

## Reliability analysis of assisted-GPS technologies for post-flight analysis

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*Abstract: This research analysed the reliability of an assisted-GPS mobile phone in tracking several flight parameters during a typical flight. The reliability was assessed against that of a GPS-based remote tracking device of common use in aviation. The results suggest that the reliability of both devices is similar, which may prove advantageous to those pilots with lesser resources or less interested on a dedicated tracking device.*

### Introduction

Until recently, GPS-capable devices were few and relatively high cost, and only professionals or dedicated enthusiasts could afford them. Of lately, however, GPS-capable devices are becoming widely available and affordable, especially when incorporated on mobile telephony handsets which use non-proprietary programmes, such as Google Earth, for navigating their way through cities or, even, in the air. Yet, it may be that there is not such thing as a “free lunch” and that the reliability of those devices is lesser than that of specialized ones. Therefore, this research attempted to assess the reliability of an Assisted-GPS mobile phone by comparing its performance with that of a specialized GPS tracking device onboard a general aviation aircraft.

### Methods

A GPS tracking device and an Assisted-GPS mobile phone were mounted onto a Piper PA-28-161 Warrior prior to the commencement of a flight training session. Both technologies as well as a stopwatch were started at the same time prior to the flight (the time recorded by the stopwatch was to be used as a triangulation measure). At the end of the flight one hour and seventeen minutes later, the data sets from both technologies were downloaded onto spreadsheets, and four pairs of variables were selected for analysis: latitude, longitude, altitude, and speed. (Variables such as pilot’s experience, type of aircraft, weather conditions, etc were believed to have no effect on above variables, and, thus, were neither controlled nor measured.)

The research sample consisted of pre-determined time intervals (data points) at which each technology recorded all four flight parameters. However, because each technology tracked at different intervals (for example, the mobile phone tracked per second while the tracking device did so per minute), the total size of the sample of usable data points was limited to the maximum number of data points recorded by the fleet tracking technology. This restricted the sample size to 76 data points per technology.

### Results

Prior to analyse the data, a discrepancy between the altitude recorded by both technologies and the altitude of the runway was found. The fleet tracking device recorded an altitude 11.28 metres below the known altitude of the runway, while the mobile phone recorded an altitude 13 metres above the known altitude of the runway. Assuming that the discrepancy would remain constant during the flight, these variables

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were corrected by adding or subtracting the corresponding net discrepancy, respectively.

The data were analysed using Pearson's product-moment coefficient as the most informative statistic. Pearson's coefficient showed almost perfect (and significant) correlation between the same pair of variables from each technology: latitude ( $r=.991$ ,  $p<.000$ ), longitude ( $r=.997$ ,  $p<.000$ ), altitude ( $r=.990$ ,  $p<.000$ ), and speed ( $r=.927$ ,  $p<.000$ ).

Post-hoc t-test analyses for paired-samples resulted in no significant differences between the same pair of variables from each technology. Latitude ( $t=.091_{(df\ 69)}$ ,  $p=.927$ ,  $power=.950$ ) and longitude ( $t=-.257_{(df\ 69)}$ ,  $p=.798$ ,  $power=.860$ ) were the variables with lesser means differences between both technologies. The power for both variables was relatively high, enough for capturing a small effect size ( $d_z=.1$ ). These results suggest a relatively similar accuracy in measuring those variables by both technologies. Speed ( $t=-.803_{(df\ 69)}$ ,  $p=.424$ ,  $power=.575$ ) and altitude ( $t=-1.164_{(df\ 69)}$ ,  $p=.248$ ,  $power=.408$ ) also showed no significant differences between technologies, although the accuracy of both measures was lower than that for the other two variables. The mobile phone measured speed 1 knot faster than the fleet tracking device. The mobile phone also measured altitude 3 metres higher than the fleet tracking device, once altitude was corrected as indicated in the procedure above. Without correction, however, there was a significant difference between the altitude recorded by each device, which differed, on average, some 28 metres ( $t=-7.471_{(df\ 69)}$ ,  $p<.001$ ;  $power=.999$ ).

## Conclusions

These results suggest that the GPS technologies under comparison, namely a mobile phone device and a fleet tracking device, measure flight parameters with similar efficacy. Although both technologies differ in the number of variables recorded and the features users can avail of, the recording of important variables such as longitude and latitude, for location, and speed and altitude, for navigation, correlate highly between them.

The research was not designed for "proving" the null hypothesis that both technologies were similar in performance; yet the results on power analysis suggest that longitude and latitude were measured accurately by both devices, while speed and altitude were less so. The difference in speed amounted only to one knot, and may count as anecdotic. The difference in altitude, however, was notorious, as both differed from the actual altitude of the runway when the aircraft was stationary on the apron. Once altitude was corrected as per the actual altitude of the runway, differences in altitude as measured by both devices turned not significant.

Therefore, it seems that assisted-GPS mobile phones can be used with confidence for tracking flight performance for post-flight analysis. This opens an opportunity for manufacturers to produce GPS-enhanced products, and an opportunity for pilots with lesser resources to avail of a technology capable of measuring certain flight parameters cheaply and reliably.