Characterization of Signal Deformations for GPS and WAAS Satellites
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Introduction
WHAT ARE SIGNAL DEFORMATIONS?
The ICAO second-order step fault model defines analog and digital signal deformations:

Digital distortion \( \Delta \): 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 \( \sigma \): 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
a. What is current signal deformation behavior of GPS and WAAS satellite signals?
b. 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

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 \( \Delta \) 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.

The authors gratefully acknowledge the sponsorship of the Federal Aviation Authority (FAA) for this work.