

**GRAS SAF Open Loop Workshop**  
**Helsingør, Denmark**  
**June 6-8, 2005**

DMI Technical Report 05-11  
ISSN: 1399-1388  
Kent B. Lauritsen and Frans Rubek, editors



## **Removal of the Navigation Signal using GOLD\_RTR**

Antonio Rius (1), J. M. Aparicio (1,2), O. Nogues (1)  
(1) IEEC, Barcelona, Spain (2) Meteorological Service of Canada, Dorval, Canada  
rius@ieec.fcr.es

When the GPS signals are received after traversing a random channel (propagation through a substantially heterogeneous media, or the reflection on a rough surface) its phase and amplitude experience excursions which are larger than the Phase Lock Loop (PLL) window. In this case it is indicated to use the receiver in Open Loop (OL) mode. The phasors are then reconstructed in post-processing, whereas in PLL mode this reconstruction is performed in real time.

In addition, the navigation message increases the randomness of the signal in the OL mode, but this could be eliminated if we observe the same signal through a non-random channel, extract the navigation signal and use it for the calibration of the random signal. In the case of satellite radio occultation, this non-random channel could be established by upgrading the network of ground receivers to include this functionality.

This presentation presents the GOLD\_RTR (GPS Open Loop Differential Real Time Receiver) built for gathering reflected signals, and examples of automatic removal of the navigation information from a signal acquired in Open Loop mode.

# Removal of the Navigation Signal Using GOLD\_RTR

A. Rius, O. Nogués, J. M.  
Aparicio

## Purpose

- To give an example of assisted wipping off the navigation bits
- Based on the GOLD\_RTR
- Perhaps useful in open loop occultations

## Wipe-off

- We need the phase without the navigation bit
- Squaring the signal removes it
- But, if the SNR is low, this procedure is prone to produce too many cycle slips
- The example is similar to the “A-GPS” techniques

## The GPS System

GPS has been designed and built for users with direct visibility of the GPS Constellation.

## The GPS System

In the occultation link we do not need to decode the navigation msg.

## The GPS System

And the receiver in this link could be assisted with information from other sources, to create the models to be used in the cross-correlation.

## An example: GOLD\_RTR

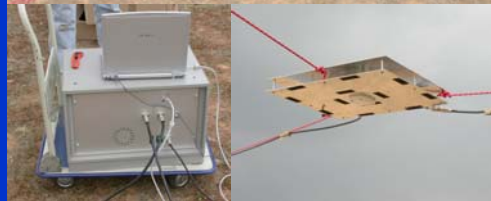
- GOLD\_RTR (GPS Open Loop Differential Receiver) uses information from a standard receiver (NOVATEL OEM4) to assist in the correlation process.
- The system contains 640 complex correlators which produce in real time cross-correlation functions in different RF configurations.



## Field experiment

IEEC

- ✓ Two antennas: one uplooking (zenith), another downlooking (nadir)
- ✓ Distance antennae ground 1.5 meters approx.
- ✓ Wire mesh to produce reflected GPS signals
- ✓ The instrument produced in RT correlations each 1 msec. The navigation bit extracted from the uplooking antenna was used to remove the navigation bit in the downlooking antenna



*Testing GOLD\_RTR for real time applications*

