



Open source Precise Point Positioning with GNSS Data Structures and the GPSTk

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The goal of this work is to show how open source software, coupled with a proper GNSS data management strategy, is able to provide the foundation to easily develop non-trivial GNSS data processing strategies.

The 'GPS Toolkit' (GPSTk) project is an advanced GNSS Open Source Software (GOSS) suite initiated by the Applied Research Laboratories of the University of Texas (ARL:UT), aiming to provide a world class GNSS library computing suite to the satellite navigation community.

One of the main goals of the GPSTk is to free the research community from implementing common GNSS algorithms, providing a publicly accessible software repository where those algorithms may be found. Currently, the GPSTk development is open to a set of researchers around the world.

The GPSTk is a highly platform-independent software code base thanks to the use of the ANSI C++ programming language. It is reported to run on the following operative systems: Unix family (Linux, Solaris, AIX, etc.), Windows and Mac OS X. Also, it may be compiled using several versions of free and commercial compilers, both in 32 bits and 64 bits PC platforms. Besides, some parts of it are reported to run in such disparate platforms as the Nokia 770 Internet Tablet and the Gumstix line of full function miniature computers.

We will show how the GPSTk suite, coupled with the so-called "GNSS Data Struc-

tures" (GDS), is used to implement GNSS processing algorithms. In particular, the implementation of "Precise Point Positioning" (PPP) will be shown, taking advantage of the data encapsulation that GDS provides.

The GDS processing paradigm was developed in order to address important GNSS data management issues. After working with the GPSTk for some time, several GPSTk developers came to the conclusion that some kind of hierarchy of data structures should be added in order to easily cope with frequent data management situations that were very difficult to deal with when using just vectors and matrices, as was often the case.

As the GPSTk user base grows, the GPSTk developers thought that these data handling issues would undoubtedly gain importance, pushing for the need to develop a new and flexible set of data structures ('GNSS Data Structures'). These structures hold several kinds of GNSS-related data, properly indexed by station, epoch, satellite and type, and store them efficiently. In this way, both the data and the corresponding metadata is preserved, and the data management issues are properly addressed.

The methodology to be used is to briefly describe the GDS paradigm, and to show how the different GNSS data 'processing objects' may be combined. Several examples are given and their relative merits discussed. As a final example, a simple PPP processing strategy is presented, using a forward filter, obtaining a positioning performance comparable with other high-end GPS data processing suites.