GPS is now not just for Yacht Navigation - Part 2
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In the first paper I discussed the use of the Global Positioning System (GPS) to help the dinghy racer log his performance on the race track. This paper discusses and reviews the application software that is used to ‘post-process’ and analyse that GPS sailing track data.

At this point I must stress that the use of GPS trackers has not been completely clarified with the majority of dinghy classes and the specific rules carrying and operating such devices during a race. For example the Merlin Rocket class (March 2010) has the rule 17b:

“Electronic aids are prohibited except that a Merlin-Rocket may use an electronic digital compass with chronograph (timer and/or clock). The compass must be entirely self-contained with either an internal battery and/or solar power. The compass shall have no external connections. This includes power supply and data inputs, such as wind information, boat speed or navigational features. It shall not have the ability to compute correlations between time, compass and VMG”.

The one-design Laser class will not permit such devices as its part of their fundamental rules. The principle of the Laser Class rules is that no changes to the boat are allowed unless they are specifically permitted by the class rules.

The GPS tracker receiver that is recommended is a completely passive unit with no display, or information available to the crew. The only information (via an LED) available is that unit is tracking GPS satellites OK and is powered up. A simple slide switch is used to enable the OFF/LOG function. All the track data is ‘post-processed’ so no real-time information about position, speed, VMG etc is available to the crew during the race. There is no display on the unit. If fact, it is recommend that the GPS tracker is placed in a small sealed waterproof protective cover and then placed in a zipped pocket such as a spray jack or buoyancy aid pocket. The GPS chip is sensitive enough to track and process the GPS signals from within a sealed pocket and cover.

The TackTracker Sailing Software Application

A software application is just as important as the hardware it supports. Software must be simple to use, specifically functional for the task, a clear user interface, and well documented. It is obvious when using this software that it is written by programmer who is also an enthusiast for his sailing. It is a well designed, built, tested and supported application by a like minded sailing enthusiast. This is always the key to a successful product like the TackTracker software.

TackTracker software is a scalable product. It comes in 4 modules with a common user interface. The base module is the free downloadable TackTracker player. This gives you a taste of what is to come, with the ‘Race Viewer’ base module. This is available at www.tacktracker.com

With this base module, users can view and replay a preprocessed published sailing event. (With a suitable internet connection available).

The base module also allows GPS track data can be imported via a number of popular GPS formats such as the Garmin GPX, NMEA and the QStarz CSV files. The base module does not have the functionality to upload, configure and erase data on a GPS receiver such as the recommend QStarz unit.

The other TackTracker modules that can be purchased are:

Race Editor – Allows you to upload your tracks from the GPS receiver, create libraries of events, edit your tracks, define a course, add buoys and start / finish lines.

Club Tools – Allows you to add the Portsmouth yardstick of a boat and TackTracker calculates handicap placings and percent to win throughout the course. This module also creates a range of reports and allows you to publish online your race event.

Navigation Rally - Allows you to automate the running of power boat log trial events.

It is the Race Editor version of TackTracker that is reviewed and discussed in this paper.
Installing the Software

The software is easy to install. Just run the setup program (you will need an internet connection) and it will check you have the Microsoft support libraries of .NET installed. If you are prompted to install .NET Framework 2.0, just follow the on-screen prompts.

Once you have the basic Race viewer installed, it is recommended that the Race Editor module is purchased (via a licence). This is essential to upload and configure the GPS QStarz receiver. It also allows the user to edit the sailing tracks, define a course, lay marks, manage your race libraries and share events as required.

Uploading the GPS Track Data

The GPS receiver is logging ‘tack data’, that is a date, time and a horizontal position (Latitude and Longitude).

Depending on the GPS manufactures receiver used, other ‘attribute’ data can be logged to indentify the sail track. This attribute data can be a boat or helms name and other details such as sail or bow number used in the Regatta. Also, the DGPS option (read part 1 of this paper for more details on DGPS) is turned ON when resetting the device. (QStarz BT receivers only)

Left is a typical screen from the TackTracker upload dialogue. Here I have connected the QStarz GPS receiver to the PC USB (Com18) and setup the sail number, class and helms details. As you will see later these details can be displayed on the main graphics of the sail track program.

With the Race Editor version of TackTracker the user can have a ‘Library’ catalogue of racing events that contain sailing tracks. Each event is displayed and logged automatically in date order, so it easily to locate events and races. Under each named event is actual track of the boat or individual. Below is a screen snap showing a typical library of race or training events.

The track of each boat is stored in a comma separated value file (.CSV)

The major part of the user interface is for the graphics. Below we see a plan view of the sailing area. Once a sail track in uploaded, it is displayed in the graphics area with a suitable avatar for the dinghy. The plan view has north up the display, but this can rotated as required.

Below the plan graphics are the leg details for the selected boat (Sarah is the current boat in the example shown below). Below this information is the player & time line controls.
Typical TackTracker graphics showing the start committee boat, line and pin end mark. (The boat positions are 4 seconds after the start gun.)

Each sail track is represented by a boat graphic of a particular colour.

You can choose the colour. The boat may have a trailing "tail" of type selected in the bottom control bar.

For example, the "Long" tail will extend to the beginning of the current leg.

<table>
<thead>
<tr>
<th>Sarah-Laser Radial</th>
<th>Tack (m)</th>
<th>Tack (m/s)</th>
<th>Leg (m)</th>
<th>Leg (m/s)</th>
<th>Deviation</th>
<th>Bearing</th>
<th>VMG Wind</th>
<th>VMG Course</th>
<th>Knots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leg01. Tack 1</td>
<td>9.5</td>
<td>00.00.04</td>
<td>9.5</td>
<td>00.00.04</td>
<td>-32</td>
<td>42</td>
<td>3.47</td>
<td>3.40</td>
<td>4.03</td>
</tr>
</tbody>
</table>

The Race editor also allows the GPS track data for the event to be trimmed, and deleted (if required) to remove the erroneous data at the start and end of the race. Below are a series of typical screens from TackTracker showing the deletion of erroneous track data after the finish of the race.

The start time can also be set either by keying in a suitable value or moving the boat along the time line and using the SET button to use that nominated time. This will remove the track data before that time.

![Figure 1](image1.png)
**Figure 1**
Track Data BEFORE edit of track after the finish

![Figure 2](image2.png)
**Figure 2**
Track Data is 173 records in length

The track is how split at this point in the timeline, and we can how save or delete this end section of track data. In this example, this will now be deleted as it is not required. In **figure 4** and **5** below you can see the results.

If the track data after the race is required (for example a back to back race follows), then TackTracker allows the data to be saved to a new race and this can be named accordingly.
In figure 6 you can now see the data set has been deleted down to 133 records and saved.

**Figure 4 & 5**

Use the SPLIT option remove the unwanted track data at the end of the race.

**Figure 6**

The final saved and trimmed track data set.

Course and Marks

The course and marks can be user defined in the software. Users can select from a standard or a user defined course (or a training session). Marks can be located by their Latitude and Longitude (if known) or simply located on the graphics display by the cursor. Start and Finish committee boats can be defined, along with the pin end mark on the start line. Marks are scaled to a nominal 1m.

Once the course and marks are defined, the time line then shows a typical display as shown in figure 7.

**Figure 7**

Note the marks A and B on the TackTracker time line. Boat GBR617 is just about to start through the
defined start line. The grey shading on the time line marks the ‘non race’ track at the start and finish of the race data.

**The Time Line**

As you navigate using the blue play buttons, you will see the currently selected boat move along the time line. The time line bar offers a convenient way to navigate the boat.

**Acceleration Control**

To the left of the timeline is an acceleration control.

If you drag the red circle to the right, this moves the time forward. Drag the circle to the left to reverse back.

The further you drag the circle from the centre, the faster the boats go. When the race is playing (by pressing the red triangle play button), the acceleration control becomes a play speed control.

**Wind Direction and Strength**

The TackTracker system allows the user to define the wind direction which of course has an effect of the boat sail graphics. User can graphically turn the wind indicator or key-in a bearing of the nominal wind direction.

However, to analyse your sail track data, versus wind speed and direction, users can import wind data from a local weather station. TackTracker will import a simple CSV file. The below the file format is required. Actual wind data courtesy of the Cambermet station on the south coast of the UK.

(http://www.cambermet.co.uk)

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<thead>
<tr>
<th>TIME</th>
<th>BEARING</th>
<th>SPEEDKNOTS</th>
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<td>11.1</td>
</tr>
<tr>
<td>09:40</td>
<td>20</td>
<td>11.6</td>
</tr>
<tr>
<td>09:45</td>
<td>19</td>
<td>12.1</td>
</tr>
<tr>
<td>09:50</td>
<td>15</td>
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</tr>
<tr>
<td>09:55</td>
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</tr>
<tr>
<td>11:00</td>
<td>25</td>
<td>11.3</td>
</tr>
</tbody>
</table>

**Background Maps and Google Earth**

The TackTracker software also allows the user to integrate data from Google Earth.

Features such as fixed obstructions, features, coastlines and fixed navigation buoys can be added to the TackTracker display. Import of these features is via an ASCII KML file which can be exported from Google Earth.

TackTracker has also an easy export/import option with Google Earth (must be pre-installed). Simply press the ‘Send to Google Earth’ button on the toolbar and TackTracker will launch Google Earth and create a ‘Temporary Places’ folder with all the event details which is then displayed in the main Google Earth graphics. See **Figure 9** below for a typical example.
Conclusion

GPS receivers and systems have now come of age and the market has matured. They are an everyday item, and in some cases part of many life-critical systems. Now for the dinghy sailor, available from Rooster Sailing with backup support, we have technology at our disposal that has developed sufficiently to give use a very useful and practical sailing analysis tool.

Using a combination of low cost, good battery performance, small and very lightweight GPS receivers such as the recommended QStarZ BT-Q1000XT or the BT-Q1300ST, that can in carried in a sealed pocket and with specialist software like TackTracker, we can now accurately see how the race played out. The wind shifts, upwind, and downwind paths can be studied and replayed at leisure.

As a training aid, it will become as important as the HD video camera, and support coach boats that are now regarded as essential items in our sport.

Invite to see TackTracker in action at the Rooster Sailing Stand

Come and see the regular demonstrations on the Rooster Sailing stand at the RYA Volvo Dinghy Show (5th and 6th March 2011) on how this technology can help you maximise your sailing performance.

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