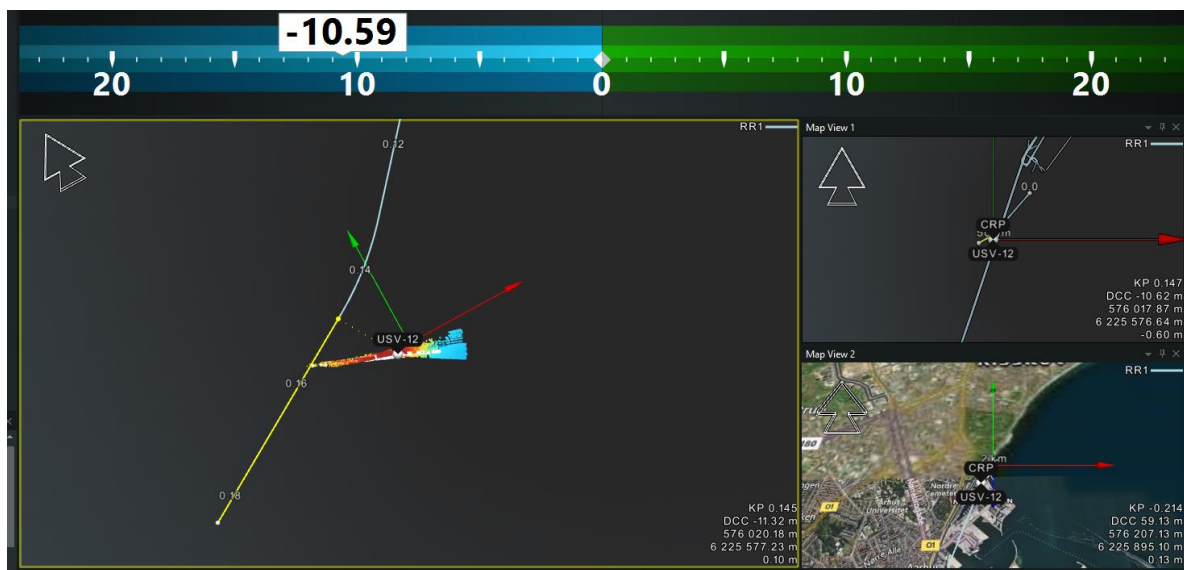


Figure 29 Map view with topped left/right indicator

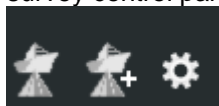
Runtime: USV-12 → RR1	
Header	USV-12
KP	KP 0.15
DOL	-9.59 m
DEOS	36.04 m
ETA EOS	30/11/2021 15:43:26
DEOL	36.04 m
ETT EOL	00:09:11

Figure 30 Runline follow status information

The left/right information (DCC or DOL) is the same information which will be sent to the autopilot.

3.4 Sensor, display and logging control

Beside the toolbar logging control buttons, NaviSuite Kuda Core includes a dedicated survey control panel. This is enabled via the NaviScan toolbar component:



A special control dialogue is now opened. You may open and close or leave open, whatever suites you the best. Please note that the content of the dialogue depends on the sensor spread in use.

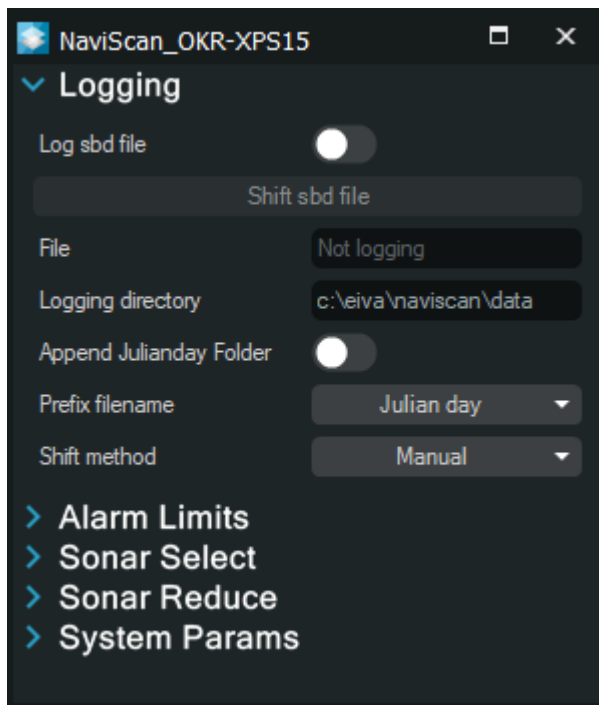


Figure 31 NaviScan control panel

The first part of the panel defines the data recording part, as it enables the operator to control file naming, location and file switching.

3.4.1 Alarm limits

The second part of the control panel allows the operator to define time-out alarm level for critical sensors such as MBE, laser, position etc.

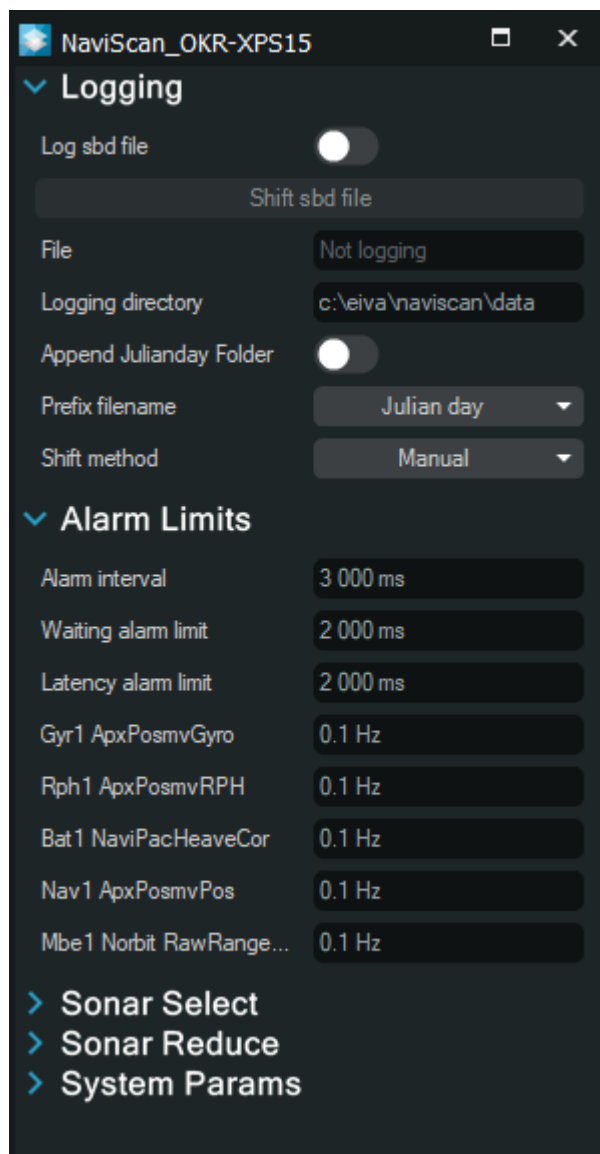


Figure 32 Sensor and system time-out alarm

3.4.2 Data down sampling

When using a remote NaviSuite Kuda Core display on low bandwidth connection it can be a challenge to send all data across to get a decent data display. To improve this, NaviSuite Kuda Core offers two different down sampling tools

- Along
Simple down sampling by skipping scans, eg just sending one out of 10

- Across
Sending fewer points across a scan, either by simply using every n'th point or intelligent by looking at significant points

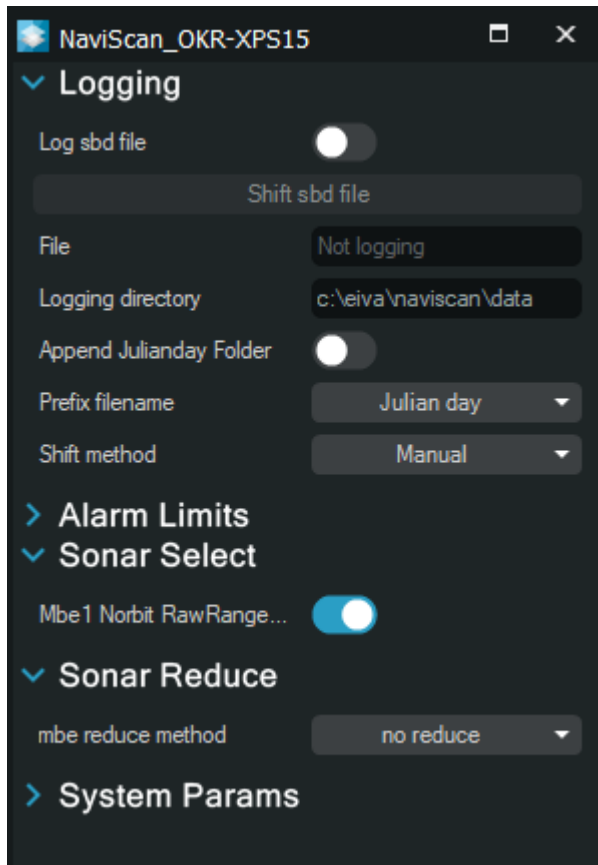


Figure 33 Display all data

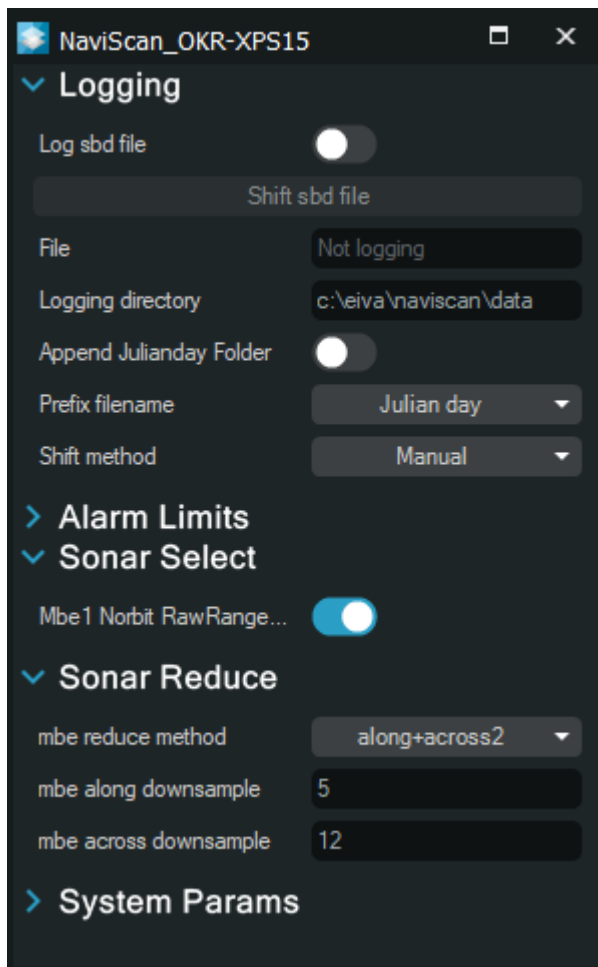


Figure 34 Along and across down sampling

Please note that to ensure the best data coverage, down sampling only affects data display and not recording.

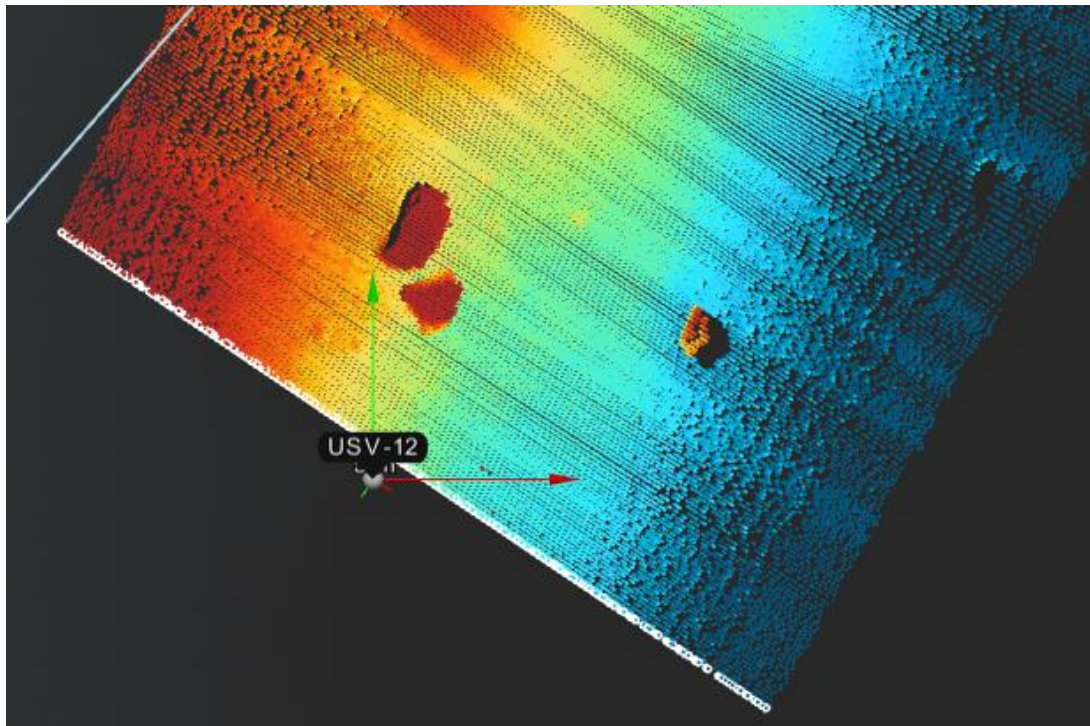


Figure 35 Full data coverage

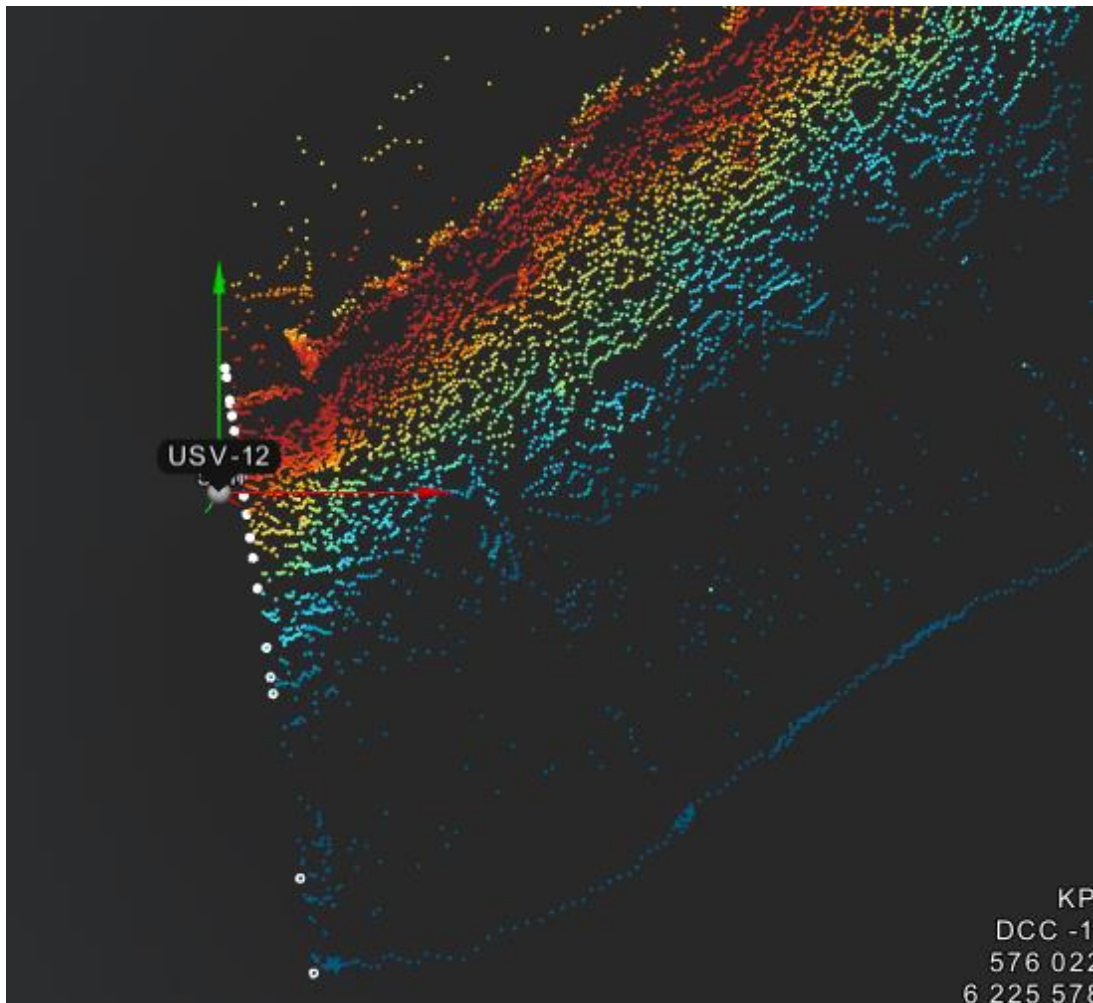


Figure 36 Across down sampling

3.4.3 Sonar and filtering control

Depending on the sonar system you can furthermore perform various sonar control settings like power, gain, range etc.

This is handled together with various data windows settings.

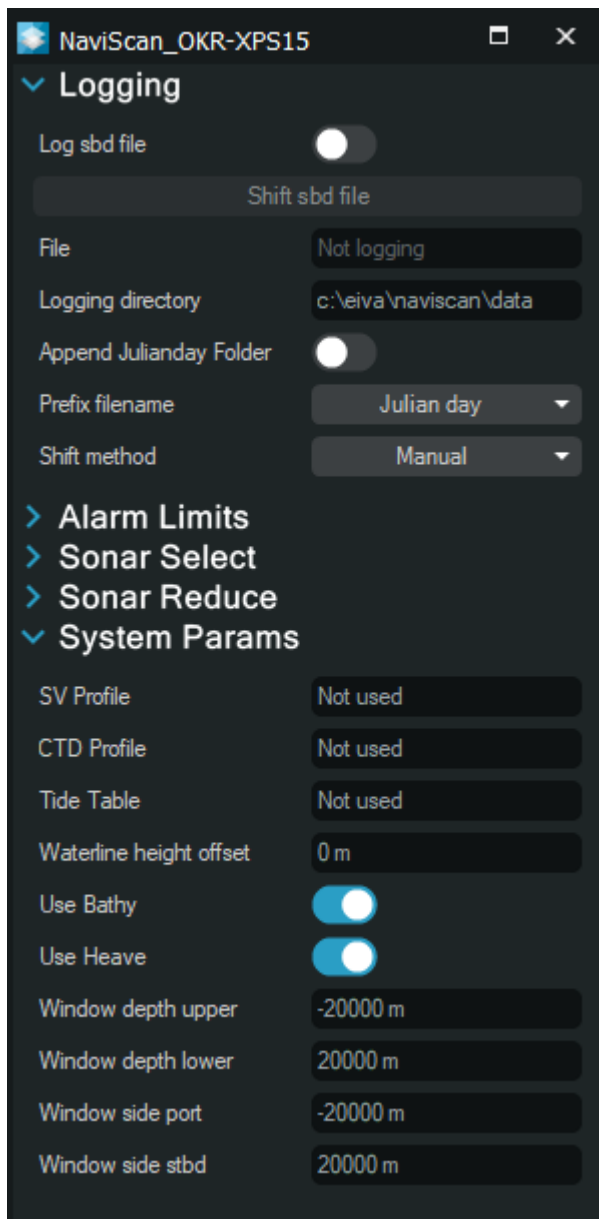


Figure 37 Sonar and system control parameters

3.5 MBE/Laser patch test

NaviSuite Kuda Core includes the patch test module. It is activated from the Tools menu. Please refer to patch test guides for NaviModel [Patch Test Calibration with NaviModel](#) : [EIVA Support \(freshdesk.com\)](#)

A sample of laser patch test can be found here: [Laser Scanner Patch Test Calibration with Carlson Merlin LiDAR : EIVA Support \(freshdesk.com\)](#)

4 Data recording

NaviSuite Kuda Core uses same logging format as in NaviScan, that is all data is recorded in EIVA SBD format, which then can be loaded into NaviEdit/NaviModel. The SBD format is compatible with NaviScan version 9.

5 Remote operations

NaviSuite Kuda Core is especially made to support both manned and unmanned operations, and in both cases it allows the operator to have a single remote workstation that controls both the planning/configuration part as well as the real-time survey and line planning operations.

This is done by having the entire NaviSuite Kuda Core software installed on the remote computer and ensuring a (fairly) stable IP connection between the vessel and the remote workstation. From this remote workstation you can both supervise and execute the operations.

The remote operations monitoring, supervision and control uses the same features as known from NaviPac 4.

5.1 Remote NaviSuite Kuda

Remote supervision will allow the operator to:

- Start/stop recording
- Initiate and control **Coverage Assist**
- Define and upload runlines and waypoints
- Sonar and software control via sonar control panel
- Update background information like display lines, CAD drawings etc – not relevant for USV operations

When starting the NaviSuite Kuda Core on a remote computer, it will start up in the status **Remote**:

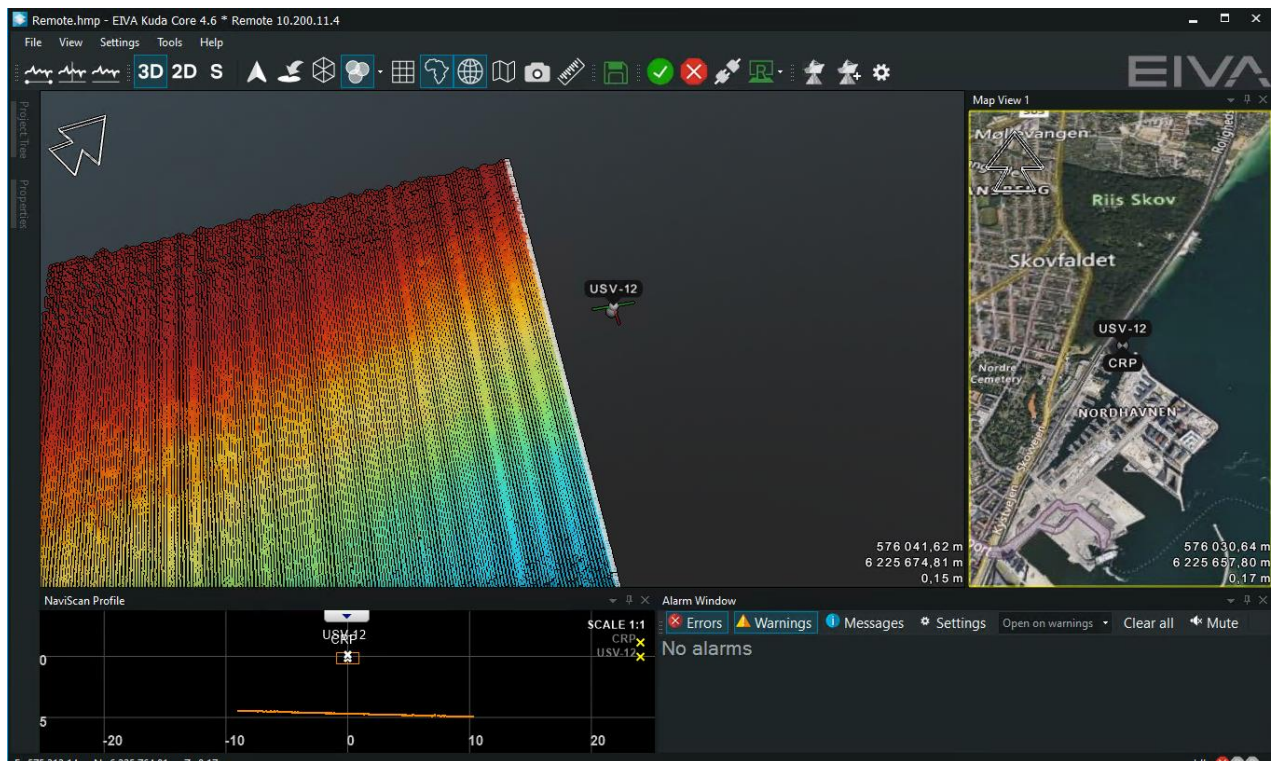
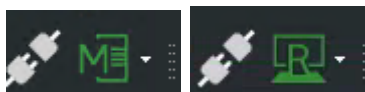


Figure 38 Remote Kuda display

This is seen in the status icon next to the connection, where M is for **Master** on the main computer and R is for **Remote** on any connected computer,



In this initial **Remote** mode, the remote computer is purely for monitoring the operation – for example as a second display on a manned vessel. However, in **Supervisor** mode, it can be used to let the operator take control of the survey.

Changing the mode is done in the same toolbar as above. Click on the R symbol and choose **Supervisor** mode. The program will then take control of the survey and at the same time send a message to the master which will be 'downgraded' to **Supervised** mode.

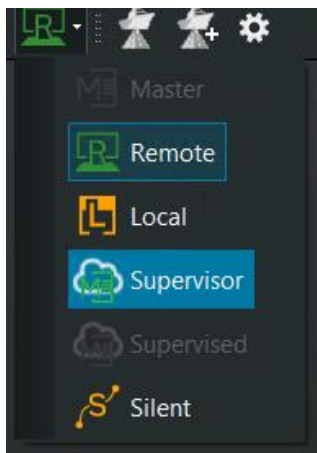


Figure 39 Becoming Supervisor

The operator can now control the recording, generate runlines, waypoints and perform **Coverage Assist** operations.

Waypoints and runlines will initially be generated locally on the remote client. To bring them into use, you must first upload them to the vessel.

All operations are performed via the cloud icon in the toolbar:

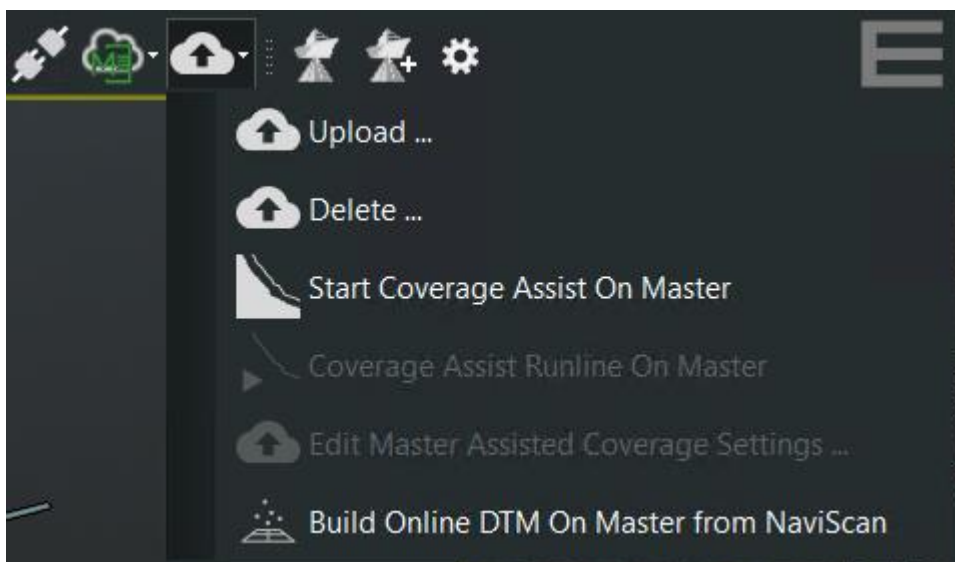


Figure 40 Supervisor command tool

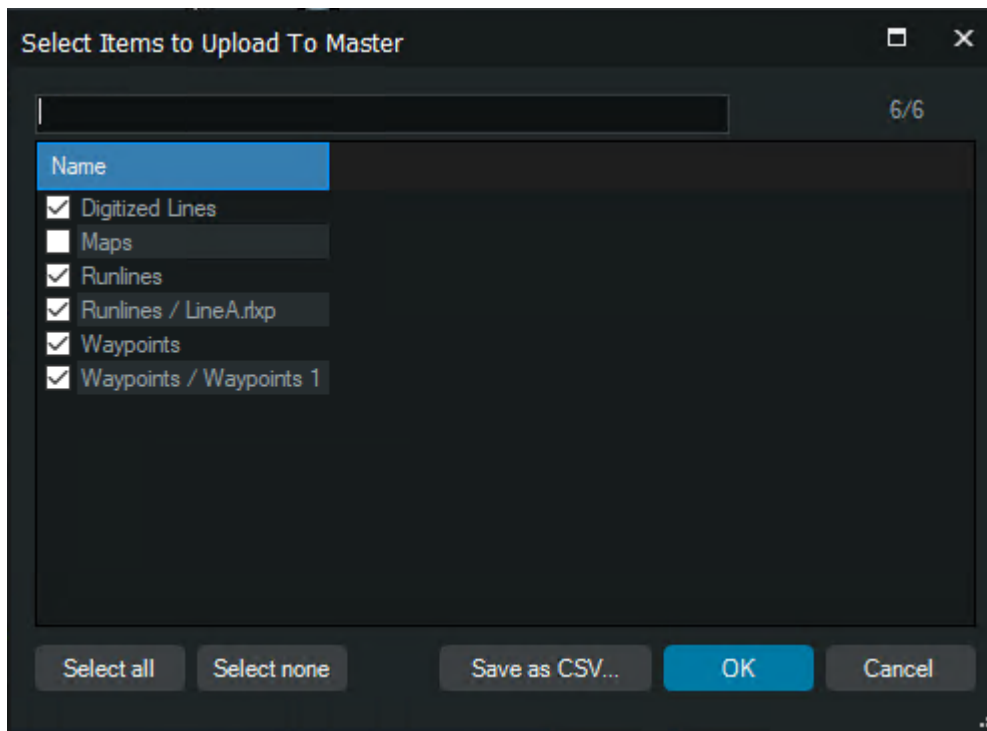


Figure 41 Uploading files

When in **Supervisor** mode, besides this upload process, all other tools act as they do normally.

Please note that the autopilot handling is performed by the onboard NaviSuite Kuda application, so it must be kept running during the entire operation.

5.2 Remote NaviSuite Kuda Config

Remote configuration allows you for example to:

- Download configuration file
- Change sensor and sonar settings
- Change geodesy
- Run local test
- Upload configuration file
- Restart onboard operation

To be able to make a remote configuration, you must first enable remote control from the master system (onboard NaviSuite Kuda Core Config). This is done by going to the menu and clicking **Options** then **Remoting**:

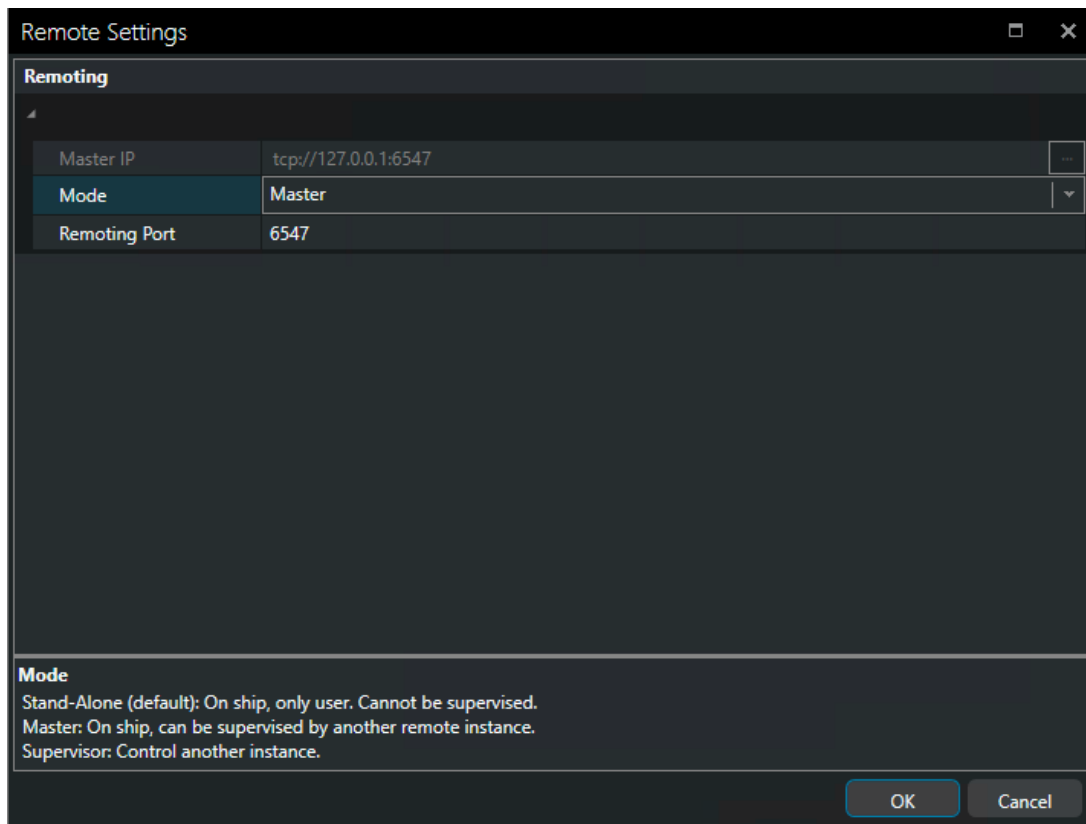


Figure 42 Remote NaviSuite Kuda Core Config

The default is **Stand-Alone** which means that the system is blocked from outside control. Change settings to **Master** and accept.

For the supervisor application do the same but select the mode **Supervisor** and enter the IP address of the onboard computer.

The NaviSuite Kuda Core Config will now download the configuration from the main system and load it for editing like a standard setup except that the controls are defined as remote operations.

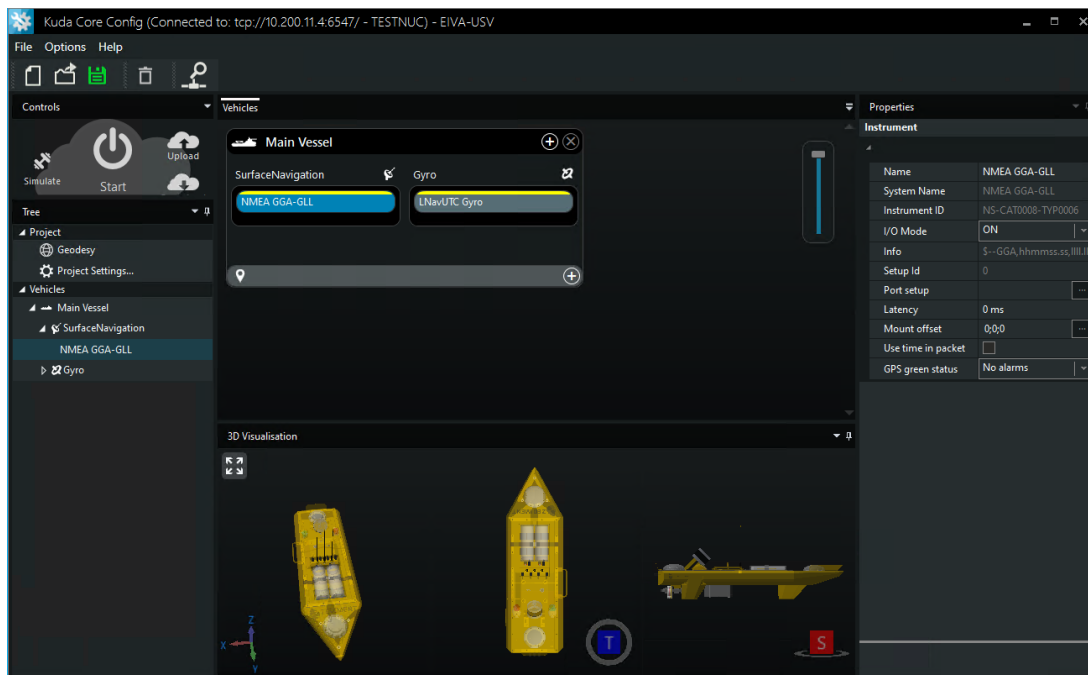


Figure 43 Remote configuration

At the same time, the local configuration changes title so it's clear that it is under supervision:

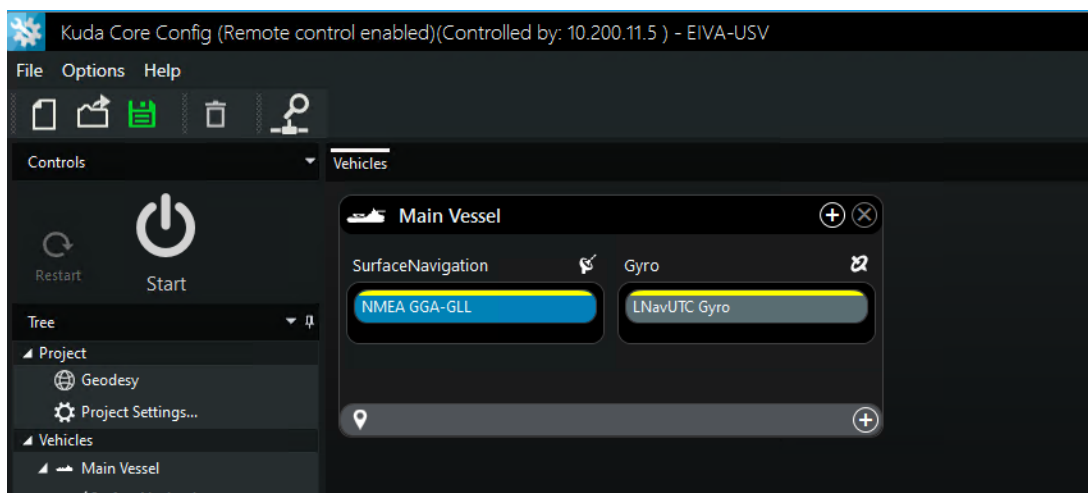


Figure 44 Supervised config

The control part of the will now enable you to edit the setup, test it locally and upload to the master computer including start/stopping onboard system.

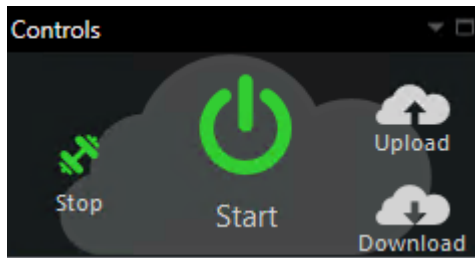


Figure 45 Kuda Core Config control

6 NaviSuite Kuda Autopilot

Autopilot Control now has a NaviSuite Kuda Autopilot.

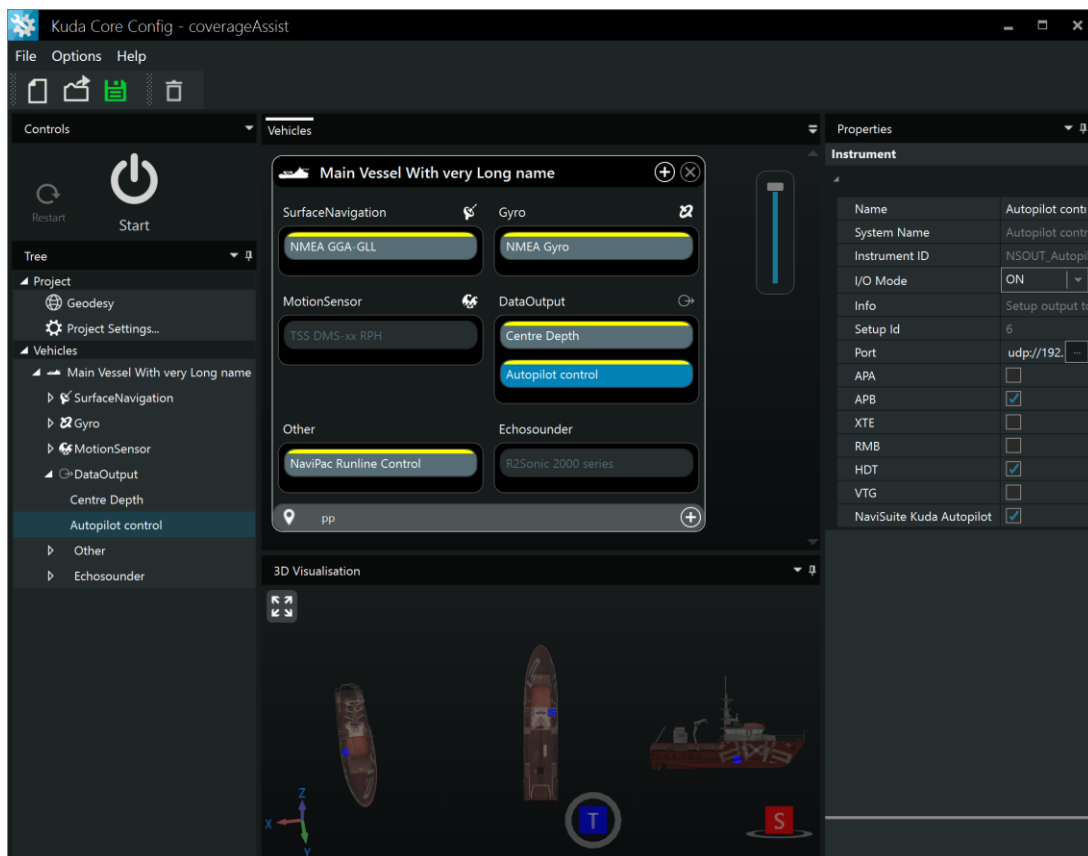


Figure 46 Autopilot Control with NaviSuite Kuda Autopilot option

With new buttons in the Vehicle control to control the Autopilot

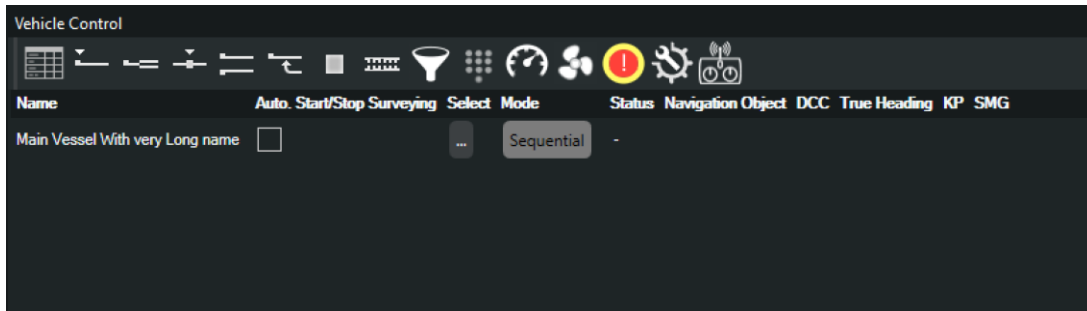


Figure 47 Vehicle Control with new NaviSuite Kuda Autopilot controls



Figure 48 NaviSuite Kuda Autopilot controls

From Left to Right, there is Set Speed, Start thrusters, Emergency stop, Settings to edit Auto Emergency Stop which stops a vehicle in no remotes have been seen after a specific amount of time, and lastly manual control

Manual Control docks in the vehicle control, and changes the Autopilot mode to manual with a set heading. On closing the Manual Control view, the mode is set back to auto, and the thrusters are disabled.

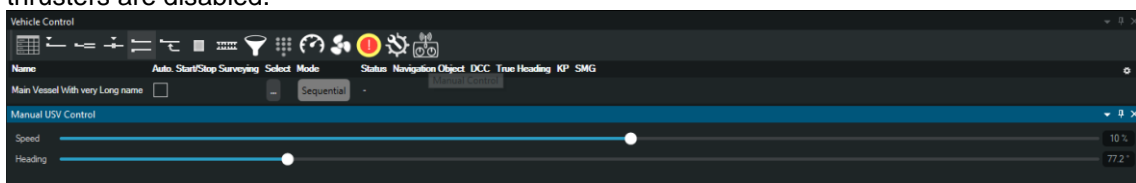


Figure 49 Manual Control docked inside vehicle control, with speed and heading control

7 Backwards compatibility

The data recorded in **NaviSuite Kuda Core** is fully backwards compatible, and can be used in NaviEdit 8.6/NaviModel 4.5 for processing

Runlines, waypoints and DTMs created in NaviPac and NaviModel version 4.5 can be used directly in NaviSuite Kuda Core 4.6