Hochschule Karlsruhe (HSKA) – University of Applied Sciences

Geomatics Master (MSc.) **Faculty of Information Management and Media (IMM)**

Candidate
Paola M. Gonzalez P.

Master Thesis (Year 2013)
Online Precise Point Positioning (OPPP) for Low-cost GNSS Sensors

Referee
Prof. Dr.-Ing. Reiner Jäger

Key Words
OPPP, Absolute Point Positioning, Single Frequency GNSS Receivers, Precise orbits, Ionosphere, Troposphere, SSR-products, Solid Earth Tides.

Summary

Some years ago it was almost impossible to imagine that precise positions could be obtained in a non DGNSS-mode, by using one receiver without the help of one or a network of active reference stations, namely observation corrections (OSR-related). And it was even less probable that precise sub-decimeter absolute coordinates could be the result of single frequency observations. In modern times, precise absolute point positioning (OPP) is possible with one receiver, most of the time a double frequency, is used together with state space products (SSR-related), and an accuracy can be in the sub-decimetre range.

Fig. 1.: u-blox evaluation kit 6T

Therefore, the challenge of today is to be able to employ low-cost receivers, that - by post-processing or online - offer sub-decimeter results to the user.

In this master thesis, a MATLAB algorithm (fig. 2) was implemented to compute absolute SSR-related positions from single frequency receiver observations. The whole point of this source code was to use open IGS SSR-products, like precise orbits, ionosphere information and stable models for the processing.

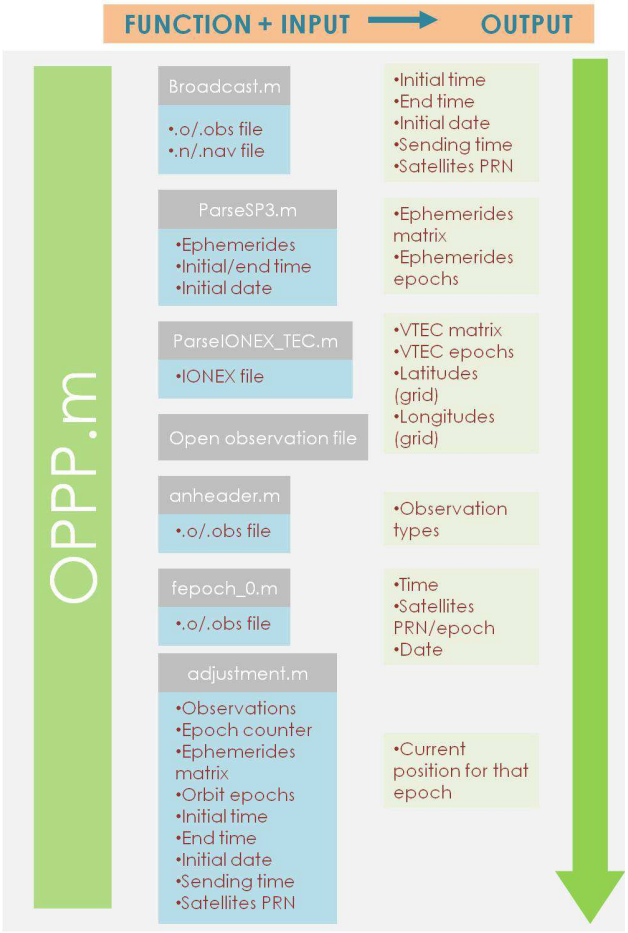

Fig. 2: Developed OPPP algorithm

The observations used were collected with a LEICA (double frequency) and a u-blox (low-cost single frequency) receiver, also DGNSS-data from an IGS station were employed for comparisons. The precise data here employed (e.g. Precise Orbits, IONEX files) was processed using stable algorithms, like for example Lagrange interpolation for the determination of the position of the satellite, the approach of Goad and Goodman to estimate the troposphere corrections. In the case of the ionosphere corrections, the position of the ionosphere pierce point (respect to each satellite) is computed in order to do an interpolation between consecutive TEC (Total Electron Content) maps to obatin the value for the point and then compute the correction, therefore exact UTC time and position are needed. Solid Earth tide corrections were determined using spherical harmonics, specifically the degrees 2 and 3, that are those who give a major influence. The Love and Shida numbers for such determination were derived with a function respect to the latitude and later on, corrections for these values were also computed.