Ph.D. Candidate

James Daniel Mtamakaya

Graduate Academic Unit

Geodesy & Geomatics Engineering

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

October 10, 2012

1:00 p.m.

Head Hall
ADI Studio - Room #HC25

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Examining Board:
Dr. James Watmough (Math & Stats) Chairperson
Dr. Peter Dare (Geodesy & Geomatics Eng.)
Dr. Yevgen Biletskiy (Elect. & Comp Eng.)
Dr. Marcelo Santos (Geodesy & Geomatics Eng.) Supervisor

External Examiner:
Dr. Joseph Henton
Research Scientist
Natural Resources Canada

The Oral Examination will be chaired by:
Dr. John Neville, Associate Dean of Graduate Studies

BIOGRAPHY

Universities attended:

2009-2012	Doctor of Philosophy candidate, Geodesy and Geomatics Engineering, University of New Brunswick
2006-2008	Master of Science in Geodesy and Geomatics Engineering, University of New Brunswick, Canada.
1989-1990	Post-Graduate Diploma in Geographic Information Systems for Cadastral Applications, University of Twente, Faculty of Geo-Information Science and Earth Observation (ITC), Enschede, The Netherlands.
1980-1983	Advanced Diploma in Land Surveying, University College of Lands and Architectural Studies [then Ardhi Institute].
Professional Affiliation	Full Registered Surveyor of the National Council of Professional Surveyors of Tanzania (NCPS)

Publications:

Mtamakaya, J., M. Santos and M. Craymer (2012). "Assessment of Temporal Behavior of IGS Stations in Canada Using Least Squares Spectral Analysis." *International Association of Geodesy Symposia*, Volume 136, Geodesy for Planet Earth, Part 3, Pages 705-712, Springer.

Posters:

Mtamakaya, J., and M. Santos (2009). "Harmonic Analysis of Temporal Behavior of IGS Stations in Canada." *Eos Trans. AGU, 90(22), Joint Assembly Supplement, Abstract G11B-03*, 2009, Toronto, Canada.

Mtamakaya, J., M. Santos, M. Craymer (2009). "Harmonic analysis of IGS stations time series". *Eos Transactions, AGU, 90(52), Fall Meeting Supplement, Abstract G11B-0634*, 2009.

Mtamakaya, J., M. Santos, and M. Craymer (2010). "In search of periodic signatures in IGS REPRO1 solution". *Eos Transactions, AGU, 91(51), Fall Meeting Supplement, Abstract G51B-0665*, 2010, San Francisco, USA.

Mtamakaya, J., M. Santos, and M. Craymer (2011). "Periodic Effects on IGS REPRO1 *Solutions"*. *The International Union of Geodesy and Geophysics (IUGG) XXV General Assembly*, Melbourne, Australia 27 June - 8 July 2011.

ASSESSMENT OF ATMOSPHERIC PRESSURE LOADING ON THE INTERNATIONAL GNSS REPRO1 SOLUTIONS PERIODIC SIGNATURES

Abstract

Unambiguous, consistent and homogeneous GPS station coordinates are the fundamental requirement in the appropriate determination of geodetic velocities that are often used to derive geodetic and geophysical models for different applications. As for that, there have been significant efforts in the past decade to improve the modeling and parameterization of GPS solutions. Recently, the International GNSS Service (IGNSS) has generated REPRO1 solutions by reprocessing the historical GPS data from 1994 to March, 2010. REPRO1 solutions adopted the new absolute antenna phase center variations model along with most of the recent model parameters available by then and they are the first solutions to be consistently represented in one reference frame, IGS05.

Based on the availability of REPRO1 solutions, this research have two objectives. The primary objective of this research is to identify the remaining periodic signatures in the International GNSS REPRO1 solutions. These signatures are the impacts of short and long term miss modeled and un-modeled effects from both known and unknown phenomena. As a parallel activity, this research will try to explain the signatures by correlating them to different effects with a specific attention to the atmospheric pressure loading (APL). The secondary objective of this study is to perform the harmonic analysis investigation of REPRO1 positions and residuals domain using Least Squares Spectral Analysis (LSSA) and Least Squares Coherent Analysis (LSCA) with and without APL corrections. Based on the resulting least squares spectra, the impact (benefits) of APL corrections in the present solutions have been assessed as a basis of recommendations in future similar reprocessing campaigns. To accomplish the research objectives, a set of twenty nine (29) stations (part of the IGNSS network) were selected. Thereafter, the selected stations were analyzed using LSSA and LSCA frequency domain multiplications with and without the impact of APL from GGFC model. The investigations were carried out at both REPRO1 positions and residuals domains.

Based on the LS spectra results, it is evident that periodic signatures are still present in the REPRO1 solutions for most of the stations under study and they appear as spectral peaks. Furthermore, the observed signatures appear to be consistent around the first to fourth draconitic harmonics with respective periods of 351.2, 175.6, 117.1 and 87.8 days, within a range of ± 14 days (± 0.04CPY). It was also observed that, there is a slight improvement to spectral peaks that may result into slight improvement of coordinate repeatability if APL were included in the processing. However, the pattern was neither clear nor consistent at different harmonic levels of the same station as well as from one station to another. Furthermore, it was also observed that, the APL does not cause any significant reduction in spectral peaks that are still present in the REPRO1 solutions. This suggests that, most of the remaining signatures could be attributed to other un-modeled displacements such as non tidal loading forces, high order ionosphere terms and miss-modeling effect in GPS attitude models. To ascertain the findings, independent solutions for YELL and NRC1 were generated (1995-2010) using Bernese v5.0 software in a baseline mode, in conjunction with most of the latest IERS models presently available. The new solutions were found to be compatible with REPRO1 solutions within a range of ±2.5 cm. LS spectra based on them were thereafter generated with and without the impact of APL as a basis of recommendations and future work.