TECHNOLOGY

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A New Doppler Removal and Correlation Method for Software GNSS Receivers

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Background

A team of researchers from the University of Calgary's Department of Geomatics Engineering, lead by Dr. Gerard Lachapelle, has developed a new method for Doppler removal and correlation in software GNSS receivers. These processes are typically very computationally expensive, and as such, methods of reducing the computational burden are desired. By performing the Doppler removal on all tracked satellites simultaneously, as opposed to traditional approaches that remove the Doppler on a satellite-by-satellite basis, this process increases the speed and efficiency of the signal acquisition process, as well as reducing the number of computations needed for Doppler removal.

Global Navigation Satellite System (GNSS) signals consist of a carrier wave modulated by a ranging code which contains information used to identify the satellite and to determine its approximate distance. As part of signal tracking in GNSS receivers, the incoming carrier frequency, and optionally phase, must be generated within the receiver to match the incoming signal. The two signals (local and incoming) are then effectively multiplied together in a process known as Doppler removal. If the local and incoming signals match, the result of the Doppler removal process contains no carrier frequency component and consists entirely of the ranging code. This signal is then multiplied by time-shifted versions of the receiver generated ranging code in a process is known as correlation.

Areas of Application

- Software-based GNSS receivers offer the promise of flexibility, adaptability and cost-effectiveness. Such software-defined GNSS receivers will serve a wide range of uses from researchers developing novel GNSS applications, to the users of mobile phones and software radio. By improving on traditional hardware receivers, software receivers will enable real-time power density analysis, raw IF data collection, storage and replay, as well as multi sensor integration.

Competitive Advantages

- Increases the speed, sensitivity and efficiency of the GPS signal acquisition process. The number of frequency bins that can be searched in a given amount of time effectively increases without increasing the computational resources used.

- Reduces the number of computational calculations used for Doppler removal by approximately 24-28%, therefore reducing the processing power required by the receiver.
- Performance benefits are independent of platform and operating system used.

Stage of Development

- A series of simulations have been run to analyze the power, phase tracking and code tracking performance of the new method. Real data has also been collected and analyzed to verify the algorithm implementation.

Intellectual Property Status

- Issued, United States
- US 7,679,551

Publications

- Petovello, M.G. and G. Lachapelle (Sept. 2006) "An Efficient New Method of Doppler Removal and Correlation with Application to Software-Based GNSS Receivers," Proceedings of ION GNSS 2006, The Institute of Navigation, pp. 2407-2417, Sept. 2006.