Titolo della tesi
GNSS Atmosphere Smart Modeling in Local Dense Networks with Low Cost Hardware and Free and Open Source Software
(specificare se sperimentale, progettuale o compilativa)
Sperimentale

Tipo di Laurea (triennale, magistrale con indirizzo)
Laurea Magistrale in Ingegneria per l'Ambiente e il Territorio – Indirizzo: Difesa del Suolo

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Riassunto della tesi (max 2 pagine)

Il riassunto della tesi non deve superare le due pagine e non devono essere inserite figure

The aim of this thesis is to evaluate the accuracy of absolute coordinates and tropospheric information estimated using Free and Open Source Software (FOSS) and both single and dual frequency GNSS receivers with Precise Point Positioning (PPP) technique. In fact, next to the receivers of geodetic class whose very high accuracy is well known, GNSS single frequency receivers have turned up more and more in marketing in the last few years especially for very low cost with respect to high level of performances, comparable to those of dual frequency devices. Differential positioning with these receivers, in the case of short baselines, leads to high precision results and this opens to different applications in Geosciences: long term ground or infrastructures monitoring are only two examples. Furthermore, the recent development in computer science has led to the creation of FOSS for high precision positioning that are candidates to be used also in scientific research.

PPP is a technique commonly used in the last years to obtain high accurate positioning. This method combines the observations coming from all satellites and additional files in order to remove different errors which hinder the achievement of high levels of accuracy. The major source of errors is represented by the electron content of the ionosphere which could induce disturbance of about different meters. Using geodetic receiver, it is possible to eliminate ionospheric delay until the first order combining L1 and L2 into Iono - Free combination.

As regarding tropospheric parameters, the most important parameter is zenith total delay (ZTD) that can be connected to Precipitable Water Vapour (PWV) and Integrated Water Vapour (IWV), which describe the integrated water vapour on the column above the receiver. In addition to ZTD, horizontal tropospheric

gradient must be taken into account in order to describe especially the abrupt variation in water vapour content that occurs during huge rainfall.
The software used to perform a PPP analysis in this work is RTKLIB, an open source program package for GNSS positioning which provides results in a very short time compared to scientific software now on market. The potentialities of RTKLIB have been studied with PPP processing, without ambiguity fixing, of data from M0SE permanent station for the period August 2014 - July 2017. Residuals, obtained with respect to EUREF reference data, shows a RMSE of about 1 cm for both horizontal and vertical components. As regards tropospheric delay, considering even the complete years 2013 and 2014, RMSE for M0SE ZTD residuals with respect to reference values given by EUREF and ASI is about 5 mm even in the case of huge rainfall.
Working with low cost receivers, since Iono-Free combination is no longer applicable, a new ground based augmentation strategy was developed in order to achieve high accuracy PPP solutions. The algorithm, using unique dual frequency receiver, allows to create L2 synthetic observations for low cost receivers placed nearby and, so, enables the single frequency observations to be processed with all well known dual frequencies approach. The model is an extremely interesting tool since centrimetrics positioning accuracy and RMSE less than 1 cm for ZTDs is obtained up to about 70 km far from reference station working with “simulated” single frequency receivers. Considering the positioning with real low cost receivers, RMSEs of less than 1.5 cm in horizontal components and less than 3 cm in UP direction are observed even 30 km away from reference station.