Notice of University Oral Examination

Geodesy and Geomatics Engineering

Doctor of Philosophy

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Head Hall – Room E-11 @ 1:00 pm

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MODELLING TROPOSPHERIC GRADIENTS AND PARAMETERS FROM NWP MODELS: EFFECTS ON GPS ESTIMATES

ABSTRACT

The neutral atmosphere delay still remains one of the most limiting accuracy factors in global navigation satellite systems (GNSS) and other radiometric space-geodesy techniques. Due to the fact that the neutral atmosphere is a non-dispersive medium, the use of dual frequency approaches cannot eliminate the effect of neutral atmosphere delay at radio frequencies.

In recent years the use of numerical weather prediction (NWP) models has been investigated to mitigate the neutral atmosphere delay on GNSS signals. However, due to the practicality issues NWP-based approaches have not yet been widely used by GNSS users. Ignoring the asymmetry of the atmosphere has been a common assumption in GNSS processing for a long time. As NWP models provide a 3-D state of the neutral atmosphere, the motivation has been raised to consider the asymmetry of the neutral atmosphere in the GNSS processing.

In this dissertation recent developments in NWP-based modeling of neutral atmospheric delay are reviewed and compared. As an example of an NWP-for-GNSS operational service an online ray tracing package has been developed which has been accessible to the public for the past 2 years. Routine 3-hourly global maps of zenith delay, gradients and comparison with climate-based models have been also generated.

Asymmetry of the hydrostatic part of the neutral atmosphere has been modeled based on a dual radiosonde ray tracing approach developed for part of North America. An approach based on a semi-3-D retrieval of delays from NWP models also has been developed. The NWP-based parameters including zenith delays, mapping functions and gradients have been implemented in the Bernese GPS software. This made the software capable of correcting pseudorange observables in all related processing options.

Modified software has been employed to study the effect of the implemented NWP-based processing on GPS estimated parameters. The result of a month-long precise point positioning experiment shows millimetre-level improvement in the latitude component at most of the stations when hydrostatic gradients are introduced as a priori. Height and zenith tropospheric delay parameters are also affected by implementing NWP-based gradients as well as by implementing zenith delay values and mapping functions; even though the effects were not found to be systematic.

Based on the results of this dissertation research, implementing NWP-based parameters in GPS processing for high accuracy applications such as geodynamic, defining terrestrial reference frames, and climatology is suggested. This is now possible with the modified Bernese which is capable of considering NWP hydrostatic, non-hydrostatic and total gradients as a priori in GPS observables as well as zenith delay and mapping functions based on NWP models in all processing strategies.

Faculty Members and Graduate Students are invited to attend this presentation