NOTICE OF UNIVERSITY ORAL

GEODESY AND GEOMATICS ENGINEERING

Master of Science in Engineering

Tristan Goulden

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Head Hall – Room E-11

Board of Examiners:	**Supervisor:**	**Dr. Peter Dare, GGE**
	Examining Board:	**Dr. Yun Zhang, GGE**
		Dr. John Spray, Geology
	Chair:	**Dr. Sue Nichols, GGE**

PREDICTION OF ERROR DUE TO TERRAIN SLOPE IN LIDAR OBSERVATIONS

ABSTRACT

Glacial environments around the world are experiencing changes over time that result in a consistent decline in their volume. Currently there are many tools used to map and monitor the change in glacial surfaces. One tool that has proved successful is LiDAR, or Light Detection and Ranging. This technology is relatively new and error parameters are not well defined making it difficult to separate detected melt from the error. One error source in LiDAR observations that is particularly prevalent in glacial environments but has remained undefined is caused by the slope of the terrain. Terrain slope has long been known to add significant error in DSMs, especially those determined by LiDAR. The terrain slope error will have significant consequences to any parameters derived from the DSM and will cause determent to subsequent analyses.

This paper presents an approach for predicting the level of error in LiDAR observations resulting from terrain slope. The algorithm is based on initial error estimates obtained by propagating the error of each hardware component through the LiDAR direct geo-referencing equation. Once initial estimates of error are determined they are represented as 3D error ellipsoids at each LiDAR observation. The local slope of the observed terrain and the initial error estimates are combined to calculate a worst-case scenario prediction of the true terrain. Vertical errors are then extracted by comparing the elevation of the actual point and the predicted surface.

Two test sites were chosen to verify that the predictions matched observed errors on sloped terrain. One test site was located at a ski hill in Windsor, Nova Scotia and a second from a sloped road in Fredericton, New Brunswick. Tests from the ski hill showed optimistic predictions of the observed error. Testing from the road site in Fredericton showed pessimistic predictions of error, which were expected since the algorithm was designed to predict worst-case scenario solutions. Both test sites showed an improvement over existing LiDAR error prediction capabilities. It was concluded that the algorithm would benefit from additional predictions of currently un-defined sources of error in LiDAR observations. The error predictions do serve as better estimates of final DSM error than predictions based solely on hardware errors and should be included in studies involving LiDAR DSMs.

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