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P1.04 | Development of a Test Facility for GNSS Positioning System Validation and Certification

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Objectives This project is developing a system that can be used to quantify and validate the performance of real-time Global Navigation Satellite System (GNSS) positioning systems in determining its 'fitness-for-purpose'.

Outcomes

- Identify the requirements of a test system based on an assessment of application requirements and operating scenarios
- Revise a practical methodology for repeatable and traceable system tests
- Develop, implement and test a robust set of statistical algorithms that characterise the performance of the positioning system.

Introduction

Global Navigation Satellite Systems (GNSS) technology has become so pervasive that a lot of critical applications depend on the positioning outputs of a GNSS device. The consequences of the equipment not working to its expected requirements may have legal repercussions or even endanger personal safety. Currently, there are no assessable and independent facilities which provide system 'fitness-for-purpose' certifications for end users and as such, this research aims to establish both the theoretical and practical foundations of the underlying architecture used for these proposed facilities.

1) The Need for Receiver Benchmarking

GNSS receivers across different manufacturers have proprietary ways of processing GNSS measurements which has made receiver performance benchmarking difficult. Universal benchmarking algorithms are being developed to understand the capabilities of a receiver which would allow end users to determine and test the most suitable equipment for an application.

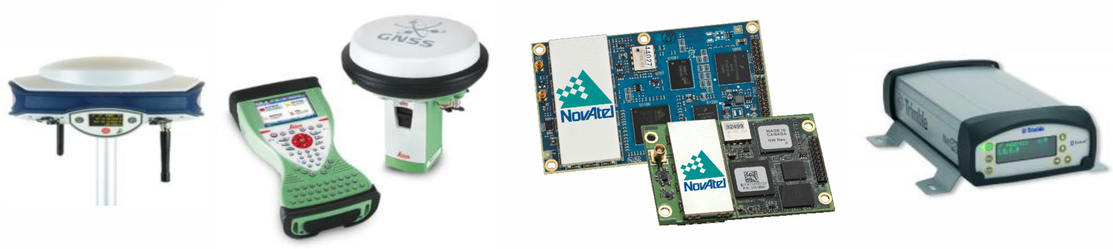

Figure 1: Different GNSS receiver types

2) Developing Repeatable Test Scenarios

Repeatability of the tests is a crucial aspect of the overall methodology and the Record and Playback System (RPS) provides an invaluable tool to record and generate consistent real world GNSS signals. Conventional real world signal tests are limited as they do not provide many sets of repeatable quantitative data for significance testing.

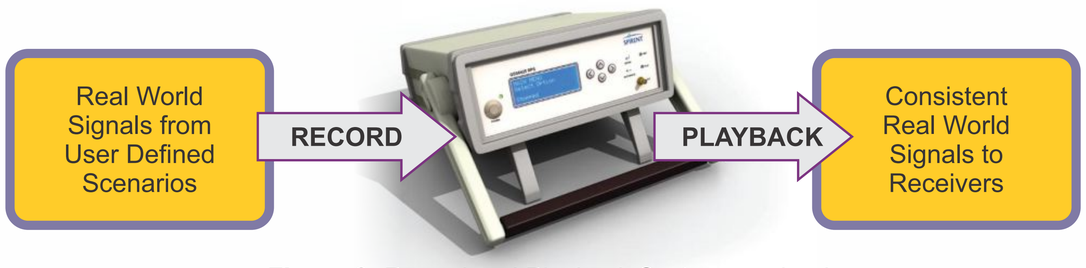

Figure 2: Record and Playback System mechanism

3) Receiver Performance Variability

The histograms below show the receiver positioning uncertainty produced by varying high precision GNSS receivers under test. Receiver uncertainties are generated based on the coordinate difference between 30 playback sequences. This research has provided empirical evidence that the quality of positioning are affected by a GNSS receiver type, hardware, and firmware.

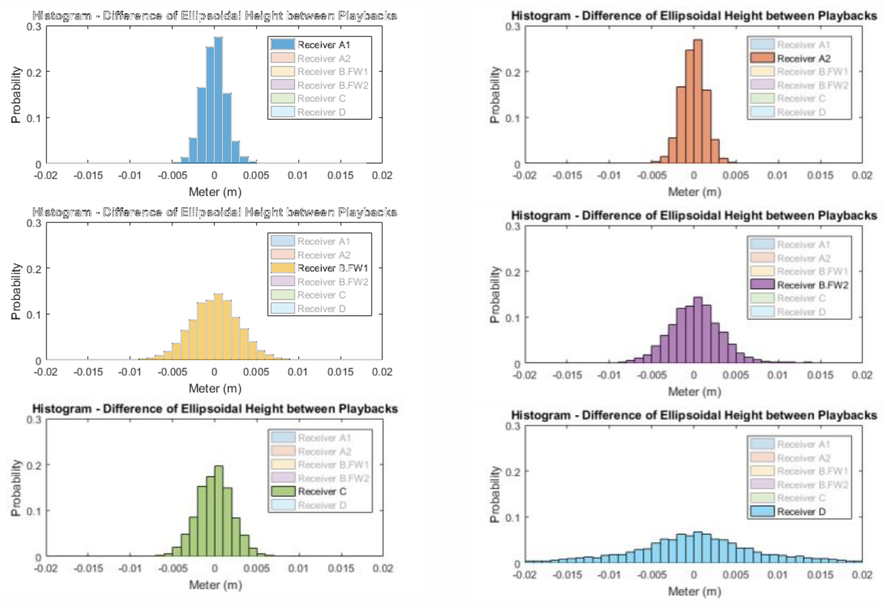

Figure 3: Histogram of receiver uncertainty in a low-multipath static antenna scenario. A1 and A2 are separate identical receivers; B.FW1 & B.FW2 is the same receiver hardware with varying firmware.

4) Testing & Certification

As there are many aspects of the GNSS that influences positioning performance, the independent certification process involves a set of many predefined test routines, parameters and statistics which are prioritised according to user requirements. The outcomes of this test enables users to compare individual receiver performance against similar or other receivers in the database.

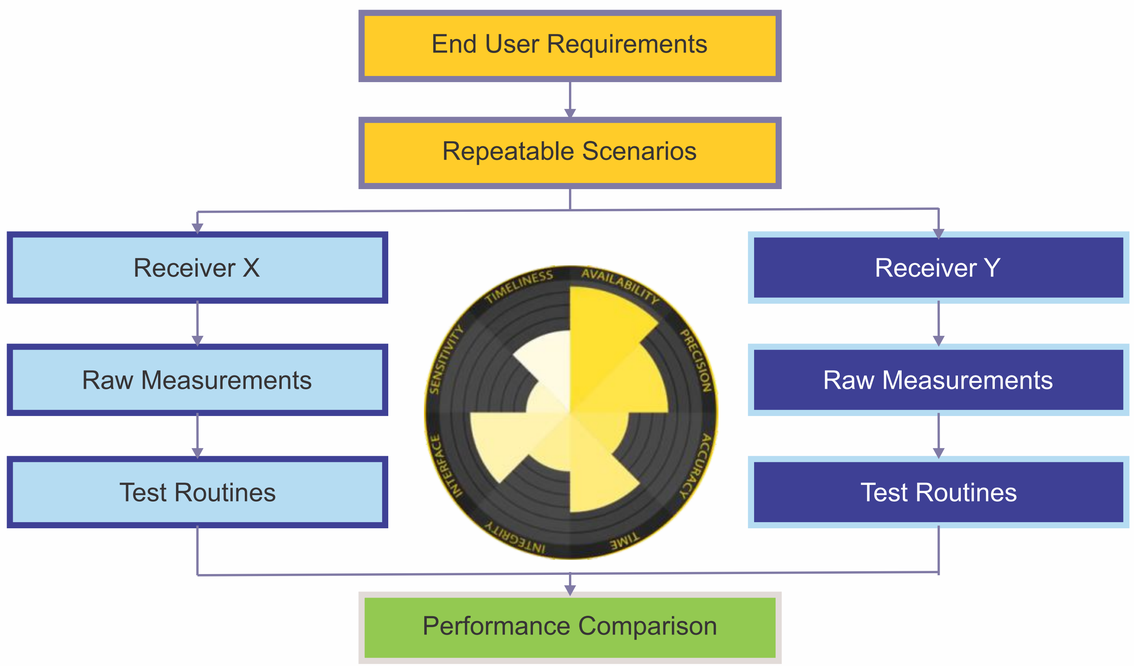

Figure 4: Test Concept

Summary

The test facility concept being proposed in this research envisages providing users with the ability to routinely and regularly assess the performance of GNSS equipment. Once realised, greater assurance can be given to an individual equipment towards its intended and expected levels of performance under common GNSS operating scenarios.