Next-generation algorithms for navigation, geodesy and earth sciences under modernized Global Navigation Satellite Systems (GNSS)

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Introduction: The project on "Next-generation algorithms for navigation, geodesy and earth sciences under modernized Global Navigation Satellite Systems (GNSS)" has been under development in the scope of the GEOIDE Network. In this presentation we display an overview of some of the activities which have been taken place under this project. They involve: (a) Processing and analysis of real modernized GNSS data (L2C) as well as simulated data; (b) Designing algorithms for precise point positioning (c)Study of the improvement of ambiguity resolution with modernized GNSS signals; (d) Development of a PPP software with options to calibrate satellite and receiver phase biases

IMPROVEMENT OF AMBIGUITY RESOLUTION WITH MODERNIZED GNSS SIGNALS (1/2)

Based on the normal equation matrix a theoretical discrimination factor for ambiguity resolution was derived. It can be obtained without actual observations and allows to judge the instantaneous ambiguity resolution potential for a given constellation.

Theoretical discrimination factor $\kappa = \frac{\sigma^2_{2^{nd}\,best}}{\sigma^2_{best}}$

Extensive simulations for GPS, Galileo and combined constellations were performed, showing the improvements obtained by a hybrid solution in the dual and triple frequency cases.

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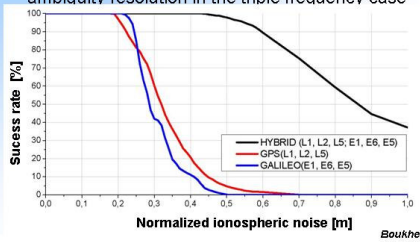
IMPROVEMENT OF AMBIGUITY RESOLUTION WITH MODERNIZED GNSS SIGNALS (2/2)

Simulated success rate for instantaneous integer ambiguity resolution in the triple frequency case



Boukhecha (2006)

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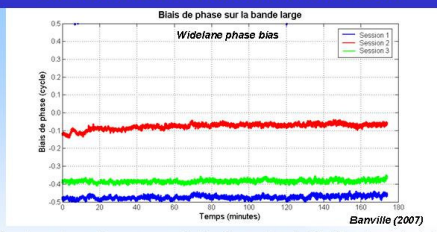
CALIBRATION OF RECEIVER PHASE BIASES (2/2)



Banville (2007)

- Receiver phase biases were similar for each satellite (for simulated signals)
- Receiver phase biases were different from session to session
- Receiver (absolute) code biases affects the estimation of phase biases
- Receiver temperature variations caused a drift in the calibration values
- Delays in the simulator electronic components have also to be investigated

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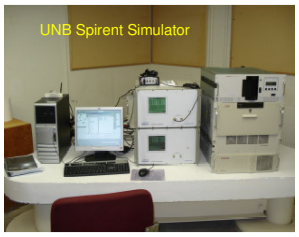
CALIBRATION OF RECEIVER PHASE BIASES (1/2)

The calibration of receiver phase biases is one of the key elements to be able to fix phase ambiguity in PPP and to potentially reach cm accuracy level without long convergence periods.

The use of errorless code and phase signals from a hardware simulator would (theoretically) allow to isolate receiver phase biases, since all errors are set to zero (including satellite phase biases).



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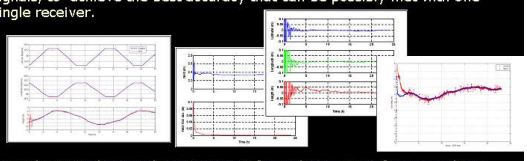
Related Posters at IUGG

L2C signal assessment using IGS L2C network

A new GPS data analysis and positioning tool

Precise GPS Point Positioning

Precise point positioning (PPP) is a positioning technique in which a single receiver is used to determine its coordinates. It is said to be "precise" because precise products such as the satellite orbits are used in the data processing. More than that, PPP techniques use a very complete mathematical model to account for the several effects present in GPS signals, to achieve the best accuracy that can be possibly met with one single receiver.



GAPS (GPS Analysis and Positioning Software) is a PPP software package which has been developed at UNB. Besides its use for coordinates determination, UNB researchers designed GAPS to be also used as a tool for GPS data analysis and quality control.

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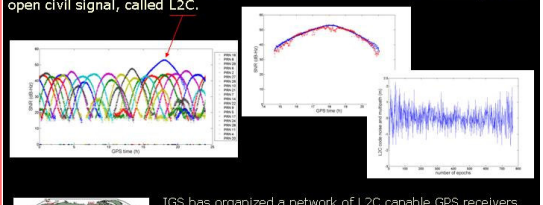
UNB3 Station – New GPS Signal

The United States started an extensive modernization program to provide better service to Global Positioning System (GPS) users. This modernization program includes launching of modernized GPS satellites, transmitting a new open civil signal, called L2C.



IGS has organized a network of L2C capable GPS receivers which have been established in different places. One of these stations is UNB3, operated by UNB. The role of this project is to analyze the quality of the new signal, as well as the impact of its use for positioning and navigation.

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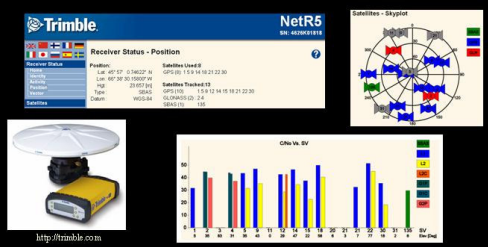
UNB3 Station – Trimble NetR5 Receiver

GPS station UNB3 is operated with a Trimble NetR5 receiver. This receiver is owned by Trimble and it is on loan to UNB. In compensation for this loan, the members of the GPS Group provide feedback to Trimble with respect to performance of the receiver and its related utilities.



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