



# HAVE YOU EVER WANTED TO COMPARE GPS ROVERS?

TechRentals offer a broad selection of GPS rovers available for rent and each rover is supplied with accessories and site-ready tough cases.



**Trimble**



**TOPCON**



**TR**techrentals

# INTRODUCTION

Many clients choose to work with a single brand of surveying GPS system out of convenience and ease of use. At TechRentals, we are in a unique position of having a broad selection of Leica, Trimble, and Topcon GPS systems in our fleet. As technically-minded surveying enthusiasts, we decided to put them through their paces.

This is far from a scholastic analysis, but we aimed to look at the accuracies of four popular GPS models in a relatively open environment and see the impact of the GPS systems in an environment with many obstructions. All GPS units provide the best possible accuracy with a clear view

of the sky, but accuracy will deteriorate with increasing obstructions – such as trees and buildings – until a fixed high accuracy GPS solution can no longer be established.

TechRentals offers a comprehensive range of network GPS units for rent, so we have access to various models and recommend the ‘right tool for the job’ depending on where the client is working, their budget, and the obstructions they will be encountering.

[Details including manufacturer best possible accuracy are shown in the table below:](#)

## Leica GS18T

Use case	Surveying
Released	2017
Horizontal acc.	8mm
Vertical acc.	15mm



## Trimble R10-2

Use case	Surveying
Released	2018
Horizontal acc.	8mm
Vertical acc.	15mm



## Trimble R2

Use case	Mapping/Surveying
Released	2015
Horizontal acc.	10mm
Vertical acc.	20mm



## Topcon HIPER SR

Use case	Entry-level Surveying
Released	2012
Horizontal acc.	10mm
Vertical acc.	15mm





# METHOD

A pair of points were coordinated with a robotic total station and observed for this comparison:

- Obstructed point (OB)
- Open point (OP)

As seen on the cover images and the aerial photograph below, there is a clear difference in the sky view conditions between the points.

One at a time, each GPS model was then setup on a fixed tripod to log 1 point per second (fixed only) for 1000 seconds on each point. Data was then exported for plotting.

The open point is located at the edge of an open parkland on a permanent survey mark (Nunawading PM 525). The obstructed point is located in very close proximity to buildings and tall trees, obstructed just enough to allow

each GPS model to still establish a fixed position. The obstructed point coordinates were computed by traverse from the permanent survey mark.

These coordinates served as the reference (0,0) points that each GPS model would be set up on and compared against. There can be differences in the coordinates of PMs, so the reference positions should be used as a guide.

Each GPS was configured to use the default Network RTK correction signals on the MGA Zone 55 GDA94 projection – these correspond to HxGN SmartNet for Leica, Trimble VRS Now for Trimble and AllDayRTK for Topcon.



Relative location of Open point and Obstructed point





Open point (relatively clear view of the sky)



Obstructed point (trees and structures blocking view of the sky)

# RESULTS

The positions calculated by each GPS unit over 1000 seconds can be seen on the visualisations below.

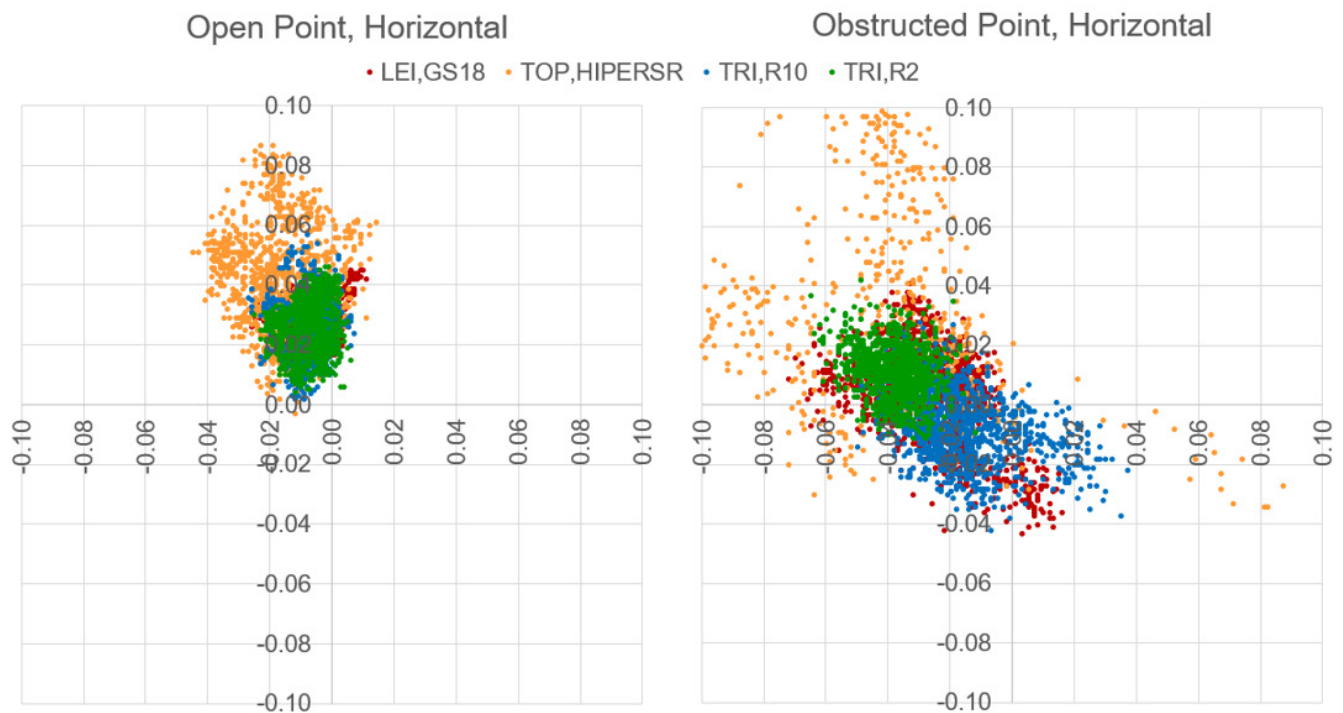
In terms of initialisation times there were no significant differences between each model. This includes time to initialise from off and time to reinitialise after losing all signals. Given the small sample this was ignored for this analysis.

As expected, it is clear that the accuracy and consistency of the calculated position deteriorates near obstructions. However, it can be seen each model is affected to a different degree. These results are summarised in the following figures.

The Topcon HiPer was the only GPS system that only observed the GPS and Glonass satellites. All other

systems were tracking all available systems including BeiDou and Galileo. Unfortunately, our HiPer VR systems weren't available at the time of testing, but has been analysed in 'Additional Testing' below. The results highlight the importance to use a higher end GPS system when you require better accuracies or are operating in an obstructed GPS environment.

Please see the Disclaimers for further details on the testing and analysis. If you have any suggestions or would like any other units tested, TechRentals have all three major brands to provide you with the most appropriate system when you need it, and would welcome your suggestions for further testing.

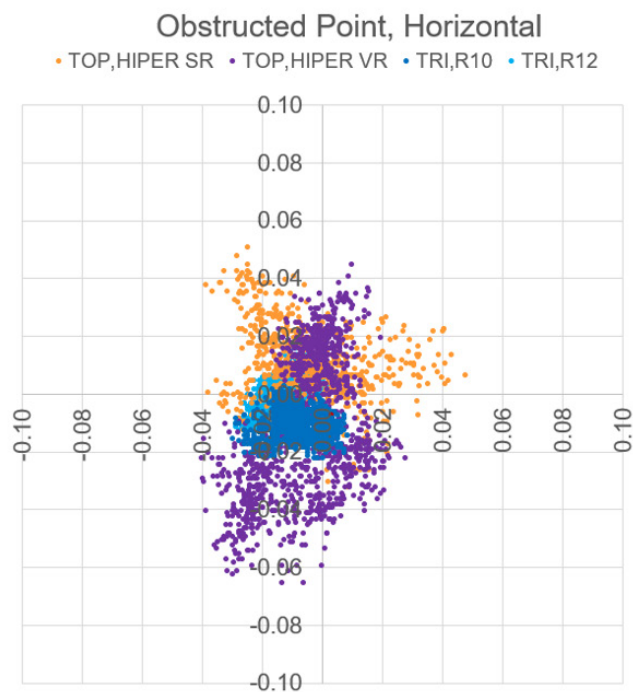
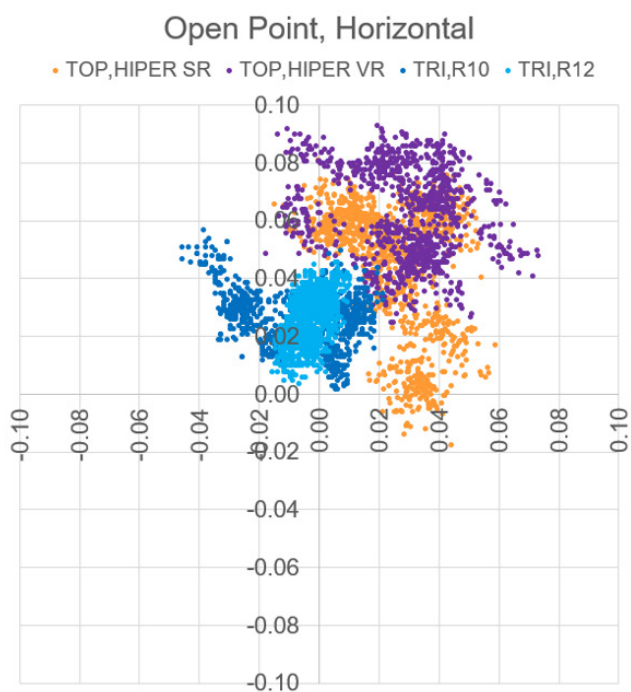




## ADDITIONAL TESTING

Following our existing testing we were able to get access to the Topcon HiPer VR and the new Trimble R12 for testing. As these were tested on a different day we have kept the testing independent, but included the Topcon HiPer SR and Trimble R10 as a benchmark.

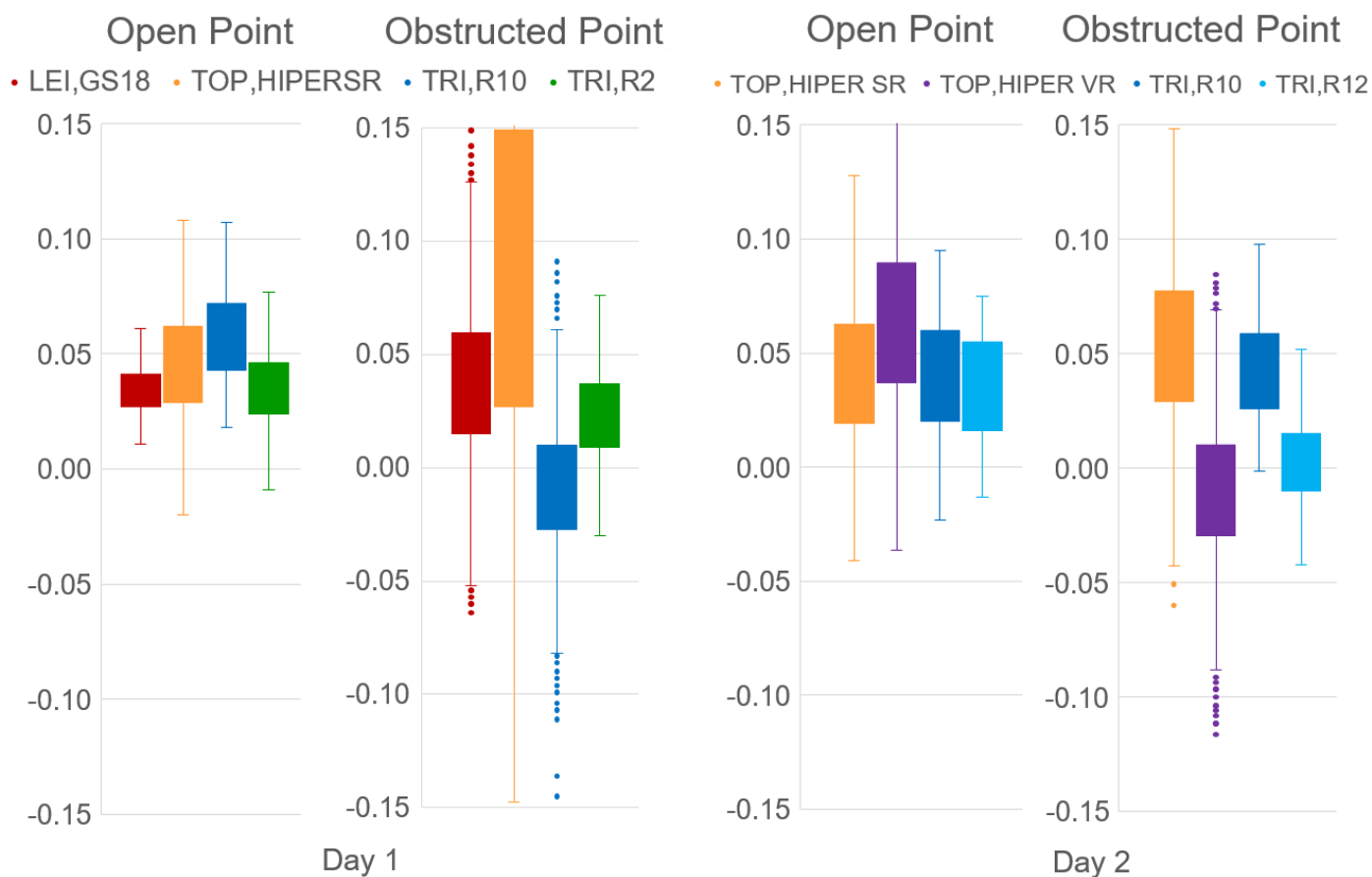
It is clear that the Trimble R12 performed as well, if not better than the R10, but the Topcon HiPer VR performed in a similar way to the HiPer SR.



# VERTICAL ACCURACIES

The vertical accuracies have been analysed using the excel 'box and whisker' technique to highlight the mean, variability and outliers. For more details please click [HERE](#).

The following graph shows the Day 1 results on the left and Day 2 results on the right. Regardless of the model, this highlights the importance of being aware of the accuracy differences working around obstructions.



# SUMMARY

## Leica GS18T

Use case	Surveying
Released	2017
Open area	Superior
Obstructed area	Good

The GS18T demonstrated great accuracy out in the open area, while still providing good accuracy in the obstructed area.



## Trimble R10-2

Use case	Surveying
Released	2018
Open area	Good
Obstructed area	Good

The R10-2 offered good consistency across both points, outperforming the GS18T and HIPERSR on the obstructed point.



## Trimble R2

Use case	Surveying / Mapping
Released	2015
Open area	Good
Obstructed area	Superior

The R2 had remarkably great performance in the obstructed area and was difficult to distinguish from the R10.



## Topcon HIPER SR

Use case	Entry level Surveying
Released	2012
Open area	Good
Obstructed area	Poor

While it could be said the HiPer SR performed poorly in obstructed areas, it can also be said that in open areas the HiPer SR is competitive with the other models. The Hiper SR was the only model observing just the GPS and Glonass satellites, which highlights the need to move to higher end models when working in obstructed environments.



The findings of this case study are subject to disclaimers on the next page.



# DISCLAIMERS

- The observations were measured using relatively short occupation times and were by no means an extensive test. Occupations between brands were performed in quick succession to minimise changes in satellite constellations, but variations would likely occur between setups.
- The 2 control points were observed on different days.
- The 'Zero Coordinates' were based on a local PM 525. There are inherent inaccuracies in these coordinates, and should only be considered as reference position.
- Default manufacturers settings were used to define acceptable fixed solutions over float solutions.
- The Topcon HiPer SR is only capable of receiving GPS and GLONASS signals, whereas the other tested solutions are capable of receiving full GNSS (including Galileo, Beidou, etc.). Hence we expected a lower precision from the SR but sought to understand the quantum of difference.
- We did spend time to try and compare initialisation times on the Obstructed Point. Each receiver was deprived of satellites for 30 seconds, enough to lose all satellites and initialisation. This was done 10 times for each receiver, but each receiver reinitialised in less than 20 seconds, so no conclusions could be drawn. Any future tests would require a more adverse environment, greater length of time without signal, and movement during this process.