Charter

EUREF project on "EPN Real-time Analysis"

Introduction

Many EPN stations provide GNSS data in real-time. Disseminating their streams via Ntrip became an EPN routine operation. The aim of this Project is the processing of these data to derive and disseminate real-time GNSS products while gaining experience with the real-time analysis in general.

Objectives of the Project are
- Processing and analysis of real-time GNSS data for
    - the extension or modification of existing EPN products
    - the development of new EPN products in order to improve positioning in Europe (regional products)
- Stable dissemination of real-time GNSS data and products with an elaborated backup system

More details about the concept and goals can be found in the following concept papers:
Enhancement of EPN real-time data streams (status: October 24, 2008)
Increasing the GNSS Stream Dissemination Capacity (status: July 16, 2009).

Satellite Clock and Orbit Corrections

A minimum service for the real-time PPP support (see below) is provided via estimating real-time precise satellite clock and orbit corrections with respect to the navigation messages. As satellite clock and orbit determination needs access to global resources, this Project cooperates with and contributes to the IGS Real-Time Service (IGS RTS) which is dedicated to the same subject.

The first approach which consists in producing real-time clock and orbit correctors to Broadcast Ephemeris of GPS and GLONASS satellites is described in detail in the specific section of the EPN web page.

Precise Point Positioning

Within the Precise Point Positioning (PPP) approach only observations from a single rover receiver are used. Since error sources are not eliminated in the PPP, which is based on undifferenced observations, they must be properly modeled or corrected. The most important and at the same time minimum corrections are provided through real-time precise orbits and clocks using so-called "State Space Representation" (SSR) approach,

Schmitz, 2012 and Wübbena, 2012. Details of the potential of modern PPP algorithms can be found in, e.g., Wübbena et al., 2005 and Mervart et al., 2008.

The goal of this part of the work is to evaluate the PPP accuracy reachable in real-time: A sole EUREF and IGS based service shall allow real-time decimeter-level satellite positioning everywhere on the European continent when using a dual frequency GNSS receiver.

Monitoring

Incoming real-time GNSS observations from the EPN network as well as derived clocks and orbits are continuously monitored. Monitor results describing completeness and latency of observations are derived in the context of converting RTCM streams to 1sec/15min RINEX files.

Standardization

Except for the scientific community, real-time GNSS products like satellite clocks and orbits remain of marginal value unless they come in a standardized format supported by receiver firmware. The Project therefore supports the standardization under development in the State Space Working Group of RTCM SC-104. The tools used so far for clock and orbit correction processing and dissemination follow RTCM Recommended Standards and proposals documented in RTCM working papers. Encoding/decoding routines used in this Project will be updated when new RTCM proposals become available.

Regional-based Products

Estimating satellite clocks and orbits from EUREF and IGS sources is understood as a first and minimum step in real-time GNSS support for user-end PPP applications. Deriving other real-time products mainly focused on ionosphere and troposphere products or hardware bias estimation in order to support PPP regional ambiguity resolution and finally aimed for regional augmentations with instantaneous ambiguity resolution on user-side (i.e., PPP-RTK providing an alternative to RTK) should be main objective for future developments within European real-time activities.

Project Members

There is an increasing interest in real-time developments and applications making a static list of project members difficult. However, colleagues of various organizations are supporting this Project, namely Federal Agency for Cartography and Geodesy (BKG), Germany (W. Söhne (chair), A. Stürze, G. Weber), Royal Observatory (ROB) Belgium (C. Bruyninx), Czech Technical University Prague (CTU), Department of Geodesy (Z. Lukes, L. Mervart), Geodetic Observatory Pecny (GOP), Czech Republic (J. Dousa), German Aerospace Center (DLR), Germany (A. Hauschild, O. Montenbruck), Geo++ GmbH, Germany (M. Schmitz, G. Wübbena), Alberding GmbH, Germany (D. Stöcker), and others.

References

- Mervart L., Z. Lukes, C. Rocken, T. Iwabuchi, 2008, Precise Point Positioning With Ambiguity Resolution in Real-Time, ION GNSS 2008
- Weber G., L. Mervart, Z. Lukes, C. Rocken, J. Dousa, 2007, Real-time Clock and Orbit Corrections for Improved Point Positioning via NTRIP, ION GNSS 2007
- Wübbena G., M. Schmitz, A. Bagge, 2005, PPP-RTK: Precise Point Positioning Using State-Space Representation in RTK Networks, ION GNSS 2005
- Schmitz M., 2012, RTCM State Space Representation Messages, Status and Plans, PPP-RTK Symposium, Frankfurt am Main, 2012
- Söhne W., 2010, EPN Special Project "Real-time Analysis" - Status Report, EUREF Symposium, Gevle, 2010
- Wübbena G., 2012, RTCM State Space Representation (SSR), Overall Concept Towards PPP-RTK, PPP-RTK Symposium, Frankfurt am Main, 2012

Call for Participation

The Project is seeking for support in (but not limited to) the following areas:

- **Re-dissemination of GNSS real-time data and products in Europe via NTRIP Broadcasters**
  So far, real-time GNSS data for the EUREF community is streamed mainly using the Ntrip broadcasters www.euref-ip.net and www.igs-ip.net. For the expected and already observed usage of real-time data it is indispensable to distribute the workload. A concept and guidelines will be provided within this Project for a dedicated system of broadcasters.
- **Validation of clock and orbit correctors to Broadcast Ephemeris**
  The estimation and dissemination of GPS orbit and clock corrections will be the main target of the IGS RT-PP. In addition, the EPN Project on Real-Time Analysis will cover the aspect of clock and orbit correctors for GLONASS. The validation of these products within this Project is encouraged, e.g. by comparison with post-processing products or by using the real-time products in PPP applications.
- **Backup for all critical real-time service components**
  A reliable dissemination of real-time GNSS data and products is necessary for their acceptance within the user community. Therefore, a backup concept and guidelines will be provided especially for single points of failure in the data flow.
- **Development of regional products and augmentation**
  Improvements on the provider side as well as on the user side is expected by the development of regional products, such as troposphere and ionosphere products, and by regional augmentations supporting PPP ambiguity fixing.

Contact

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ny proposals and volunteers are very welcome to contribute!