

Introduction

WHAT ARE SIGNAL DEFORMATIONS?

The ICAO second-order step fault model defines analog and digital signal deformations:

Digital distortion Δ : amount of lead or lag in the falling edges of the distorted C/A code with respect to the expected position of those edges

Analog distortion f_d and σ : Ringing frequency and damping coefficient of ringing at the edges

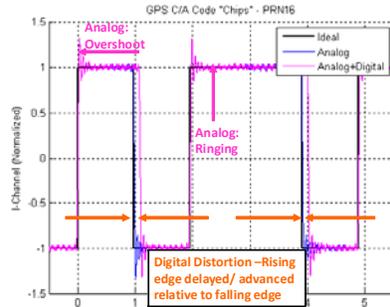


Figure 1: PRN16 GPS C/A Code Chips with Digital and Analog Distortion

Objective

CHARACTERIZATION OF ANALOG AND DIGITAL SIGNAL DEFORMATIONS

- What is current signal deformation behavior of GPS and WAAS satellite signals?
- What is the performance of the new satellite signals, some on new frequencies, from a signal deformation perspective?

Signal Processing

SIGNAL PROCESSING OF RAW DATA

The following steps were carried out:

0. Data collection using high-gain antenna
1. Code and carrier tracking for extraction of C/A code onto in-phase channel
2. Multiple C/A code epoch averaging and interpolation (**new method**)
3. Additional filtering for noise reduction and/ or interpolation
4. Application of zero-crossing determination methods.

A **new method** for multiple C/A code epoch averaging and interpolation was developed and used. This allowed noise reduction via averaging to be achieved in a simple yet efficient way.

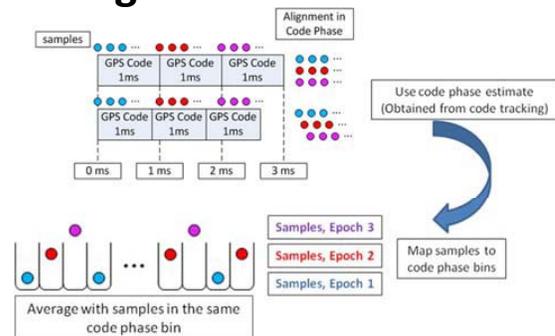


Figure 2: Summary of new method of multi-epoch C/A code averaging and interpolation

Results , Observations and Conclusion

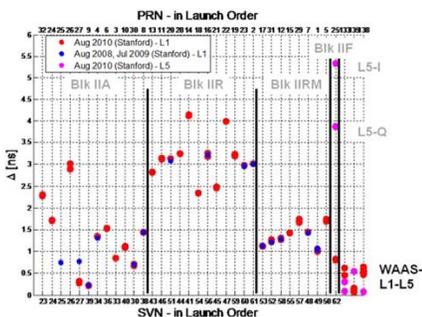


Figure 3: Digital distortion parameter Δ for entire set of GPS and WAAS signals for both L1 and L5 frequencies

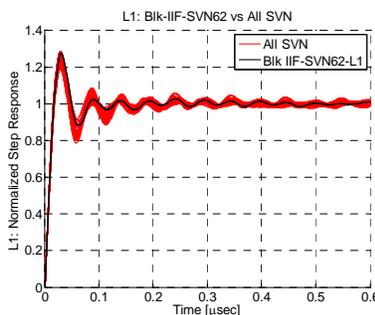


Figure 4: Analog distortion curve of SVN62-L1 in comparison with all other SVN-L1

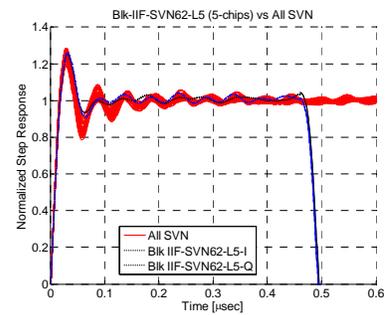


Figure 5: Analog distortion curve of SVN62-L5 Inphase and quadrature - in comparison with all other SVN-L1

The digital distortions for GPS and WAAS satellites (Fig 3) are within nominal specifications (10ns), while the analog distortions are very similar (Figs 4 and 5). The figures show that the signals from the newly launched Block IIF-SVN62 satellite, on both L1 and L5 frequencies, do not look anomalous.