

UPWIND::NMEA: USER GUIDE



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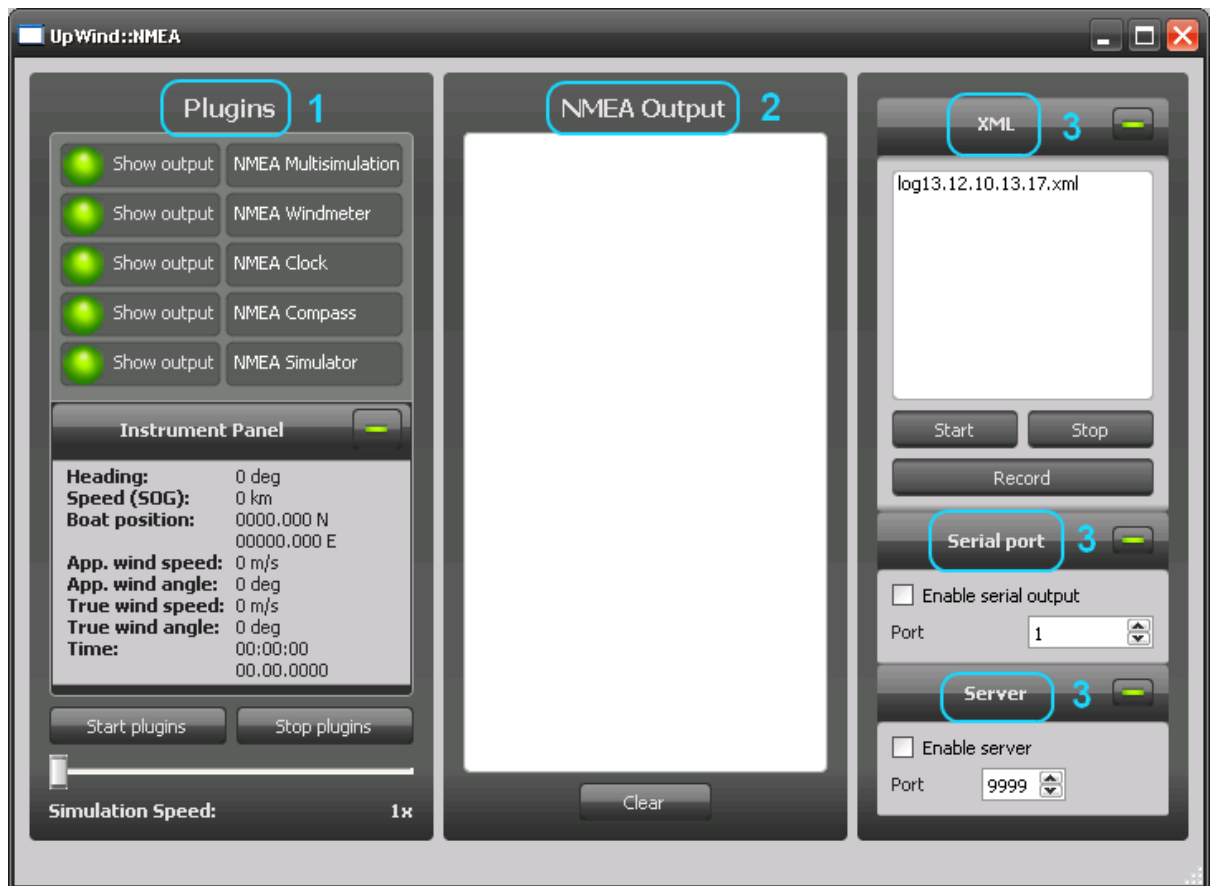
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1 Using the simulator

This section describes how to run **Upwind::NMEA** on Windows platforms.

1.1 Basics of the Application



Start `UpwindSimulator.exe` to run **UpWind::NMEA**. The application's main window is divided into three sections. The plugin section (1) is situated on the left side. It contains a list of available plugins, an instrument panel and a slider for altering the simulation speed. On the center is the **NMEA Output** screen (2), which shows the output created by the plugins. On the right are the **XML**, **Server** and **Serial port** settings (3) boxes. Click on a plugin's name to start it. All plugins will open in separate windows.

To simulate the sail boat's movement and/or to send NMEA data to clients/serial port/xml file you will need to start the simulator, compass and windmeter plugins. The simulator plugin shows a map with the boat always centered on the screen. Before starting the simulation, you must first set the boat's location. This can be done in three different ways: either by **1.** clicking on the map, **2.** dragging the map to the desired location (by holding down the left mouse button and moving the mouse) or **3.** typing in the boat's coordinates in the latitude / longitude boxes below the map.

Now, click the **Start plugins** button in the bottom part of the Plugins section. The plugins will start sending NMEA sentences, which will be shown in the **NMEA Output** section. The boat's movement will not be simulated until you click the **Start simulation** button in the Simulator plugin's window. When the Simulator mode is on, the Simulator plugin is in control and the user is not allowed to change the location of the boat. The boat's heading can be altered by either clicking on the map with the right mouse button towards the desired direction or by turning the compass dial. In order for the sail boat to gain speed, there has to be wind, so you need to choose the wind speed and angle in the **Windmeter** plugin window. The Simulator mode can be turned off by pushing the **Stop simulation** button. Also, the simulation date and time can be freely edited by using the **Clock** plugin.

As explained earlier, all the plugins are listed on the left side of the main window, in the **Plugins** section. Each plugin also has an output filter, which can be toggled on/off by clicking on the **Show output** button, which is located to the left of the corresponding plugin's button. When you click on the **Show output** button, the color of the LED on the left side of the button will change accordingly. The color green indicates that the plugin's output will be shown in the NMEA output window, whereas the color red implies that the plugin's output will not be shown.

To start recording the plugins' NMEA output to an XML file, click the **Record** button in the XML settings frame. After you press the **Stop recording** button, you will be asked to choose the name of the log file and where it will be saved. To

send the NMEA output to a serial port, click the **Enable serial output** checkbox in the **Serial port** settings frame. To send the output to a client (or multiple clients), click the **Enable server** checkbox in the **Server** settings frame.

As a tribute to the **Uusi Loisto** sail boat navigation program, the main window also contains a section called the **Instrument Panel**, which displays a summary of all the simulator data, providing the user with an alternate way to keep track of the plugins' NMEA output.

The speed of the simulation can be set with the slider that is located below the instrument panel. It is set to **1x** by default, with the maximum being **100x** the normal simulation speed. The slider allows you to change the speed in **1x** steps.

It is possible to have multiple boats sailing simultaneously on the same map and they can also be controlled by clients that are running on separate computers. The **Multisimulation** plugin and the **Heavyweight client** are needed for this task. Please see Section 2.5 for detailed instructions.

That should cover all the basics. Now you can just sit back and watch the boat sail off into the sunset.

2 Plugins

2.1 Simulator

The **Simulator** plugin mimics the movement of a single sail boat and the effects of different wind conditions on its behavior. It receives NMEA sentences about wind speed and direction (WMD) and compass heading (HDG). It sends RMC sentences containing information about the boat's location and its speed over ground every 300 milliseconds. It also sends HDG sentences when the user steers the boat by clicking on the map with the right mouse button.

Latitude and longitude coordinates are shown in the following format: (D)DDMM.MMM, where D = degrees and M = (arc)minutes.

A polar diagram XML file and a starting point for the boat must be chosen before the simulation can be started. The simulator uses the data from the polar diagram XML file to calculate the behaviour of the boat in different wind conditions. Different types of sailing boats can be simulated with different polar diagram XMLs. See section 3 for a thorough explanation.

UpWind::NMEA uses Google Maps for depicting the sail boat's movement. The boat always stays centered on the map screen. The simulator has two modes: **simulation running** and **simulation stopped**. When the simulation is running, the simulator plugin controls the boat's movement. When the simulation is stopped, the user can set the boat's location by clicking a point on the map, dragging the map or by writing the coordinates in the latitude/longitude boxes below the map.

The map can be zoomed by using the mouse wheel, + and - buttons or the zoom slider in the upper left corner of the map.

The map can be viewed in various different ways, depending on your location. Click the appropriate view button in the upper right corner of the map:

- Map - This shows a map with a traditional depiction of roads, parks, borders, bodies of water and more.
- Satellite - This shows aerial imagery.
- Hybrid - Aerial imagery combined with depiction of roads, etc. of the map view.

2.2 Windmeter

The **Windmeter** plugin sends and receives **WMD** sentences. It generates these sentences based on the currently selected wind angle (which goes from 1° to 360° , with 360° being equal to 0°) and wind speed (0 - 20 knots) parameters. The wind speed is also shown as meters per second. Upon receiving a WMD sentence, the Windmeter sets the wind angle dial and the wind speed slider's values accordingly, to reflect the new wind conditions.

2.3 Compass

The **Compass** plugin sends and receives **HDG** sentences. It generates HDG sentences according to the current compass angle (which goes from 0° to 359° , with 360° being equal to 0°). The heading can also be set by typing it in the **Orientation** text box, after which you should either **a)** press the **Enter** key on the keyboard or **b)** press the **Set** button in the Compass plugin's window. When the compass receives an HDG sentence it changes the dial's position accordingly.

2.4 Clock

The **Clock** plugin sends and receives **ZDA** sentences. The time and timezone can be set to any desired (but valid) value. The sentences are sent at a speed that

depends on the timer multiplier used. For example, if the multiplier is 10, then the simulation time increases by 10 seconds per each second of "real" time.

2.5 Multisimulation and the Heavy Client

The Multisimulation plugin has been designed with the sole purpose of simulating the simultaneous movement of two or possibly even more sail boats. Start the Multisimulation plugin from the plugins list. It will function as the server for all the competing boats. Select a suitable port and click **Start Server**. Wait for eager participants to connect to your server. You can select a different polar diagram for each boat in order to simulate the behavior of different sail boats.

The boats are represented by regular Google Maps markers. The name of a sail boat is shown inside a tooltip box when the mouse cursor is moved over the sail boat's marker.

The Heavy Client is a custom client, separate from the Lightweight Client, which is used to connect to the multisimulation server. Users of the client have to first supply the server information (ip and port) and also a unique username. After this the users have to wait until the server is ready to begin the simulation. The users can control their boats by using the compass to change their boat's heading. Users can also keep track of the wind conditions and the positions of their competitors' boats, but they can't directly tell the headings of the other boats. The server will monitor the boats and select the winner after one of the boats has reached the goal. However, the goal cannot be currently placed on the map, but it would be possible to implement this functionality into the server and automatically select the winner.

2.6 Wind speed changes

The **Wind speed changes** plugin plots the wind speed on a speed-time graph, parsing wind information from the WMD sentences that it receives. The graph

covers a span of around two and a half minutes. The graph can also be initialized by pressing the **Clear** button in the event that the user wishes to dispose of the current graph data.

3 Polar Diagrams

Polar diagrams are used for deriving the sail boat's speed from a certain range of wind speeds and wind angles. However, boat speed data isn't usually available for every possible value of wind speed and angle, meaning that the rest of the speed information will have to be either interpolated or extrapolated, depending on whether the unknown values fall within the known data or outside of it. This process is known as **linear approximation**.

The XML file structure is as follows:

- Boat information (name, model, length, width, draught, height, register number, owner and country).
- Boat speed without spinnaker. This section consists of several **wind speed** elements, each one containing a certain range of **angles** and the corresponding **boat speed** for each angle.
- Boat speed with spinnaker. This is **optional** and can be omitted.

The boat speed is stored in the XML file as **Time Allowance (TA)**, meaning how many seconds it takes to travel one nautical mile with a given sail boat.

$$\text{BoatSpeed(knots)} = \frac{3600}{\text{TimeAllowance}}$$

Using the boat speed prediction functionality is quite trivial, just select the desired XML file by clicking on the **Select XML file** button in the simulator window. The XML file can be changed on the fly, and the spinnaker can be toggled on/off by clicking on the **Use Spinnaker** check-box, assuming that the boat's XML file contains data for the spinnaker.

4 XML Logs

Simulator sessions can be saved as XML files and replayed later. To save a session click **Record** in the XML frame. Next, start the simulation to collect some NMEA sentences that can be saved. The sentences will be saved even if the sentences are filtered out with the output filters in the **NMEA Output** area. Click **Stop recording** to stop recording the XML log (this is the same button that you used to start the recording process). You are then asked to choose a name for the log file. After this, click **Save** to save the log. If you wish to cancel the saving process for some reason, then click the **Cancel** button. The simulator will search for XML log files in the **logs** folder, so please make sure that you save your log files there. All the available log files will be shown in the list that appears in the XML box on the right side of the main window.

To replay a session choose a file from the list and click **Start**. During a playback session a progress bar will be shown, illustrating the amount of log data that has been played back so far. The session can be paused by clicking **Pause**, and it can be resumed by clicking **Start** and stopped by clicking **Stop**.

5 Using the server and the serial port

UpWind::NMEA supports broadcasting NMEA data to network clients. This feature can be used to let the simulator run on one computer while using a client application utilizing the data generated by the simulator on another computer. The server can be enabled to output NMEA data to a specified port by using the Server frame on the right side of the GUI. By activating the **Enable server** checkbox, the application will listen to connections on the port specified by the spin box underneath the **Enable server** checkbox. The server can be disabled by unchecking the checkbox.

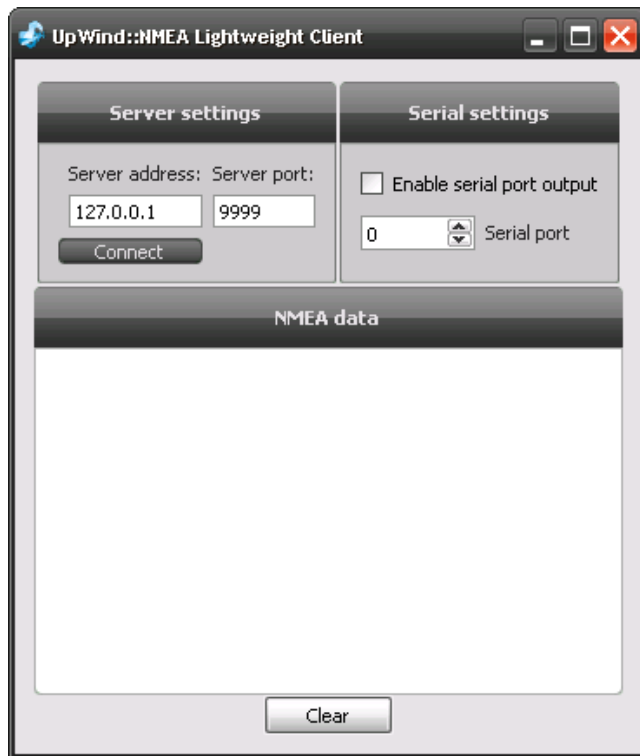
The UpWind::NMEA Lightweight Client has input fields for both the server address and port. After entering valid entries for these fields, press the **Connect** button to connect the client to the server and to start receiving NMEA data from the server.

Both the UpWind::NMEA Simulator and UpWind::NMEA Lightweight Client are capable of transmitting NMEA data to a serial port. In UpWind::NMEA the serial port settings can be found in the Serial settings box and in the Lightweight Client they can be found in the Serial port settings box. After choosing a serial port number (COM0 - COMX) from the spinbox you can use the **Enable serial port output** checkbox to toggle on the serial port output. If opening the port for communication fails, a message box with an error message will be displayed.

The developer team suggests using virtual serial ports for NMEA output since physical serial ports are not always found in modern computers and can only be opened once for serial communication unlike most virtual serial ports. The free version of Eterlogic VSPE was used during development to create virtual serial ports, but other virtual serial port applications should work as well. To create a virtual serial port with Eterlogic VSPE, you should open the VSPE application, click **Create new device**, choose Connector as the device type and set an appropriate new port as the virtual serial port. After this you should be able to use the UpWind::NMEA Simulator and the Lightweight Client to enable serial port output to the newly created

virtual serial port.

6 Lightweight client



The Lightweight Client is capable of connecting to a server created with UpWind::NMEA. It has a simplified user interface that consists of a text view and two settings boxes.

The connection settings box has input fields for defining the server address and port. After these have been set, you can press **Connect** to connect to the server. If the connection was successful and the server is transmitting NMEA data, the client will display all the received data in the text view. If the connection fails (for example, the server might not be running), a message box will appear notifying the user of an error.

The serial port settings box can be used to enable transferring NMEA data to a serial port in order to be used by other applications, such as the UpWind sail boat navigation software. To enable serial port output in the client, check the **Enable serial port output** checkbox. The port number can be selected with the spinbox underneath. If the port couldn't be opened for serial communication, a message box with an error will appear.

7 Plugin Wizard

The plugin wizard can be used to create plugins that cooperate with the Upwind::NMEA Simulator and expand its capabilities. The wizard contains a Readme file with all the necessary instructions for creating new plugins. When using the wizard a new project with automatically generated files is saved in the corresponding project's working directory. After switching the build type to **Release**, the project is immediately ready to be built and used in the main UpWind::NMEA software.

Custom wizards are located in subdirectories of the following directories:

- share/qtcreator/templates/wizards
- the local user's configuration folder, \$HOME/.config/Nokia/qtcreator/templates/wizards
- %APPDATA%/Nokia/qtcreator/templates/wizards

For example C:/Qt/2010.05/share/qtcreator/templates/wizards

All plugins are compiled as **Debug** versions by default. Please change the project's build options in Qt Creator if you want to build a **Release** version. Some plugins may work very slowly in debug mode.

Installation:

1. Copy this folder (not just the files) inside one of the mentioned subdirectories and restart Qt Creator.
2. You can now create a custom project from Qt Creator
3. File - New File or Project...
4. Custom projects - NMEA Plugin
5. Give the name of the plugin and select the project folder as UpWindNMEA/PluginSystem

6. The project is now ready to be generated.
7. You can now set the plugin build options to **Release** and build it. You should immediately be able to use it in the program.