Mobile LiDAR Request Form Reference

The mobile LiDAR Request Form and reference document has been developed as a means of communication between the project managers and the LiDAR team. By completing the form and having the subsequent consultation, the LiDAR team will have all necessary information required to execute the collection of the project and the PM will have understood expectations of what the deliverables will be. The intent of this document is to provide additional detail and descriptions to assist in filling out the Mobile LiDAR Request form

1. Project Information
    a. Project Number

        For external clients, please disregard this field. For internal clients, please enter the project number this collection is to be performed for.

    b. Requested By

        Enter your name and contact information

    c. External Client

        Enter the name of the organization this collection will be performed for.

    d. Collection Timeframe

        Enter date the collection needs to be completed by. Note: A minimum of two weeks from the date of request is typical.

    e. Requested Deliverable Date

        Enter date the data deliverables are required. Note: A minimum of three weeks from the date of request is typical.

2. Accuracy Requirements

    a. Control Accuracy Requirement
        i. Mapping Grade

            Mapping accuracy requirements are typically less stringent versus survey grade. The point clouds are produced with relative accuracy to each collected cloud with minimal trajectory correction.

ii. Survey Grade

Survey accuracy requirements require the point cloud be tied to survey control points within the project collection area. This typically requires the LiDAR team to create and placed in the field a target layout. The targets positions are determined by surveying to known control points. This method produces a point cloud at survey grade positional accuracy

iii. Horizontal Accuracy

Refers to the required horizontal accuracy of the data as defined by the project scope

iv. Vertical Accuracy

Refers to the required vertical accuracy of the data as defined by the project scope

v. Company responsible for Control
Name of the sub consultant (if any) used to set control for the project. Sub consultant data has historically been less accurate than WGI control. Adjusting lidar to substandard control will often degrade “raw” LiDAR position. (it’s better to have no control than substandard control)

vi. Company responsible for QC Data
Name of the sub-consultant (if any) responsible for the QC of the LiDAR data. Sub consultant data has historically been less accurate than WGI QC data. This can cause LiDAR to appear to be inaccurate when it does in fact meet tolerance.

b. Horizontal Datum

The horizontal datum defines the geographic system the point cloud data will be collected and subsequently delivered in. The PM should verify the coordinate system of the project with the client and select the appropriate system. NAD83-90 and NAD83-11 are two of the more common coordinate systems used. Is there a legacy network that we will be matching to?

c. Vertical Datum

A vertical datum is a surface of zero elevation to which heights of various points are referenced. Traditionally, vertical datums have used classical survey methods to measure height differences (i.e. geodetic leveling) to best fit the surface of the earth. The PM should verify the coordinate system of the project with the client and select the appropriate system. NAVD88 and NGVD29 are two of the more common coordinate systems used. Is there a legacy network that we will be matching to?

3. Project Details

   a. Project Scope Document

      When submitting the Mobile LiDAR request form, please include an electronic copy of the project scope document for the LiDAR team to review so any potential issues or questions can be raised during the consultation meeting.

   b. Project Limits: Attach a KMZ file showing the route or area of project limits

      When submitting the Mobile LiDAR request from, attach a KMZ file showing the route or area of project limits. This allows the LiDAR team to plan collection routes and clearly conveys the extents of the project area. Drawing a polygon based on DOT CITS Tab27 text will often bring up questions requiring clarification. Side streets not being scanned has been the most frequent cause of redeployment.

   c. Project Purpose

      This project purpose informs the LiDAR team what features are the focus of the collection efforts. The LiDAR team can then use collection methods that will most thoroughly capture these elements.

      i. Cross slope report - semi automated analysis of existing pavement profiles to identify geometric deficiencies that might cause hydroplaning, puddling/pooling, etc.

      ii. Pavement DTM – digital terrain model for the surface of the roadway corridor typically used for analysis and elevation referencing in GIS and CADD environments

      iii. Asset Management - Typically consists of feature extraction of above ground assets (signs , poles, valves, etc.) with corresponding imagery and evaluation of asset condition.

      iv. Pavement Condition - Extracts road distress (road wear) and generates a PCI index report (ASTM 6433 Severity Thresholds). Tools can identify Rutting, Corrugation, Potholes, Depressions and Bumps.

      v. Structures – Extract beam clearances, superstructure geometries, and various features of interest on transportation asset structures.

      vi. Overhead Utilities – Collection and feature extraction of utility poles and associated infrastructure.

      vii. Other

4. Deliverables
   a. QC Reports
      i. Trajectory report (attachment B in the surveyors report) is from Inertial Explorer (the software the processes trajectories). It shows forward and reverse separation, float/fixed ambiguity, estimated positional accuracy, PDOP, number of satellites, IMU status, and various measurements of all sensors and components. Essentially how well each of the systems performed along the route during collection, based on the settings selected for processing.

      ii. Vertical report (attachment A in surveyors report) is the DZ differences between the point cloud and selected locations in a field collected file.

      iii. XYZ report is the 3D difference between the control point origin coordinates in the lidar, and the actual values in the field collected control file.

      iv. Point cloud deviation report is a colored graphic with scale showing vertical differences between all point clouds where they overlap.

   b. Point Cloud Color Scale

      Intensity Only: Regarding LiDAR data intensity refers to the energy of the reflected laser pulse.

      Colorized: Each point of the point cloud receives the RGB value of the raster pixel that has the same location.

   c. Point Cloud Tile Size

      Tile size can be requested ;
         -described by geospatial bounds. ex: 1000’ X 1000’, 1 mile X 1 mile, from MP1 to MP2
         -based on the actual storage size of the file (1GB , 5GB, etc)
         -number of points (stored laser returns) per file. (10 million pts, etc)

   d. Point Cloud File Type

      LAS – industry standard open binary format for lidar
      LAZ – compressed LAS file
      E57 – vendor neutral format (documented in ASTM E2807)
      POD –to view, edit, and analyze point clouds in MicroStation (for users ***without*** TopoDot or TerraScan)
      RECAP - spatially indexed point cloud data, which can be loaded into various Autodesk applications to view, edit, and analyze point cloud
      XYZ – text file with XYZ coordinates of every stored return of the laser.
      DOT – optimized TopoDot specific file, generally for FDOT deliverable
      PTS – ASCI file with XYZ coordinates of every stored return of the laser.

e. Images

Planar – on Pegasus there are 4 planar cameras , each 12MP
Spherical – for Pegasus , this camera is 24MP for the 360° (lower resolution than planar)
Pavement – downward facing camera to capture the characteristics of the road

f. Web Hosting (WGIGEO Ready Data)

WGI now offers a web browser based 3D data hosting platform (OrbitGT) to make our collected data available to clients. The platform is accessible from any HTML 5 capable browser running on any device (PC, mobile device). All data will be loaded into a project specific publication that only the clients team and authorized users may access. the 3D point cloud is viewable and the environment allows for full 3 dimensional movement through the data. All collected imagery is accessible by picking the georeferenced point from which the image was captured. The publication will also include any extracted GIS data overlaid on the point cloud and imagery. Orbit also includes measuring tools that will allow for quick QC of GIS data or spot measurements of features of interest with the ability to export the information and annotations from the publication.

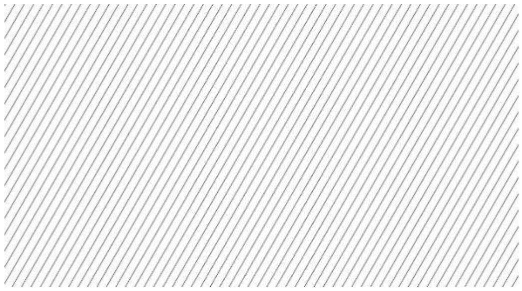
5. Data Management
   a. Mobilization and Equipment cost
   The cost to mobilize the Lidar equipment for your project. This could be driving or shipping the unit to your project location.

   b. Pavement Camera:
   Additional cameras that are mounted on the back of the Pegasus unit for pavement analysis. The cameras will assist in performing crack analysis as well as produce ortho images of the pavement condition giving a good view of manhole rims and valve inscriptions. The pavement camera will increase file size, increasing storage and hosting upload speeds.

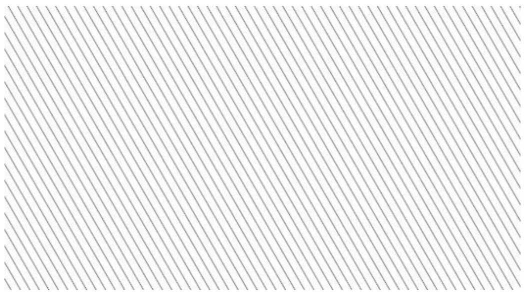
   c. DMI:
   DMI is short for Distance Measuring Instrument. This is an additional sensor that is used when there are GPS obstructions on the project. This sensor is attached to the wheel and measures the distance traveled to reduce IMU float from a lack of GPS corrections.

   d. Desired Speed of Collection:
   Speed effects the amount data that is collected. Slower speeds will result in a denser point cloud. If performing pavement analysis, a slower speed is necessary to collect the needed information.

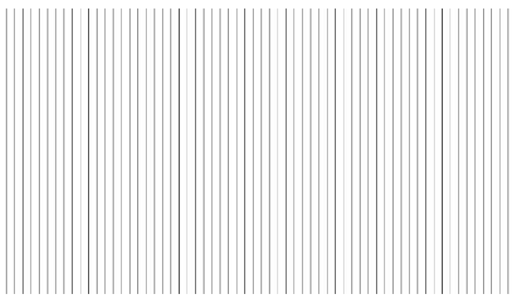
e. Scanner Rotation: +60, +30, 0, -30, -60:



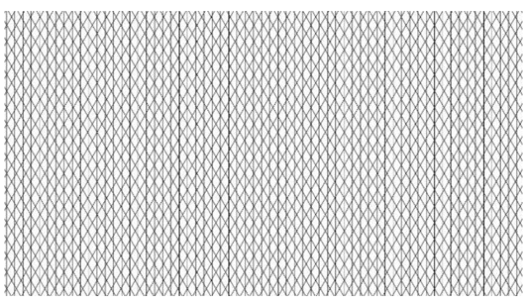
- 30º



+30º



0º



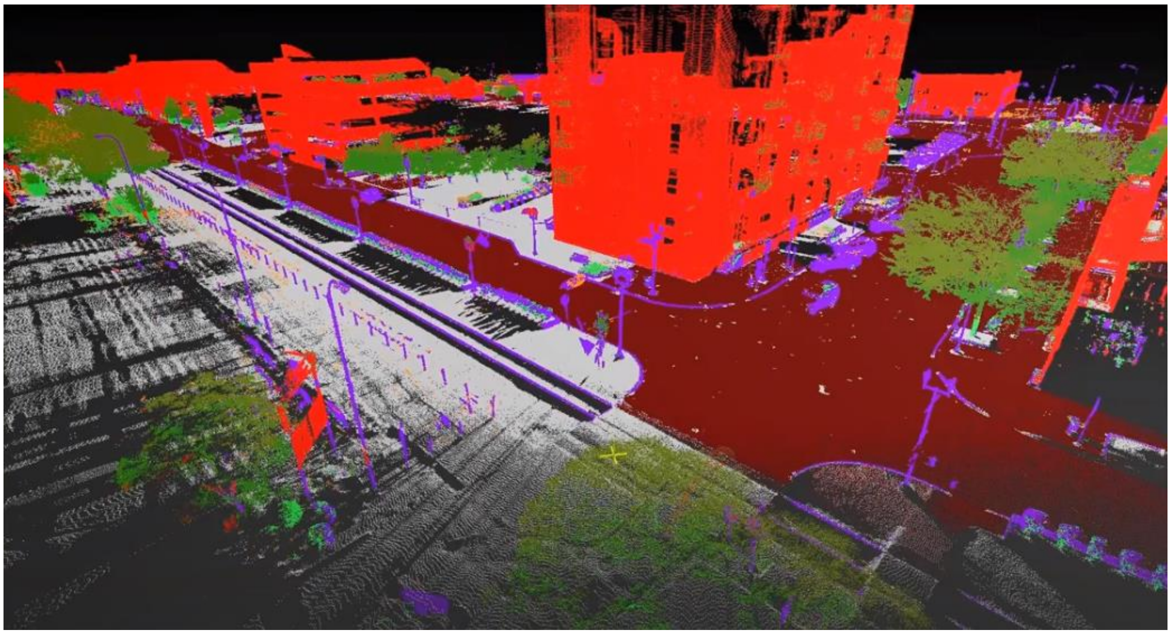
0º,+30º,-30º

f. Maximum distance from scanner to point cloud extent:

Laser accuracy can degrade as the distance from the scanner increases. Minimal changes in an IMU epoch (period of time) causes errors to become exaggerated as distance increases. Clipping point clouds at a fixed distance can prevent the introduction of points that may have accumulated error.

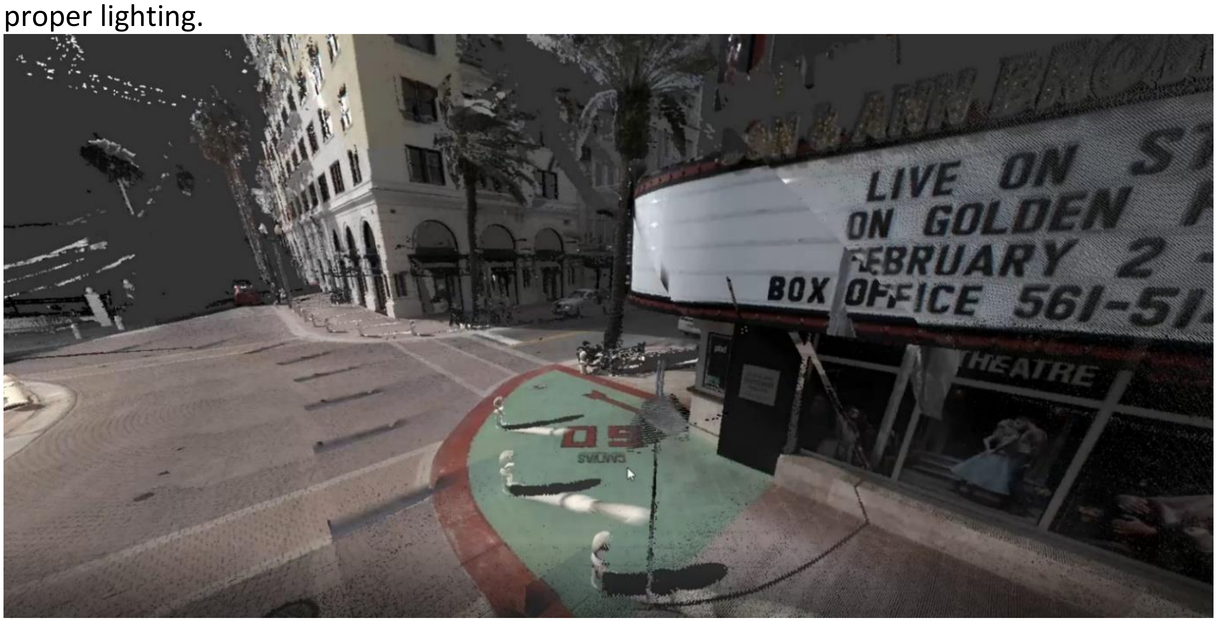
g. Classified Point Cloud:

Classifying the point cloud groups points into specific categories (e.g. buildings , roadway, vegetation, etc.) that can be toggled off and on during manual extraction. This allows the technicians to focus on points of interest and assists tools in their functions during semi-automated extraction.



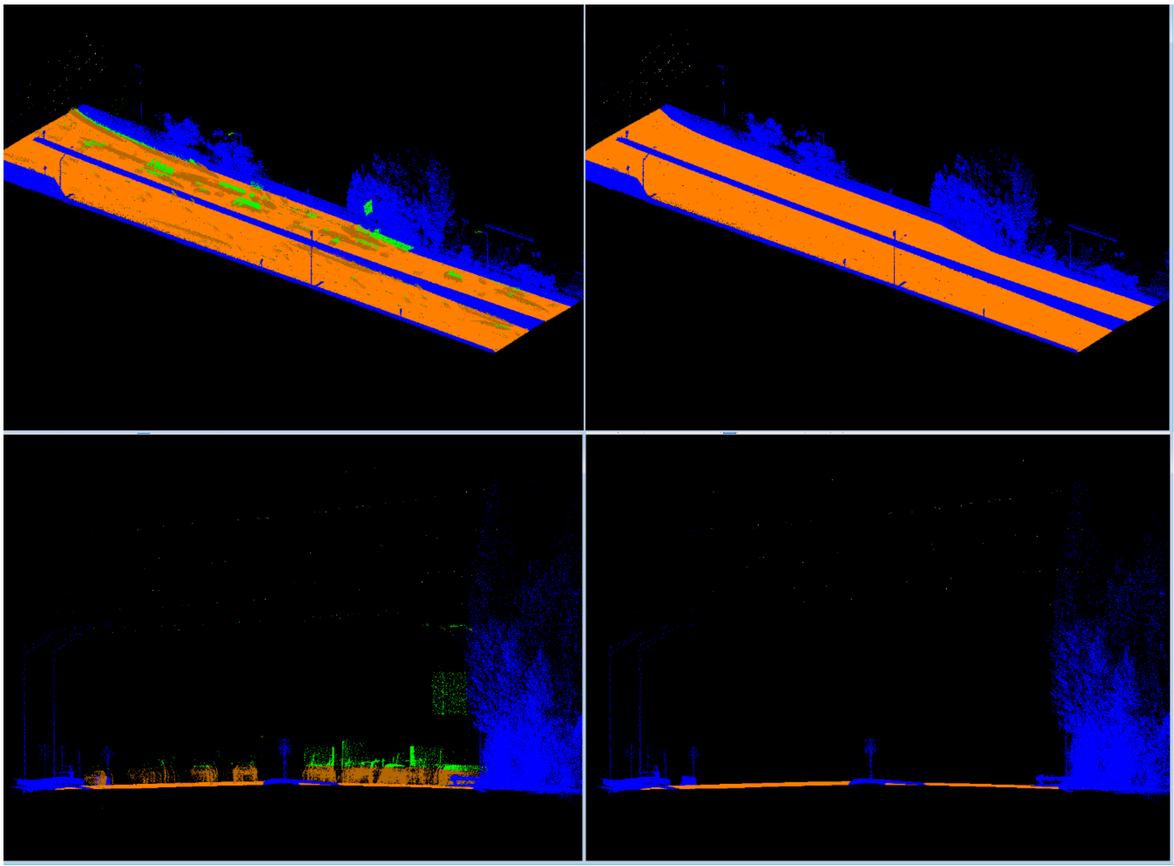
h. Colorized Point Cloud:

Points are colored by assigning an RGB value from the corresponding pixels at the same spatial location from imagery. This process requires imagery collection during daylight hours to ensure proper lighting.



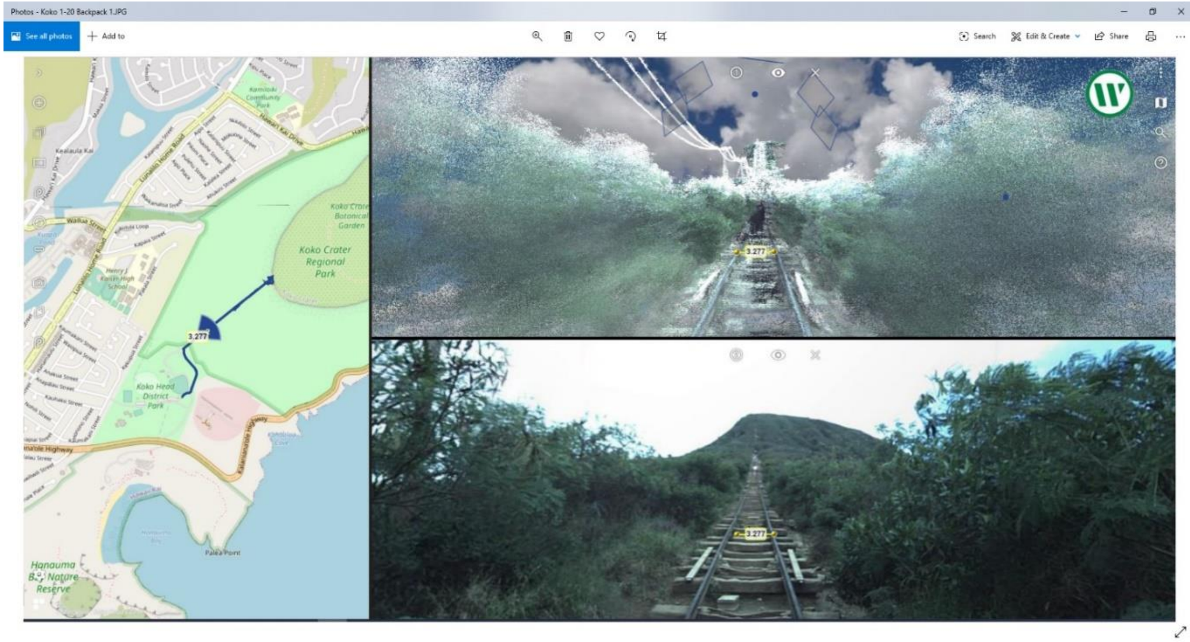
i. Cleaned Point Cloud:

Cleaning a point cloud is an involved process where technicians isolate and remove cars, pedestrians, etc. from the data. NOTE: while there are some semi-automatic processes to assist with cleaning, it remains a highly manual effort so determine for certain if the client needs a clean point cloud. If yes, then ensure adequate time has been added to an estimate to cover the effort.

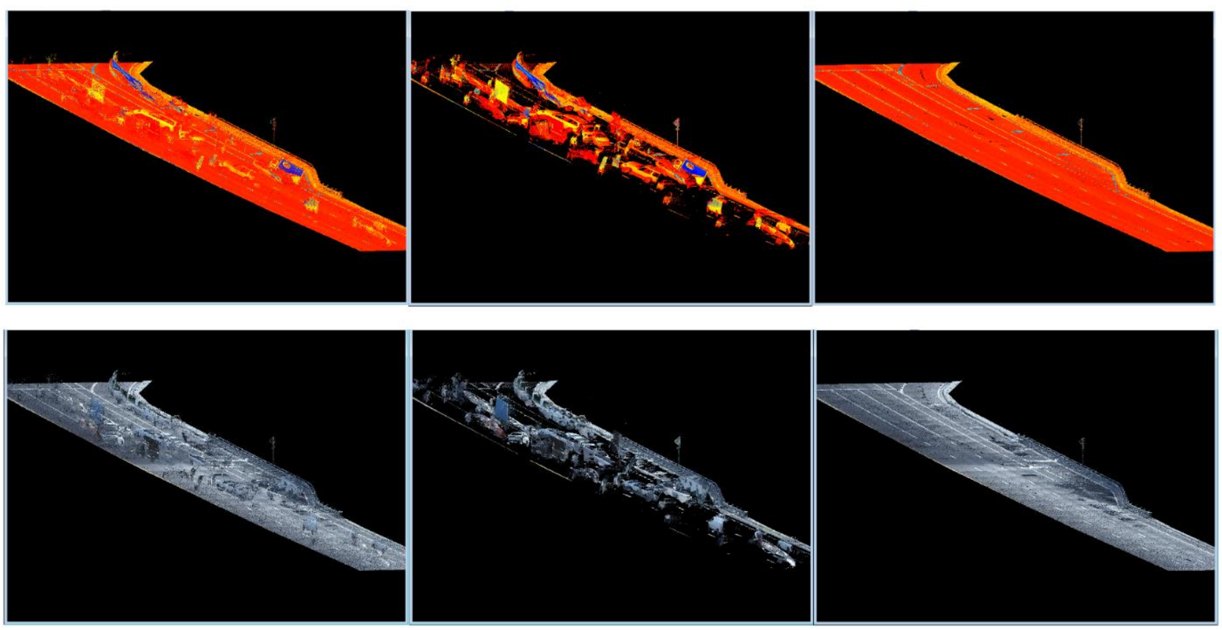


j. Data hosted on Orbit:

Web based viewer. Gives ability to view point clouds and imagery with tools for measuring, slicing, locating, tagging , exporting, etc. from devices with internet access.



k. Raw Point Cloud
The point cloud is provided as collected. I.e, cars, pedestrians, etc ***have not*** been removed.



l. Image Frame Distance:

Distance that triggers camera capture to fire. Too close, frames start dropping and large file size. Too far, small file size but features may be missed.

Glossary

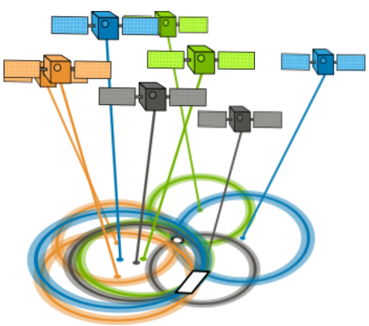
Pavement Camera: camera mounted downward facing to capture the characteristics of the road

DMI: distance measuring instrument. A sensor attached to the hub of the collection vehicle to assist positioning. Helpful for routes with GPS outages and extended traffic signals. Requires specific offset measurements each time its mounted.

Speed of Collection: affects point spacing of clouds and spacing of images captured while driving. Some semi-automated point cloud analysis programs require specific point spacing to function. Example PCI

PDOP (Position Dilution of Precision): describes error caused by the relative position of the GPS satellites. Basically, the more signals a GPS receiver can "see" (spread apart versus close together), the more precise it can be.

From the observer's point of view, if the satellites are spread apart in the sky, then the GPS receiver has a good PDOP.



But if the satellites are physically close together, then you have poor GDOP. This lowers the quality of your GPS positioning potentially by meters.

IMU(Inertial Measuring Unit): stands for Inertial Measuring Unit. IMUs can measure a variety of factors, including speed, direction, acceleration, specific force, angular rate, and (in the presence of a magnetometer), magnetic fields surrounding the device.

Horizontal Accuracy: Horizontal Positional Accuracy is the radius of the circle of uncertainty, such that the true or the theoretical location of the point falls within that circle 95-percent of the time. Horizontal Accuracy may be tested by comparing the planimetric coordinates of surveyed ground points with the coordinates of the same points from an independent source of higher accuracy.

Vertical Accuracy: Vertical Positional Accuracy is a linear uncertainty value, such that the true or theoretical location of the point falls within the sum of the positive and negative ranges of 6 that linear uncertainty value 95-per cent of the time. Vertical Accuracy may be tested by comparing the elevation of surveyed ground points with the elevations of the same point determined from a source of higher accuracy.