Ph.D. Candidate

Michael Baier Sheng

Graduate Academic Unit

Geodesy & Geomatics Engineering

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July 25, 2019

9:30 a.m.

Forestry/Geology Bldg.
Room 202

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Examining Board:
Dr. Karl Butler (Earth Sciences)
Dr. Robert Kingdon (Geodesy & Geomatics Eng.)
Dr. Ian Church (Geodesy & Geomatics Eng.)
Dr. Marcelo Santos (Geodesy & Geomatics Eng.) Supervisor
Dr. Petr Vaniček (Geodesy & Geomatics Eng.) Supervisor

External Examiner:
Dr. Petr Holota
Senior Scientist, Research Institute of Geodesy, Topography & Cartography
Prague East, Czech Republic

The Oral Examination will be chaired by:
Dr. Mary McKenna, Assistant Dean of Interdisciplinary Studies

BIOGRAPHY

Universities attended (with dates & degrees obtained):

2014 – present	PhD candidate, University of New Brunswick
2013 – 2014	MScE candidate, University of New Brunswick (transferred into PhD program effective Sept. 1, 2014)
2009 – 2013	BScE (Dean's List) Geodesy & Geomatics Eng., University of New Brunswick

Publications:

Santos, M., D. Avalos, T. Peet, M. B. Sheng, D. Kim, J. Huang (2014). "Assessment of GOCE models over Mexico and Canada and impact of omission errors." *IAG150*, Eds. C. Rizos, P. Willis. *International Association of Geodesy Symposia,* vol. 143, Springer, Switzerland.

Afrasteh, Y., A. Safari, M. B. Sheng, R. W. Kingdon, I. Foroughi (2017). "The effect of noise on geoid height in Stokes-Helmert method." *International Symposium on Gravity, Geoid and Height Systems 2016,* Eds. G. S. Vergos, R. Pail, R. Barzaghi. *International Association of Geodesy Symposia,* vol. 148, Springer, Berlin.

Foroughi, I., P. Vaníček, P. Novák, R. W. Kingdon, M. B. Sheng, M. Santos (2017) "Optimal combination of satellite and terrestrial gravity data for regional geoid determination using Stokes-Helmert method: the Auvergne test case." *International Symposium on Gravity, Geoid and Height Systems 2016,* Eds. G. S. Vergos, R. Pail, R. Barzaghi. *International Association of Geodesy Symposia,* vol. 148, Springer, Berlin.

Foroughi, I., P. Vaníček, M. B. Sheng, R. W. Kingdon, M. Santos (2017). "In defense of the classical height system." *Geophysical Journal International*. vol. 211(2), pp. 1154-1161.

Sheng, M. B., P. Vaníček, R. W. Kingdon, I. Foroughi (2017). "Rigorous evaluation of gravity field functionals from satellite-only gravitational models within topography." *International Symposium on Gravity, Geoid and Height Systems 2016,* Eds. G. S. Vergos, R. Pail, R. Barzaghi. *International Association of Geodesy Symposia,* vol. 148, Springer, Berlin.

Vaníček, P., P. Novák, M. B. Sheng, R. W. Kingdon, J. Janák, I. Foroughi, Z. Martinec, M. Santos (2017). "Does Poisson's downward continuation give physically meaningful results?" *Studia Geophysica et Geodaetica*, vol. 61(3), pp. 412-428

Foroughi, I., P. Vaníček, R. W. Kingdon, M. Goli, M. B. Sheng, Y. Afrasteh, P. Novák, M. Santos (2018). "Sub-centimetre geoid". *Journal of Geodesy.* vol. 93(6) pp. 849-868.

Janák, J., P. Vaníček, I. Foroughi, R. W. Kingdon, M. B. Sheng, M. Santos (2018) "Computation of precise geoid model of Auvergne using current UNB Stokes-Helmert approach." *Contributions to Geophysics and Geodesy*. vol. 47(3) pp. 201-229.

Sheng, M. B., C. Shaw, P. Vaníček, R. W. Kingdon, M. Santos, I. Foroughi (2019). "Formulation and validation of a global laterally varying topographical density model." *Tectonophysics.* vol. 762(5) pp. 45-60.

Sheng, M. B., P. Vaníček, P. Novák, M. Santos, R. W. Kingdon, I. Foroughi (2019). "Per partes integration of potential coefficients in global spherical harmonic series." *Journal of Geodesy.* (Under Review)

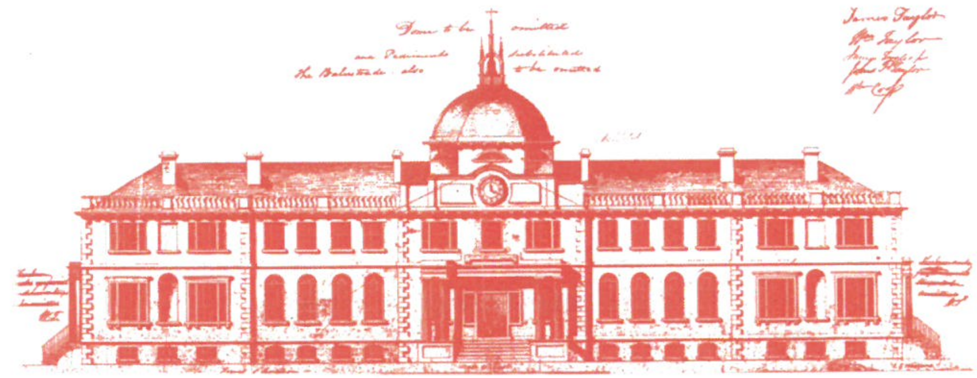
Several Conference Presentations

Improvements to Satellite Global Gravity Field Modelling

Abstract

Modelling the gravity field of the Earth is of the utmost importance for a wide variety of scientific disciplines. A global model allows for the unbiased investigation of long-wavelength properties of the gravity field. Satellite derived global models provide an additional benefit as they are uncorrelated with any potential errors contaminating regional terrestrial gravity information; this makes them ideal for use with terrestrial gravity data in order to formulate high-precision regional geoid models. This dissertation investigates several possible areas of improvement to both the formulation and evaluation of satellite-only global gravity models. The first major barrier is due to what is known to the geodetic community as the "polar-gap problem"; the lack of data collected over the poles due to the inclination angle of the orbiting satellites. The second is the rigorous evaluation of these models inside of the topographical masses (and most pertinent, on the surface of the geoid).

These problems are addressed in three articles. The first presents a mathematical tool that can be used in order to address the polar-gap problem by performing the global integration *per partes*. The second article presents a computational scheme that allows for the evaluation of various quantities relatable to global gravity models inside the topographical masses. Finally, the third article describes the formulation and validation of a 2D global topographical density model that is required for the rigorous evaluation as prescribed in the second article.



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.

The University of New Brunswick recognizes that the university sits on traditional Wolastoqey territory. The river that runs right by our university – the St. John River – is also known as Wolastoq, along which live the Wolastoqiyik -- the people of the beautiful and bountiful river.

University of New Brunswick

School of Graduate Studies

Oral Examination

Michael Sheng

In Partial Fulfilment of the Requirements for the Degree of

Doctor of Philosophy