De-Correlation of Tropospheric Error and Height Component on GNSS using Combined Zenith-Dependent Parameter

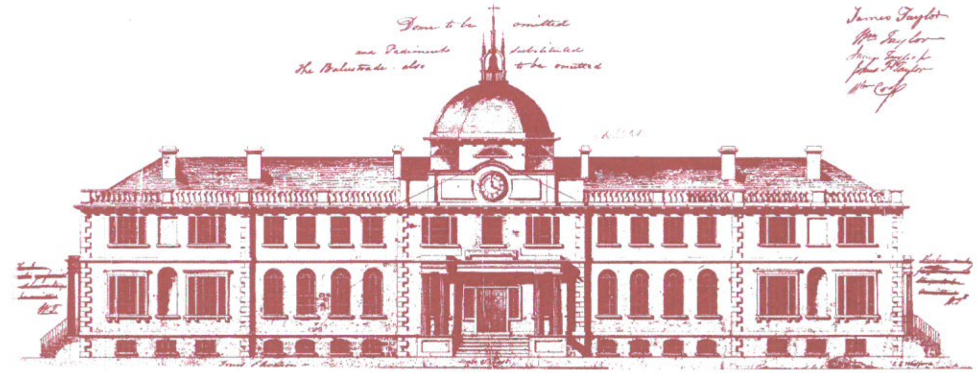
Abstract

For high precision GNSS positioning, the troposphere is one of the most problematic error sources. Typically, the effect is minimal due to the correlation when the baseline length is short enough in the relative positioning scenario. When a strong tropospheric anomaly effect is present, the problem can be much more complicated and the resultant positioning solution is typically no longer precise even for baseline of a few kilometres in length. As the troposphere delay and height estimates are almost linearly correlated above a 20° elevation angle, the problem exists of how to de-correlate these two parameters to avoid such ill-conditioned cases.

To obtain reliable height estimates, and avoid ill-conditioned cases, a new methodology is proposed in this thesis: these two common zenith dependent parameters combined into a single parameter plus weighting parameters. Once the single parameter is combined and corresponding weighting parameters are determined, the vertical component can be retrieved.

The feasibility of the methodology is investigated in a kinematic situation. To determine the weighting coefficient in this case, the residuals in a least-square estimator are analyzed. As the residuals can be decomposed into two different realms, either troposphere or ionosphere, the magnitude of the residual contribution of the troposphere for each satellite pair in the double difference can be determined. This value is further used to determine the weighting parameters. Through this new method, the common zenith-dependent parameters are found to be de-correlated. A number of data sets are processed to analyze the developed method, especially during severe inhomogeneous tropospheric conditions and under humid environment.

In summary, in a kinematic scenario, the achievement is shown to be up to 20% (4cm to 3cm rms) with processed data. Compared to the conventional approach, the degradation of the vertical component during an anomalous weather period is almost eliminated in kinematic scenario which is the main goal of the research described in this thesis. This means that this new approach is resistant to an anomalous tropospheric event.



Home of the School of Graduate Studies, Sir Howard Douglas Hall was designed by J.E. Woolford in 1825 and is the oldest university building in Canada still in use.

University of New Brunswick
School of Graduate Studies

Oral Examination

Yong-Won Ahn

in Partial Fulfilment of the Requirements for the Degree of

Doctor of Philosophy

Ph.D. Candidate

Yong-Won Ahn

Graduate Academic Unit

Geodesy & Geomatics Engineering

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November 10, 2016

9:00 a.m.

ADI Studio (HC-25)
Head Hall

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Examining Board:

Dr. Peter Dare (Geodesy & Geomatics Eng.)	Supervisor
Dr. Marcelo Santos (Geodesy & Geomatics Eng.)	
Dr. Richard Langley (Geodesy & Geomatics Eng.)	
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Universities attended (with dates & degrees obtained)

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2011	Diploma in University Teaching (DUT), University of New Brunswick
2002-2005	MScE, Dept. of Geomatics Engineering, The University of Calgary
1995-1997	MSc, Dept. of Astronomy & Space Sciences, The Chungbuk National University, South Korea
1990-1994	BSc, Dept. of Astronomy & Space Sciences, The Chungbuk National University, South Korea.

Publications (Journals and Proceedings):

- Dare, P, Y.W. Ahn and A. Cunningham (2015). Experiences in the use of a Terrestrial Laser Scanner at UNB, Ontario Professional Surveyor, Vol.58(2), pp.4-6.
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Several other publications & conference presentations