Integrating inertial sensors with GPS

Supporting GPS in obstructed areas

Survey-grade high-speed GPS is the most accurate way to measure velocity - as long as view to the sky is clear. Problems arise when buildings or tall trees obstruct the testing ground. If the GPS signal is interrupted, dropouts cause spikes in data, which is not ideal when you are relying on a clean velocity signal.

In order to keep high GPS accuracy even where sky visibility is less than perfect, Racelogic couples data from an IMU and the VBOX 3i GPS data logger.

By blending GPS with data from an Inertial Measurement Unit, housing three gyros and three accelerometers, smoother, more reliable data is produced. The solution can deal with GPS dropouts, maintaining high accuracy.

Testing in obstructed areas can lead to noisy GPS data

IMU integration realises the high accuracies that VBOX 3i can achieve even when external conditions are compromised, meaning that data has now become more reliable and easier to interpret.

VBOX 3i with IMU integration

- Uses a real-time Kalman Filter, which seamlessly blends GPS signals with data from an IMU (inertial measurement unit)
- Produces a smoother velocity trace with higher dynamic capabilities than GPS alone, due to the mutual corrections occurring between the two data sources
- Deals with GPS dropouts, maintaining high accuracy
- Separate modules allow for flexibility in vehicle placement with a number of mounting options.
- Ability to swap equipment between vehicles easily: meaning more time on the test track and less time setting up gear.
- Includes VBOX Tools Analysis software. Intuitive to use, yet has powerful features to carry out in depth analysis.

IMU Integration significantly reduces GPS noise by combining GPS and inertial data

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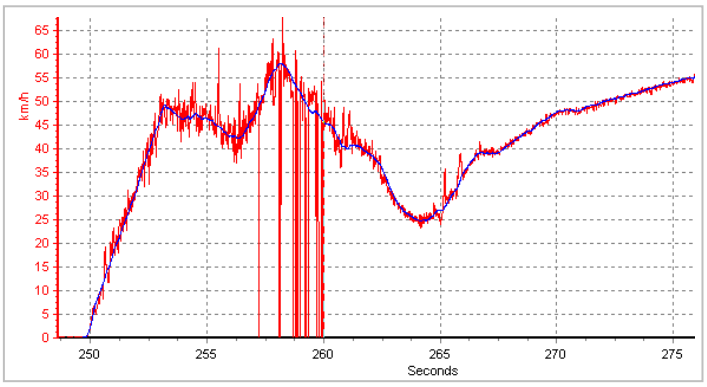
How does IMU Integration improve the GPS data channels?

Velocity

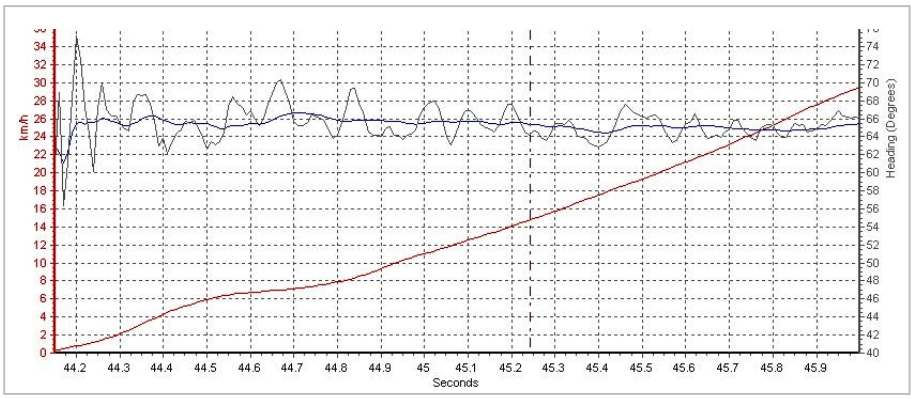
The graph to the right illustrates GPS noise followed by drop outs, incurred when driving on a section of road with very heavy tree cover (pictured overleaf). IMU integration (the blue line) decreases the noise for a more accurate reading, and maintains a precise velocity measurement throughout the GPS drop outs.



Heading

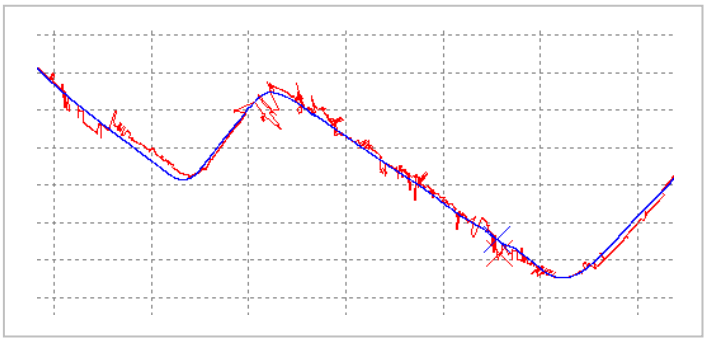
The heading reading here (the blue line) is very consistent thanks to IMU Integration, providing more accurate results than the GPS only data, which exhibits some noise.

Despite the low speed, (shown by the red line) the IMU Integration provides accurate, noiseless heading measurements.



Position

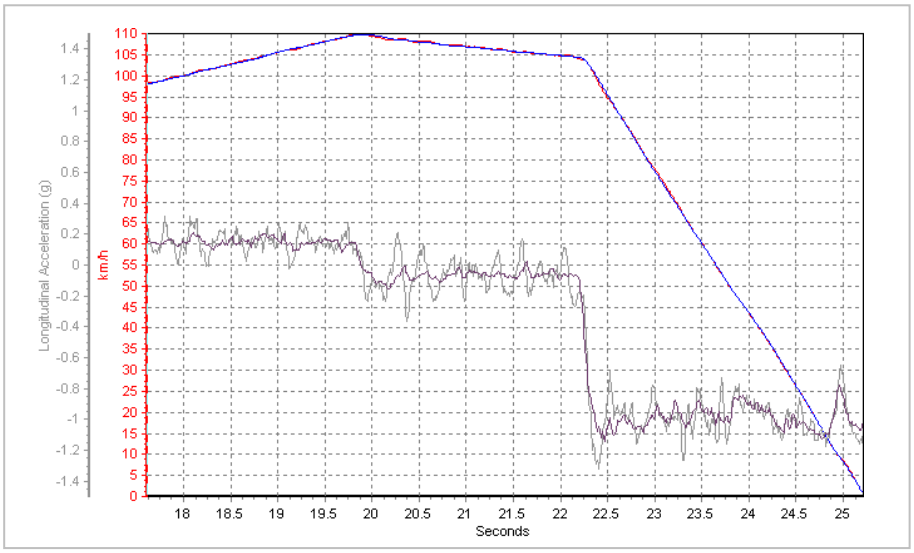
Mapping vehicle position along the heavily tree lined road as pictured overleaf; the GPS signal incurs some drop outs and reflections, producing noisy position readings. However, as shown by the blue line, IMU integration corrects the position measurements, creating smoother, more accurate data.



Acceleration

This graph illustrates longitudinal acceleration (measured in G-force) during an ABS brake stop – a very high dynamic test.

The light grey line shows the GPS only data exhibiting a small degree of noise, whilst the darker line running through it illustrates the IMU Integration data, which provides a smoother, more accurate representation of the brake stop.



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