One-Day Course on Introduction to LiDAR Survey Technology

WOMEN ENGINEERS TECHNICAL DIVISION

By Ir. Rafidah Mahfar

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Ir. Rafidah is active as Corporate Member of Institution of Engineers, Malaysia (IEM) and a Professional Interviewer for IEM's Professional Interview. She is the committee member of IEM Women Engineers from year 2008 and the Chairperson of IEM Women Engineers Sub-Committee for session 2012/2013. Presently, she was Chairman of IEM-WE Section for Session 2013/2014.

A one-day course on Introduction To LiDAR Survey Technology was organised by the IEM Woman Engineer section (IEM-WE) on 6th August, 2014, at Wisma IEM, Petaling Jaya. A total of 14 participants attended the course.

The course was conducted by Engr. Trudy R. Ganendra, who had successfully completed over 60 LiDAR projects in different applications at national and international levels. She is the Managing Director of Ground Data Solution R&D Sdn. Bhd. (GDS), a Malaysian high-tech mapping and surveying service provider, specialising in airborne LiDAR survey.

First, she introduced LiDAR survey technology. LiDAR is formally known as Light Detection And Ranging, a laser mapping technique in which laser pulses are emitted towards the surface and the time for their return is measured. There are five types of LiDAR data: Airborne LiDAR, Bathymetric LiDAR, Terrestrial Mobile & Fixed LiDAR, Handheld LiDAR and Waveform LiDAR.

LiDAR data consist of three main components – Global Positioning System (GPS), Inertial Measurement Unit (IMU), and Laser Scanner. Processing the data from these 3 sensors together generates 3D "point cloud" of the mapped area. Each of the component details is listed in the Table 1 below:

Table 1: Main components of LiDAR data

GPS	Used to precisely locate the position of the scanner during the measurement
IMU	Measure the angular changes thereby allowing the analyst to determine the orientation of the scanner
Laser Scanner	Using accurate timing, the distance to the featured can be measured

During laser scanning, laser pulses are directed towards the ground, usually by a movable reflecting surface (mirror) which orients the individual pulses into a scanning swath.

There are two primary styles of scanning, namely Rectilinear (even spacing) and Galvanometric (sinusoidal) as well as another less prevalent style, Orbital (circular).

The details of both primary styles are listed below:

Table 2: Details of two primary scanners

Linear Scanners	Galvanometer Scanners
Use multiple mirror faces	Use single mirror
Rectilinear point spacing with easy mechanics	Adjustable swath width
Improved surface triangulation geometry	High pulse utilisation
Eg. Riegl scanner	Eg. Optech scanner
Easier analysis due to even spacing	Less easy analysis

The LiDAR survey procedure started with system calibration and ended with final deliverables (Figure 1 below):

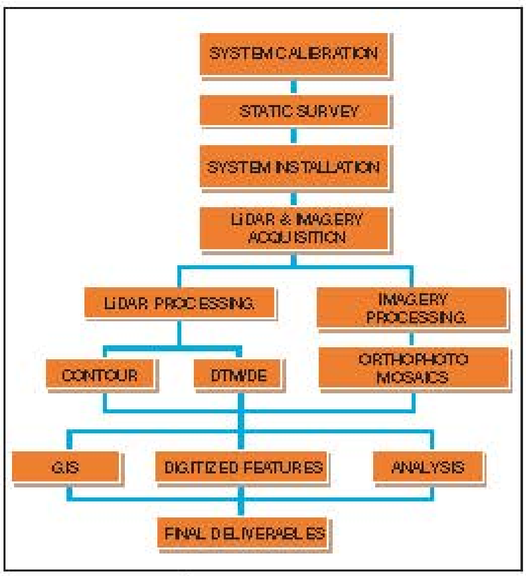

Figure 1: LiDAR survey procedure

Ms. Trudy further explain that LiDAR survey is cost effective for medium to large mapping area/corridor, fast data collection, has negligible impact on the environment, cloud free imagery, robust against weather conditions, accurate measurement in dense forest and steep terrain, independent of sun angle and acquisition based on accurate GPS network. For Airborne LiDAR survey, data acquisition using manned aircraft, will produce good, quality LiDAR data and imagery compared to using Unmanned Aerial Vehicle (UAV).

Table 3: Comparison between manned aircraft and UAV

Manned Aircraft	UAV
More cost effective for large areas (>10km)	Cost effective for small area (>1 km)
Able to fly in much more challenging terrain and weather condition	Not applicable for urban area with high rise building or challenging terrain and weather conditions
Long flight time	Short flight time compared to the manned aircraft
Able to fly in most airspaces	Highly dependent on civil aviation authority approval
	Ability to fly very low altitudes

LiDAR survey is suitable for engineering purposes as it offers detailed and accurate topography survey even in challenging terrain. Some applications of LiDAR data are listed in the Table 4 below:

Table 4: LiDAR survey application

Infrastructure/ Engineering:	• Road/Railway/ Pipeline • Transmission line • Dam survey
Environment / Disaster	• Flood Mapping • Slope Mapping • Telecommunication & Urban Planning
Natural Resources	• Forest / Agriculture • Water catchment • Mine Site

In the 2nd session of the workshop, Ms. Trudy gave an introduction to the LiDAR processing software normally used by the LiDAR provider. These are Microstation with TerraScan and TerraModeler tools and MARS Viewer - a LiDAR freeware. The software is used to read, view and edit LiDAR points, to classify LiDAR points, surfacing, contouring and can easily handle tens of millions of points with optimum performance.

Microstation is a CAD software product for 2D and 3D dimensional design and drafting works. Microstation offers a robust sub system for consistent integration of geometry and LiDAR data.

TerraScan and TerraModeler are dedicated software solutions for processing laser-scanning points and creating

Photo 1: Group photo

Photo 2: Ms. Trudy talking about LiDAR survey technology data

fully-featured terrain models. The MARS viewer is user-friendly freeware software which has a viewing application, support basic LIDAR data navigation and 3D visualisation for casual users. With MARS viewer software, we can read LIDAR point cloud, orthophoto image, view point cloud in different modes, 3D and profiling.

Ms. Trudy also shared her experience in utilising LIDAR data by using Power Line System – Computer Aided Design and Drafting (PLS-CADD) software for new transmission route alignment design and Modelling of Surface with String (MOSS)/MX software for civil engineering works.

During the hands-on session, GDS staff assisted participants in exploring LIDAR point cloud data using Microstation andfreeware software. They were guided in these procedures:

- Reading the point cloud and orthophoto image
- Viewing LIDAR data in different modes, 3D visualisation and view point cloud profile
- Measuring point density for all points including ground points, checking vertical accuracy, check point spacing and pixel resolution calculation.

The course ended with a note of appreciation from the organiser to Miss Trudy, followed by taking of photographs of all participants and organiser.