

Technical Report TR01

2D Location Accuracy Statistics for Fastloc® Cores Running Firmware Versions 2.2 & 2.3

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Introduction

This technical report presents 2D location accuracy information obtained from processing GPS constellation data acquired by Fastloc® GPS receiver technology. Two sets of results are presented, those obtained from a receiver running the version 2.2 firmware, and also from a receiver running the latest version 2.3 firmware. The equivalent firmware revisions for Fastloc® products manufactured by Wildlife Computers Inc. and Sirtrack Ltd are v3.0.3 & v3.0.4 respectively.

As Fastloc® location technology was developed for the marine environment it was deemed that 2D location accuracy statistics would be of most interest to users.

Background

Fastloc® version 2.x receiver boards (Wildtrack Telemetry Systems Ltd) were used to acquire the test data over 2 separate periods of 3 & 1 days, resulting in 10000 and 4000 acquisitions respectively. The software used to process the acquired constellation data was developed by Wildtrack Telemetry Systems Ltd, and it forms the basis of the processing software provided by all vendors of Fastloc® based products.

Since firmware version 2.2, the satellite ranging data has been provided in the form of a 15 bit integer value, earlier firmware revisions only provided 14 bit ranges and hence had a reduced range resolution. Users need to check with vendors to confirm that full resolution ranges are being implemented. Results will be slightly degraded from those presented if this is not the case.

Data Processing

The parameter setup used for processing the constellation data was as follows:

Initial location: Randomised within 0.5 decimal degrees of the true location.

Initial altitude: Within 20m.

Maximum time error: ± 1 s.

Search radius: 400Km

Fixed height processing: Only for acquisitions with 4 Satellites.

Altitude bounds: ± 50 m

An increased maximum time error may affect location accuracy for 4 or 5 satellite solutions, as it is more likely that there are multiple location solutions.

Results

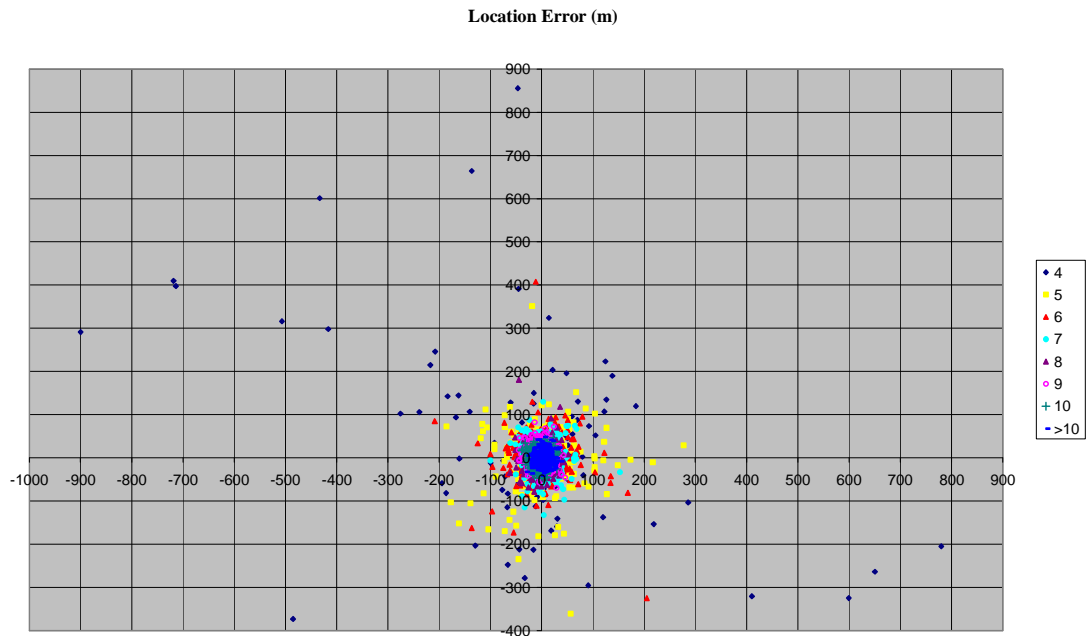


Figure 1 Location error for v2.2 Fastloc®

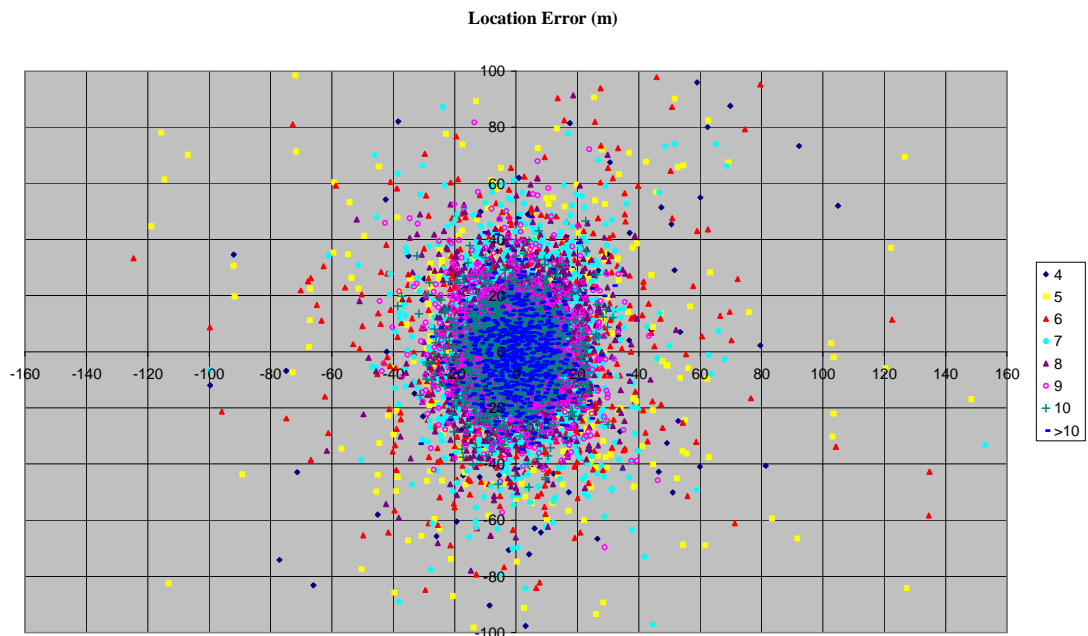


Figure 2 Location error

The results of the data processing are presented above. Figures 1 & 2 illustrate the spread of location estimates around a fixed point, the constellation data were from a receiver with firmware version 2.2, the figure legends indicate the number of satellites used for the location calculation. The location of the receiver was suburban with a

partially masked view of the sky. Location estimate outliers are typically the result of solutions from <7 satellites.

The results highlight a reasonably accurate location solution, comparable with standard GPS receivers when Selective Availability was switched on. Figures 3 & 4 illustrate the cumulative density plot of location errors. It can be seen that the more satellites detected the better the location solution e.g. for >10 satellites 100% of the solutions will be within 50m and 50% will be within 13m accuracy.

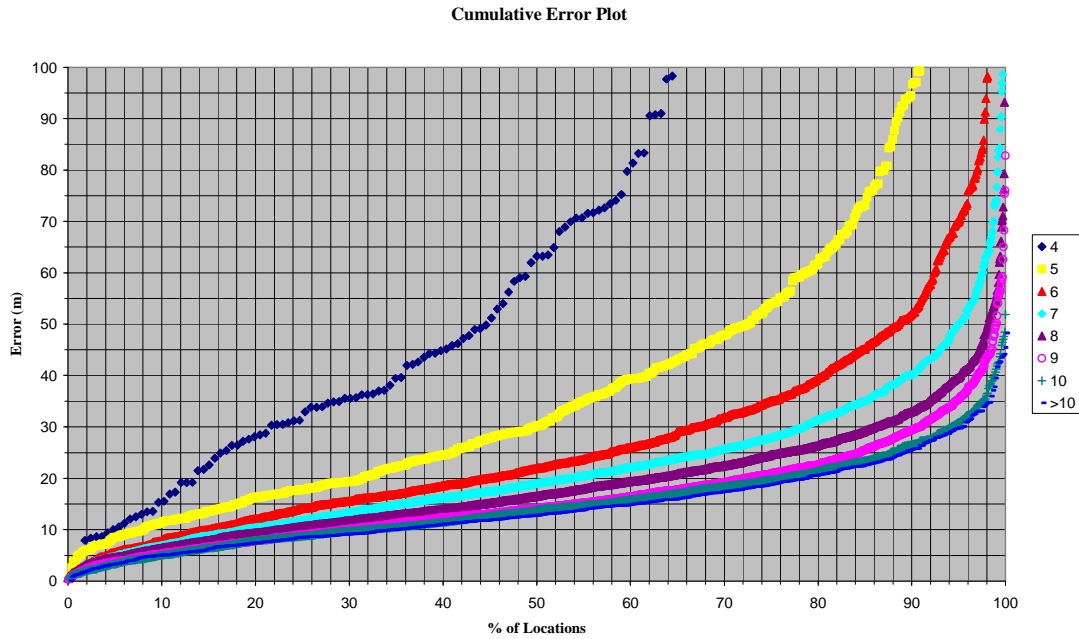


Figure 3 Cumulative Error

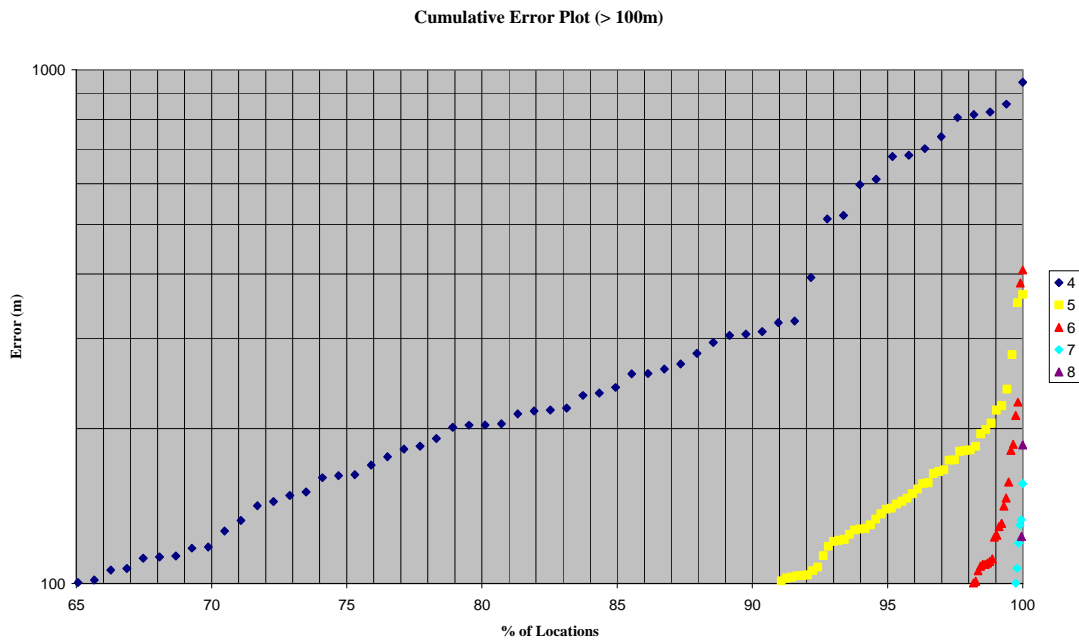


Figure 4 Cumulative error (>100m)

Positioning is most effective when more than 5 satellites can be tracked by the receiver. However a location estimate can be made with just 4 satellite detections, but as has been highlighted in the previous plots, errors can be high.

Figures 5 & 6 present the cumulative error plots for locations calculated from data from a receiver with version 2.3 firmware.

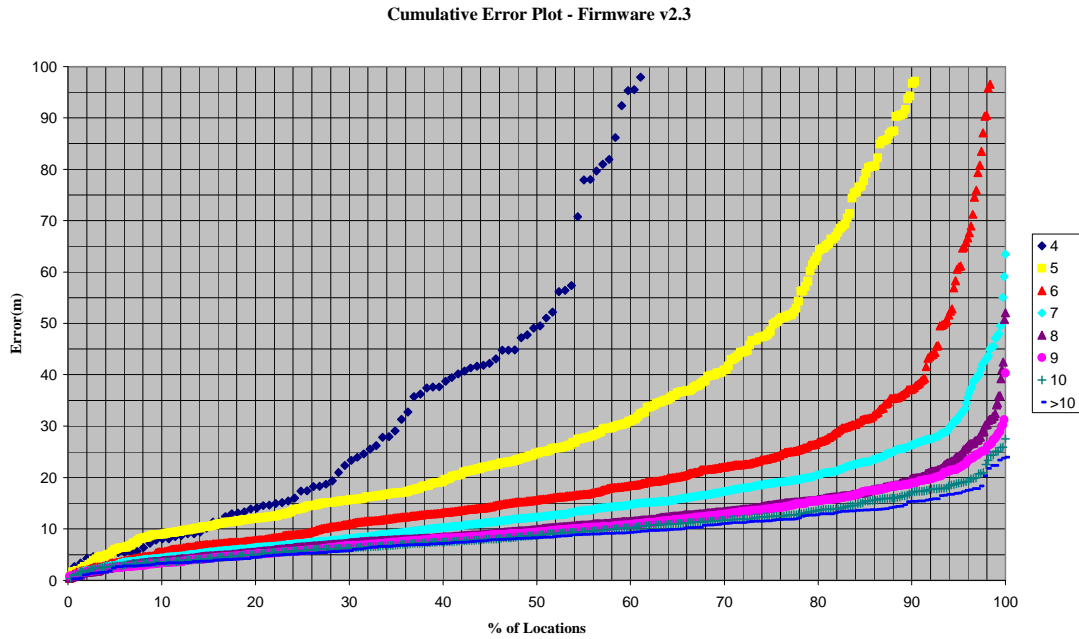


Figure 5 Cumulative error - v2.3 firmware

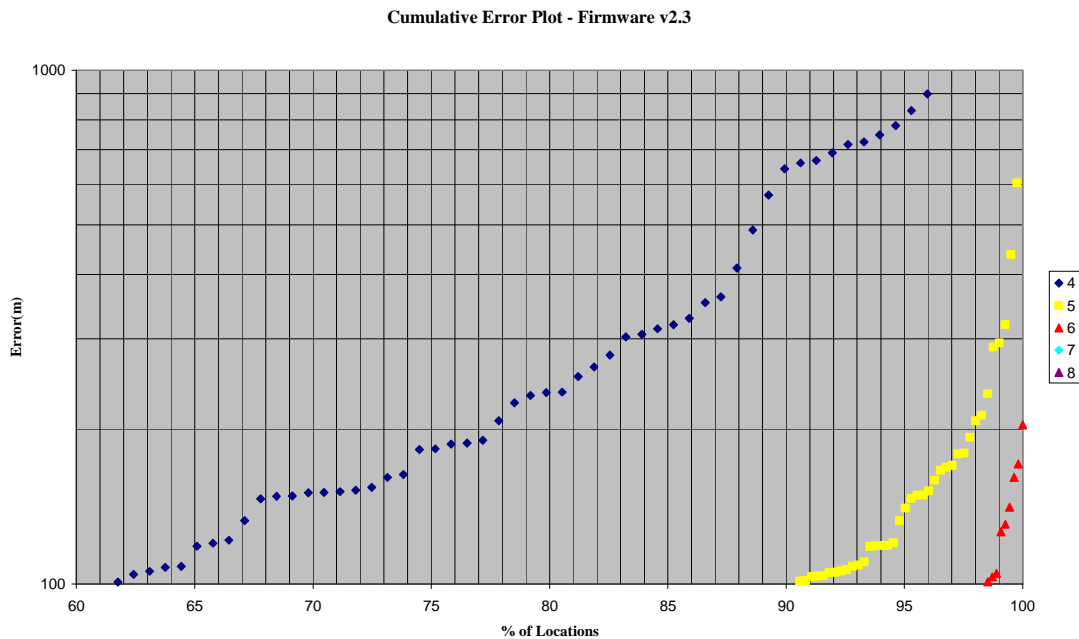


Figure 6 Cumulative error - v2.3 firmware (>100m)

From these results we can see that the version 2.3 firmware enhancements have resulted in an improvement of the location estimation, with locations calculated from

acquisitions with >6 satellites seeing significant improvement. It should be noted however that for acquisitions with only 4 satellites the errors outside the 50th percentile would appear to be slightly increased. Table 1 summarises the results from both receivers.

Table 1. Location Accuracy Statistics

No. Satellites	Firmware v2.2		Firmware v2.3	
	CEP	95%	CEP	95%
4	63.2	630	49.5	810
5	30.1	140	24.7	140
6	21.9	70	15.6	61.0
7	19.0	50	12.3	31.8
8	16.5	39.6	9.9	24.2
9	14.1	35.3	9.4	21.9
10	13.8	30.8	8.8	18.9
>10	12.8	29.8	8.3	17.0

If we examine table 1, the location estimation accuracy improvement of v2.3 firmware data over v2.2 firmware is immediately apparent. For all acquisitions there is an improvement in the circular error probability (CEP, the probability that 50% of locations will lie within a circle of this radius). For the 95th percentile the error is higher for acquisitions with only 4 satellites, indicating that the false locations have higher errors in this case. In general, for acquisitions with 7 satellites or more with the v2.3 firmware, there is a 30-40% reduction in 2D position error.

Summary

The 2D error statistics for Fastloc® GPS receivers running version 2.2 and 2.3 firmware have been presented. It has been shown that there is a significant increase in accuracy for positions calculated from GPS constellation data acquired by Fastloc® receivers running version 2.3 firmware.