Short Introduction to Laser Scanning Technology

Airborne laser scanners enable the acquisition of dense and accurate elevation data. Data is captured in strips with sufficient overlap to ensure that no gaps appear between the strips. With the help of differential GPS and Inertial Navigation Systems, INS, the positions and attitudes of the aircraft, which defines the origins of the distance measurements, is calculated. The distances are measured using pulse ranging or multi-frequence sidetone phase. To deflect the laser beam across flight direction different techniques are used, mostly based on moving mirrors. Based on the recorded positions of the aircraft laser points are calculated in ETRS89 or WGS84. Some final transformations lead to the coordinates of the local reference system and data is finally presented as evenly or irregularly ditributed three-dimensional points.

Data from laser scanning systems offer some different characteristics compared to classical photogrammetric measurements. One of them is the possibility to penetrate vegetation and the capability of measuring ground points beneath the canopy. Another is the capability to capture data at night or at low sun angles and in weather that aerial photography can't accept, as the systems are using active illumination sensors. The technology also leads to good results in regions where aerial photographs can't be used due to the lack of tie points as in coastal regions or ice and glacier areas.

A large application area for laser scanning systems is the production of Digital Elevation Models, DEM, of land and shallow sea surfaces. Raw or unfiltered laser data describes the ground surface including vegetation, buildings and other objects. In order to obtain a DEM without these objects, data must be filtered and processed. The obtained accuracy for such a DEM is, expressed as standard error, of a magnitude of 0.1-0.2 m partly depending on flight altitude. Another suitable task for laser scanning is in the production of 3D City models (fig 1).

Only a small number of private companies are offering laser data capture and the required post-processing, using proprietary software developed by each company. As the laser scanning techniques and also some laser parameters, as wavelength and laser frequency, are very different, results from different systems have different characteristics and can be difficult to compare.
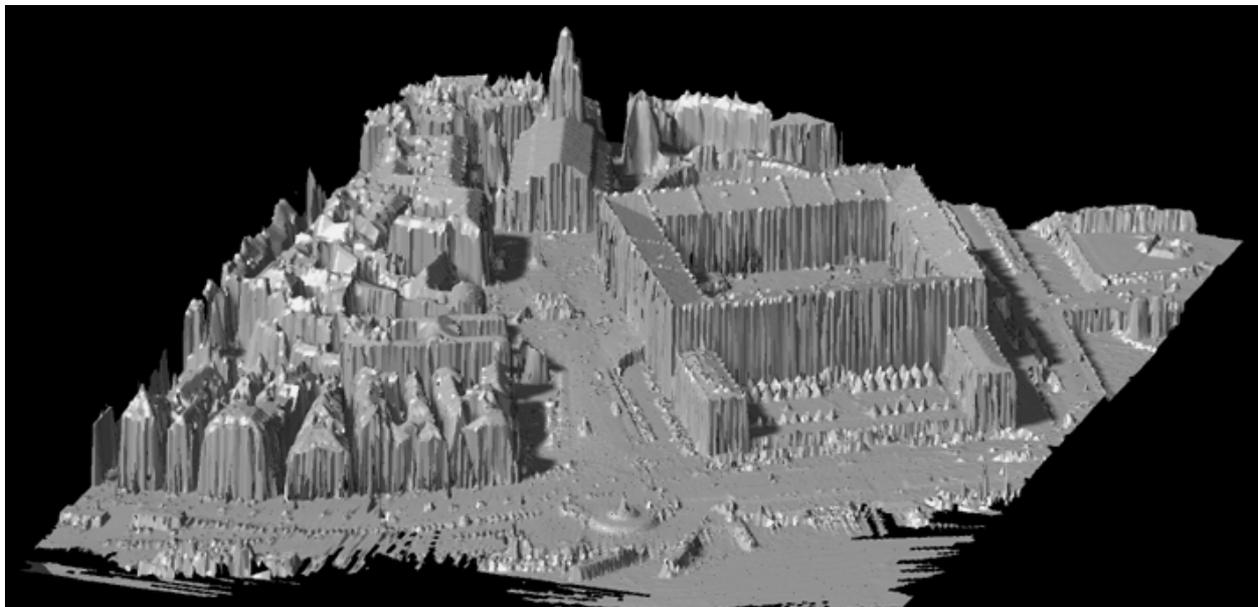
Figure 1.   Laser scanner data interpolated to a regular grid with 0.5 m grid size. Data set from Saab TopEye covering parts of Stockholm.