

SLAM

scan-off

#GoGeoExpo2023

November 3-5, 2023

Participant Package

Education Partners

SCHULICH
School of Engineering



[GoGeomaticsExpo.com](https://www.GoGeomaticsExpo.com)

Photo: Calgary TELUS Convention Centre



What is the SLAM Scan-Off?

The 2023 GoGeomatics SLAM Scan-Off is designed to be a “right tool for the right job” awareness event. It is an unbiased comparison of different Simultaneous Localization and Mapping (SLAM) systems available to the geospatial community within an interior urban environment. The objective will be to navigate approximately 100 linear metres of the course located at the Telus Convention Centre in downtown Calgary in the days leading up to the [GoGeomatics Expo](#), compare the results against a control model, compare spatial determinations and make all prescribed data *available to the public*.

The data generated by each participant will be compared against another scan of the area using a conventionally accepted laser scanner and survey method (Terrestrial LiDAR or TLiDAR,) then each is evaluated for their spatial fidelity. Each participant will be asked to:

- Scan the pre-selected area as completely as possible.
- Process the data into a prescribed absolute reference frame.
- Determine the spatial confidence of the point cloud.
- Report the spatial coordinates of control locations extracted from the point cloud in a csv.
- Provide a ‘best practices’ guide for data collection in this environment using their instrument of choice.
- Provide a workflow for the model constructed, including software involved and/or associated.
- Submit the point cloud and csv to the committee and *allow them to be made publicly available*.

The data submitted will be evaluated against a set of criteria (described below, see “Evaluation Criteria” section) to demonstrate the performance capabilities of each platform. This is done in an unbiased manner with no ‘winners’ or prizes.

The data from the Scan-off will then be made available through [GoGeomatics.ca](#) for independent review. GoGeomatics and the Scan-Off committee will highly encourage companies and individuals to utilize this data for their own independent review and analytics. Use of this data in combination with tools like point cloud extraction software trial licenses will aid start-up and established geospatial companies/departments choose the right tools for the job, both in the real and virtual.

Additionally, it is our hope that companies looking to source reality capture data of their environment will use this information to put out ‘realistic’ RFPs and avoid setting requirements that unnecessarily increase the complexity and spatial requirements of the job at hand. In the end, it’s just as much about informed clients as it is informed users.

GoGeomatics Education Partners

The SLAM competition is being coordinated locally by Carina Butterworth and Lance Hummel from SAIT. Geomatic students have stepped up to measure and create a control network for the SLAM competition. The Telus Convention Centre has been kind enough to offer its public space as the location of the SLAM scan-off route. SAIT students are completing outdoor GNSS and interior laser scanning control surveys for the competitors to adjust their coordinates to. The students are also processing the observations to provide a csv file with coordinates of the control points provided for judging. They will be completing a terrestrial laser scan of the route for visual purposes for the participants and to be the control laser scan for the scan-off.

A heartfelt appreciation goes out to the students from both SAIT and the University of Calgary for their invaluable efforts and contributions!



Who can participate in the scan-off?

As this scan-off is being hosted as a means to aid commercial and industrial data collection awareness and selection, only commercially available units are able to participate.

Due to this year's event being in a public, populated area only commercially available hand-held or human-mounted SLAM units are encouraged to participate. Aerial and vehicle platforms will not be allowed to participate as these drones pose a potential danger and disruption to the public. Robot platforms may be considered provided they are escorted, equipped with high-visibility markings, are terrestrially bound and do not pose a potential danger or disruption to public activities and thoroughfares.

Dates of Event: November 3 to 5, 2023

Allotted time for collection: 1 hour

Approx (linear) distance to scan: 100 metres

Deadline to Apply: September 30, 2023

Time slots by availability on first come, first serve basis.

Deadline to Submit Data Deliverables: November 6 @ 13:00 MST

Participant Data Deliverables:

- Platform Data Sheet (pdf)
- Post-Processing Software data sheet (pdf, txt or html)
- Platform Operation Manual (pdf)
- Software Operation Manual (pdf, link sufficient)
- Price List - "Turn-key; ready to collect, process and present tomorrow" (pdf, Canadian Dollars)
- Post-Processing Report with positional confidence (pdf)
- Control point locations - *Point, Northing, Easting, Elevation, description* (csv)
- Georeferenced point cloud (las, laz or e57)
- Times required to:
 - 1) Scan the scene
 - 2) Post-process the scene into the extractable model

Description of deliverables on page 4. See "Deliverable Details" Section

Evaluation Criteria

All point clouds are impressive when first constructed. They provide unprecedented representation of almost any environment and can be used in a great number of applications and analytics. However, the success of your application will relate directly to the fidelity of the point cloud, the requirements of the software tools you intend to apply to them, and what (exactly) you plan to do with the information extracted. For example, a floor flatness survey or engineering design will have more stringent point cloud requirements than an internal asset map or a video game scene design; one requires millimetre accuracies (therefore, a scrupulously 'tight' point cloud) while the other has an unmitigated 'win' if it can get you within 15 centimetres of the right location.

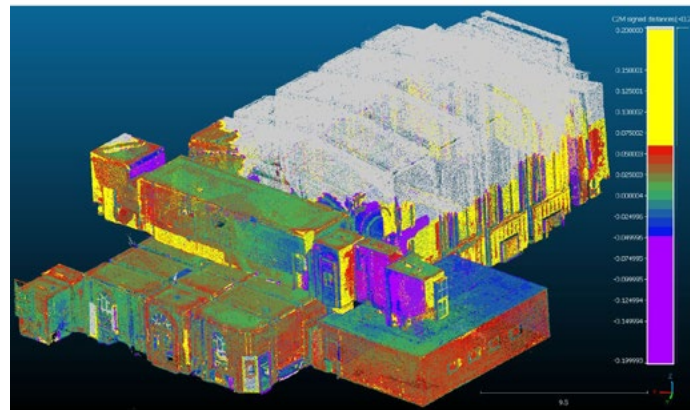
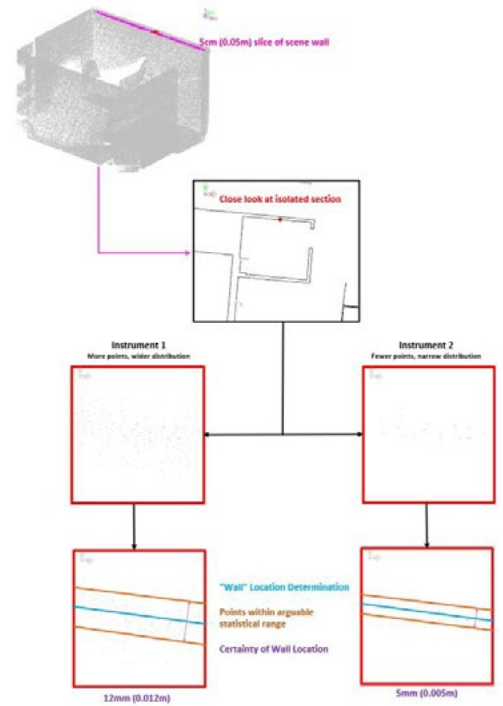
As the applications vary more greatly than the available technology, these evaluations will be conducted in an objective manner. While there can be a 'right answer' when it comes to SLAM device application, the SLAM committee fully acknowledges that ***the most accurate device is not always the most suitable device***. As such, these evaluations will be presented without bias or prize.



The following fields will be evaluated and reported on to the Expo attendees:

Point Cloud Thickness. How 'thick' walls, roads, floors or other surfaces are due to the inaccuracy of point distance determination. Typically in SLAM systems, 'time-of-flight' (ToF) determinations are made based on the laser information. That is, the computer considers how long it took for the light to hit the object and return, then determines distance by taking the speed of light and half the time it took for the laser to return. These determinations can be affected by a large number of factors, from the temperature in the environment to the material type, to the angle at which the laser hits the object and more. As a result, not all laser pulses will read exactly the same distance, no matter how still the platform.

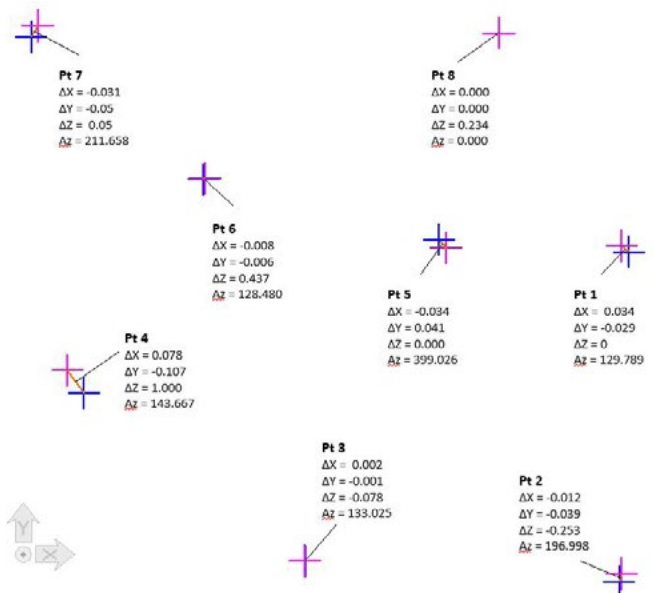
Point cloud thickness is important because the 'true' distance lies somewhere in the nebulous center of that distribution (not necessarily 'in the middle.') The more widely distributed the point cloud at any given place, the less certain one can be about the position's true location.



Absolute Scan Alignment - Each scan will be placing the structure's point cloud within a known coordinate system using points within the environment that are determined to a quantified certainty ("It's *here*, or within *this far away* of there.") As such the SLAM committee will introduce our precision scan point cloud, then the participants point cloud in the same space. Point cloud differencing software will then be used to determine how identical the scans are, where the differences are, and how large those differences are.

Control Point Alignment - While all control points locations will be disclosed to the participants, the coordinates of some points will be undisclosed. The participant's post-processing team will have to find these targets and report the positions of whichever controls they find. These reported positions will be compared against the 'true' values, the positional confidence values of the point cloud, and the other evaluation criteria to determine the 'success' of these determinations.

Again, this is only important for those interested in precision. However, in cases of site orientation and office asset maps, getting a potential user within 15 centimetres of a light switch or the door to the emergency supplies station is more than enough.





Feature Representation - Preselected items, objects and shapes will be introduced into the scene prior to scanning. The committee will attempt to locate those areas of interest in the participant's point cloud and determine how well they were represented. This will help demonstrate the complexity of a SLAM constructed point cloud scene and help potential users understand the benefits or limitations of each instrument, thus helping in informed purchasing.



Security of Data - In the digital era, threats are ever increasing. To address this concern, many industries and government facilities require the utmost in confidentiality and security in their spatial data collection, storage and reporting. As such, cloud processing and cloud storage of data poses a serious risk to these clients when looking to utilize this technology. As such, it's important to know *where* your data is going when submitted and whether the instruments taking part are able to fulfill this critical requirement to collection/storage/distribution of these areas.

Deliverable Details:

The following information is provided to clarify the requirements of the deliverables. Please note, *all submitted documents will be made available to the public by GoGeomatics:*

Platform Data Sheet (pdf) - Generic data sheet for the instrument. This shall be provided in a pdf format so as to accompany data sets for public consumption. *This document will be made available to the public by GoGeomatics.* Accompanying Canadian sales contact information strongly encouraged.

Post-Processing Software data sheet (pdf/html) - Generic brochure for data processing software. If web-based, please provide link in Platform Data Sheet or through a separate digital document (text, html.)

Platform Operation Manual (pdf) - A copy of the operation (user) manual that typically accompanies the platform. This will be provided in pdf and provided to the public so that an interested party can view the functionality and accessories intended for the submitted device.

Software Operation Manual (pdf, link sufficient) - A copy of the operation (user) manual that typically accompanies the software extraction suite. This shall either in be a pdf or, if web-based and/or requiring log-in, an HTML copy of the material. This will accompany the data set in order to give potential users an understanding of functionality, requirements, and capability.

Best Practices and workflow (pdf) - A brief description of the data collection method used for the submitted scan. This shall include a flow chart outlining the steps used in data collection and post-processing. This can be in the form of a written document or video but must contain the workflow diagram and, at minimum, bullet points of the methods used.

Price List (pdf, Canadian Dollars) - "A turn-key price list; buy today to be ready to collect, process and present tomorrow" - As this event is being put on to encourage adoption and application, a mock 'invoice' price list shall be submitted in pdf format, in Canadian Dollars. If originally in foreign currency prices, Canadian amounts shall be listed as if the sale took place November 2, 2023. Please submit exchange rate figure along with final prices.

Price list must contain all hardware and software items required to repeat all steps taken by the participant. That is, the list must contain the cost of the platform, all attachments and software used in the collection or processing of the data and be a complete list of what a first-time user must buy in order to:

- A) Collect data with the instrument.
- B) Post-process the collected data into a final, finished, quantifiable product.
- C) Export that data in its various formats.



Additional items and accessories can be listed on the mock invoice. All items essential to the three functions listed above must be identified as critical purchase items.

In recognition of companies being hesitant to post prices on open forums, prices may be considered 'approximate' or optional altogether.

Post-Processing Report with positional confidence (pdf) - A copy of the post-processing report, giving the positional confidence of the point cloud, the quality of alignment to ground control, the coordinate system used, and the absolute confidence of the point cloud. All units are to be metres.

Control point locations - Point, Northing, Easting, Elevation, description (csv) - Prior to the scan participants will be given a map of the area containing control point locations and coordinates for all 'primary' control while 'secondary' control locations will be kept secret. Participants will be required to align their models to primary control and report the locations of all secondary controls visible in their scan.

Participants may 'check in,' (physically reference their trajectories) to secondary control. If participants *physically* 'check in' to control during the scan, the coordinates will be made available for a maximum of four secondary control point locations.

Georeferenced point cloud (las, laz or e57). The point cloud shall be presented to the SLAM committee in las, laz, or e57 formats. The datums used are as follows:

Horizontal: NAD83(CSRS) Alberta 3TM, reference meridian 114 (EPSG# 3780)

Vertical: Canadian Geoidal Vertical Datum of 2013 (CGVD 2013 aka CGG 2013)

Times – Time is of the essence in some cases more than others. Why take three days to process a floor plan for emergency planning when another instrument works as well in 2 hours? Participants will be required to report how long it took them to collect the information submitted (from 'coming out of the box' to 'going back in the box') as well as the time that it took to process the data collected into a working, extractable model from 'Data plugged into computer' to 'data ready for extraction.'

Value to Manufacturers

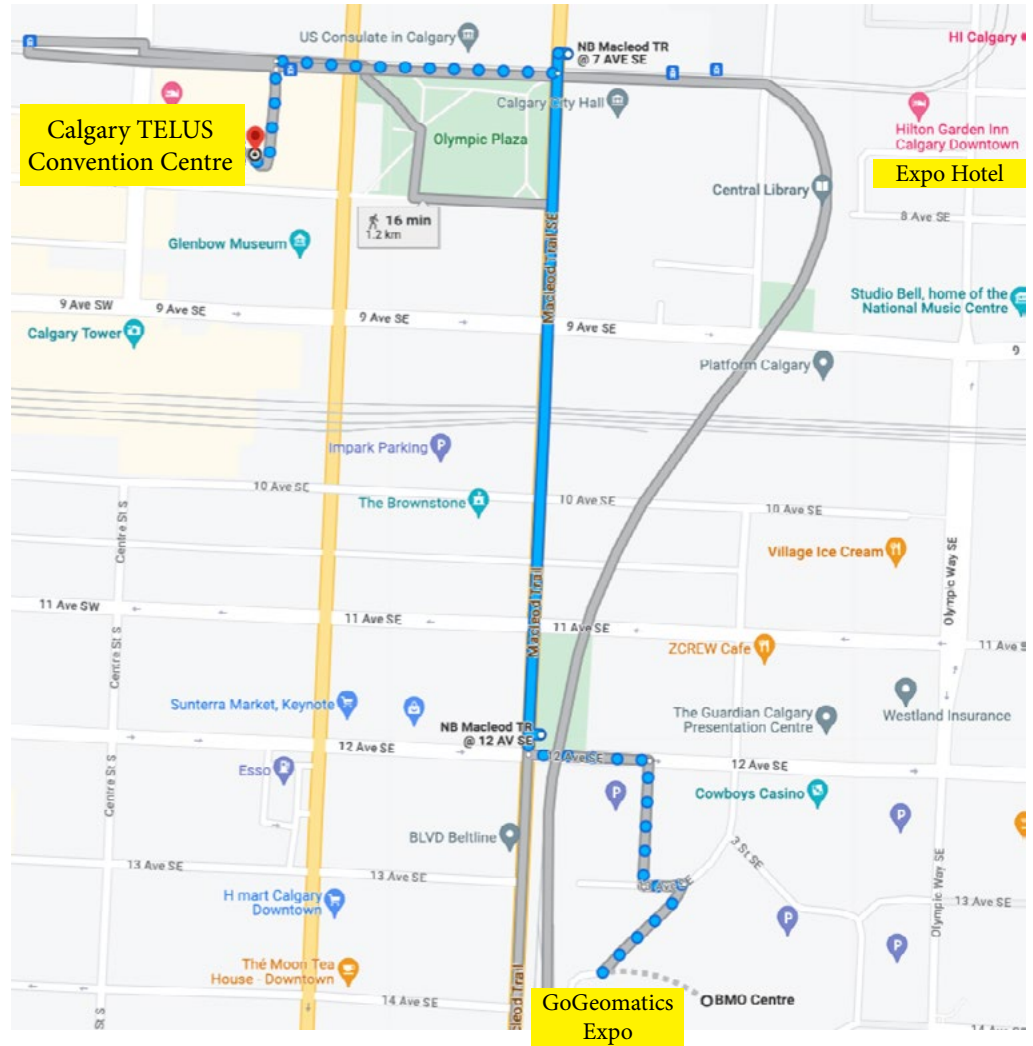
While the Scan-off event and results will be presented at the GoGeomatics Expo on the last day (November 8) as a central event, the material presented will also be showcased on GoGeomatics Expo webpage and magazine. Data sets collected will also be made available to the public with participant-drafted materials accompanying in order to outline devices and methodologies used. All scan data will be made available, free of charge, to enable further unbiased review of available platforms to aid in future Canadian industry purchase decisions. Follow-up studies with proper citations will be encouraged throughout the GoGeomatics community.

Over 73 companies and organizations have expressed interest in attending the first annual GoGeomatics Expo, not including those who will attend for networking and career fair events. As this event has already garnished a high degree of interest from the community at large, and GoGeomatics engagement with geoprofessionals on a regular basis throughout the country, we anticipate this event to be a major showcase event for the Canadian geospatial market.



SLAM Scan-Off Course Venue:

Calgary TELUS Convention Centre
136 8 Ave SE, Calgary, AB T2P 0K6



Contacts

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GoGeomatics SLAM Scan-Off 2023 - Application Form

Contact information

Company/organization name:

Number of representatives:

Name of 1st representative:

Job title:

Email:

Phone number:

Name of 2nd representative:

Job title:

Email:

Phone number:

Platform information

Make of scanner:

Model of scanner:

Type of platform (hand-held, human-mounted, or robot):

Data deliverables

Please confirm that you can submit the required data deliverables by the deadline (November 6 @ 13:00 MST):

Yes No

Course schedule: Nov 3-5, 2023, time TBD

Date preferences: 1st

2nd

3rd

Terms and conditions

By submitting this application, I confirm that I have read and understood all the requirements and details provided for the GoGeomatics SLAM Scan-Off 2023. I agree to comply with the event rules and regulations. I also consent to the public release of the data and materials submitted by me during the event.

Signature:

Deadline to Apply: September 30, 2023

Thank you for your interest in participating in the GoGeomatics SLAM Scan-Off 2023. We will review your application and inform the selected participants. If you have any further questions or require additional information, please contact Alex Hill-Stosky at alex.hill-stosky@eagle-eac.com