# NOTICE OF UNIVERSITY ORAL

**GEODESY AND GEOMATICS ENGINEERING**

**Master of Science in Engineering**

# Landon Urquhart

## Friday, December 10, 2010 @ 12:30 pm

## Head Hall – Room E-11

**Board of Examiners:** **Supervisor:** **Dr. Marcelo Santos, GGE**

**Examining Board:** **Dr. Peter Dare, GGE**
**Dr. P.T. Jayachandran, Dept. of Physics**

**Chair:** **Dr. Sue Nichols, GGE**

## ASSESSMENT OF TROPOSPHERIC SLANT FACTOR MODELS: COMPARISON WITH THREE DIMENSIONAL RAY-TRACING AND IMPACT ON GEODETIC POSITIONING


**ABSTRACT**

The tropospheric delay still remains a limiting factor to the accuracy of space based positioning techniques. The estimation of station height, which is particularly important for applications such as monitoring sea-level rise, glacial isostatic adjustment and for establishing a stable and accurate reference frame, is susceptible to errors in modeling the tropospheric delay due to correlations between the station height and residual troposphere delay parameters. As the demand on positioning accuracy and precision has increased, it has begun a trend of relying on large external data sets, rather than relatively simple models for mitigating the tropospheric delay. This trend has been possible by advances made in numerical weather models which provide accurate representations of global atmospheric conditions and by advances in computing speed which allow us to perform a large number of computations over a short period of time. The purpose of this work is to assess the current models in place for mitigating the tropospheric delay and to then assess the benefits of applying these large datasets for positioning purposes.

The contribution of this work is divided into two parts. Firstly, the current state-of-the-art models for mitigating the tropospheric delay are assessed using three dimensional ray-tracing through numerical weather models, where the full information contained within the 3D fields is used. In this experiment, over 4 million ray-traced delays were computed, over a single year, to act as a benchmark to assess the performance of these models. As three dimensional ray-tracing allows for the computation of the azimuth-dependent portion of the delay, both elevation dependent models, such as the Vienna Mapping Functions (VMF), and azimuth-dependent models for modeling tropospheric gradients are considered.

In the second experiment, a global GPS campaign is undertaken to study the use of the ray-traced delays at the observation level to model the tropospheric delay. The results indicate that although the use of the ray-traced delays are an improvement over elevation-dependent mapping functions such as the VMF, the estimation of two tropospheric gradient parameters from the GPS observations still outperforms the 3D ray-tracing for mitigating the azimuth-dependence of the tropospheric delay. However, as numerical weather models continue to improve, both in terms of spatial and temporal resolution, so to, should the benefit of applying these corrections directly to the observations.


**Faculty Members and Graduate Students are invited to attend this presentation.**