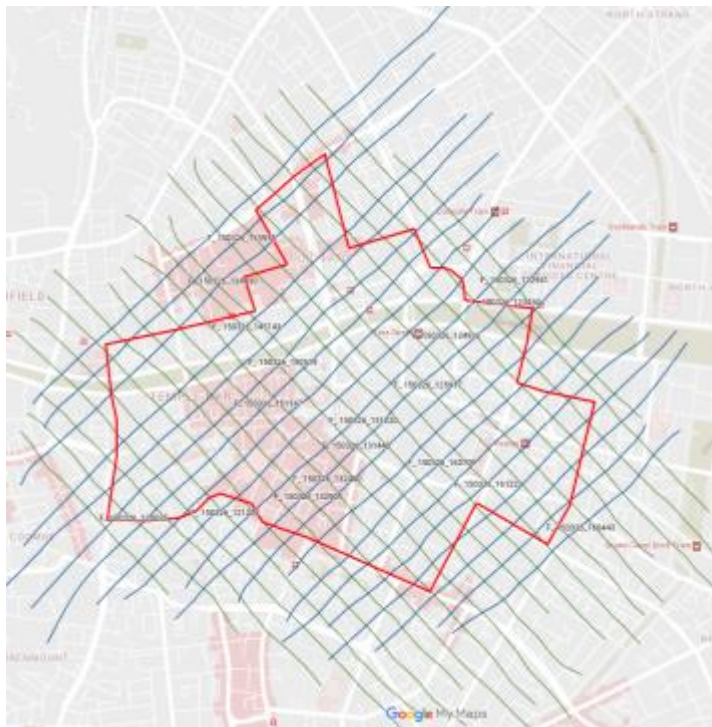


2015 Aerial Laser and Photogrammetry Datasets for Dublin, Ireland's City Center

Aerial laser scanning (ALS) and photogrammetry data collected over an area of more than 2km² in Dublin city in 2015. Over 1.4 billion laser points were acquired (inclusive of partially covered areas). ALS was carried out by contractors using a TopEye system S/N 443. Imagery data was captured using a Phase One camera system. The average flying altitude was 300m with the total of 41 flight paths.

1. Flight paths and timeline of the survey

The following map shows the crossing pattern of the flight, which is oriented 45° with the city's major street grid to alleviate the self-shadowing effect and to maximize data coverage on building facades. The flight paths within each parallel set are spaced at 100m intervals so that each location in the surveyed area is scanned 6 times from multiple angles. The red polygon represents the area specified in the survey contract.



[Interactive map](#)

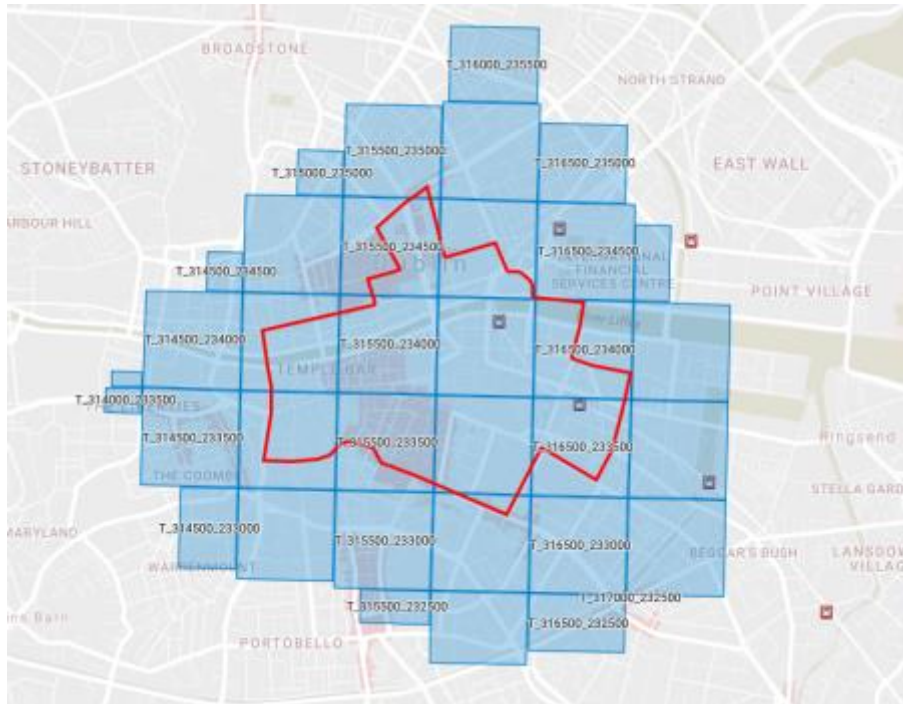


Figure 1: Flight paths

The aerial survey was conducted over approximately 4 hours on March 26th, 2015. The timeline of the survey is presented on this [online chart](#). The flight paths are named by their commencement timestamp. For instance, 'F_150326_115601' is the flight strip that began at 11h:56m:01s 26-Mar-2015. This naming convention is used for all datasets in flight structure. In some datasets (e.g. flight trajectory data), the flight paths are partitioned into two sets: (a) starting from 11h:40m:16s; and (b) starting from 14h:44m:11s.

2. Coverage

The indexed map in Figure 2 shows the survey's data coverage as a set of 500m × 500m tiles. The red polygon indicates the fully covered area with a LiDAR point density of 335 points/m² and with all imagery data available. The tiles outside the red polygon are partially covered. Tiles are named by the x-y coordinates of the South-West corners of their grid cell. The naming convention is used for all data structured by tile.



[Interactive map](#)

Figure 2: Data structured by tiles

3. Data components

The survey data consist of the following components:

- LiDAR point cloud
- LiDAR full-waveform
- Oblique imagery
- Geo-referenced RGB imagery
- Geo-referenced colored infrared imagery
- Ortho-rectified RGBi imagery
- Video data
- Book-keeping data including project report, data quality reports, metadata, etc.

These datasets are organized in either tile structure (500 × 500m grid), flight structure, or both.

[This online chart](#) shows the component datasets, their structure, and location on the hard drive. Hover over the block to see the datasets' brief description and location.

4. Detail description of the component datasets

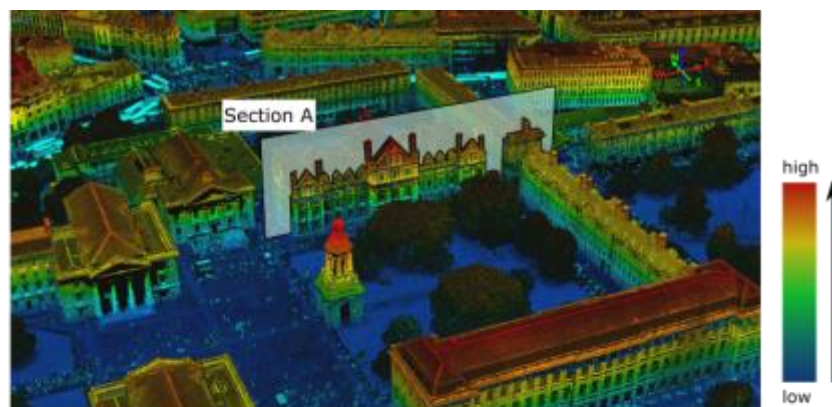
This section describes the content and format of each data component, and suggests software to work with the data.

4.1. LiDAR Point Cloud

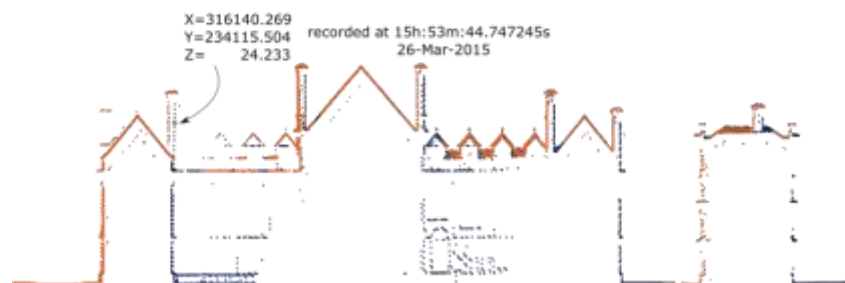
A LiDAR point cloud is the primary output of a laser scan. A point cloud is a collection of 3D points, abstractly representing the geometries of the scanned objects (e.g. roads, buildings, trees). In addition to x, y, and z coordinates, each point data record contains a timestamp, a laser intensity value, and several other attributes. See Point Data Format 1 of ASPRS's LAS v1.2 specification for the complete list of point attributes.

More information about the point cloud's accuracy and quality are available in the surveying contractor's report (i.e. 3489_Dublin_Area_2km2_project_Report.pdf in the documentation package). The raw quality control data can be found in the preservation record (i.e. 'ground-survey' and 'quality-control' directories in nyu_2451_38684_misc_other.zip package). Some spurious points are visible. Many of them are artifacts caused by the interactions (e.g. reflection, refraction) of laser beams with mirror-like or transparent surfaces (e.g. water surfaces and glass windows). Another source of outliers, commonly observed beneath ground surfaces, comes from the "ringing" effect happened on the scanner's electronic sensor subsequent to strong echoes.

Format	Reference	Software
LAZ (compressed LAS)	ASPRS' LAS v1.2 (format 1) LASzip	LAStools CloudCompare



(a) Sample laser scanning point cloud data coloured by the point elevation



(b) Points selected from 2 different sub-scans (i.e. orange and blue) at Section A

[Interactive 3D model](#)

Figure 3: Sample point cloud data

4.2. LiDAR Full-Waveform Data

Full-waveform data contains raw sensor readings in the form of time-series of laser intensity values. This data complements LiDAR point clouds to provide more information about the data's origin and richer information about the scan scene. The Dublin 2015 full-waveform data are available in 2 formats: (1) ASPRS's LAS format for full-waveform with waveform data stored in auxiliary files (WDP), and (2) Rapidlasso's PulseWaves format.

Format	Reference	Software
LAS, WDP	ASPRS' LAS v1.3 (format 4)	LAStools
PLS, WVS	PulseWaves	PulseWaves

Sample data

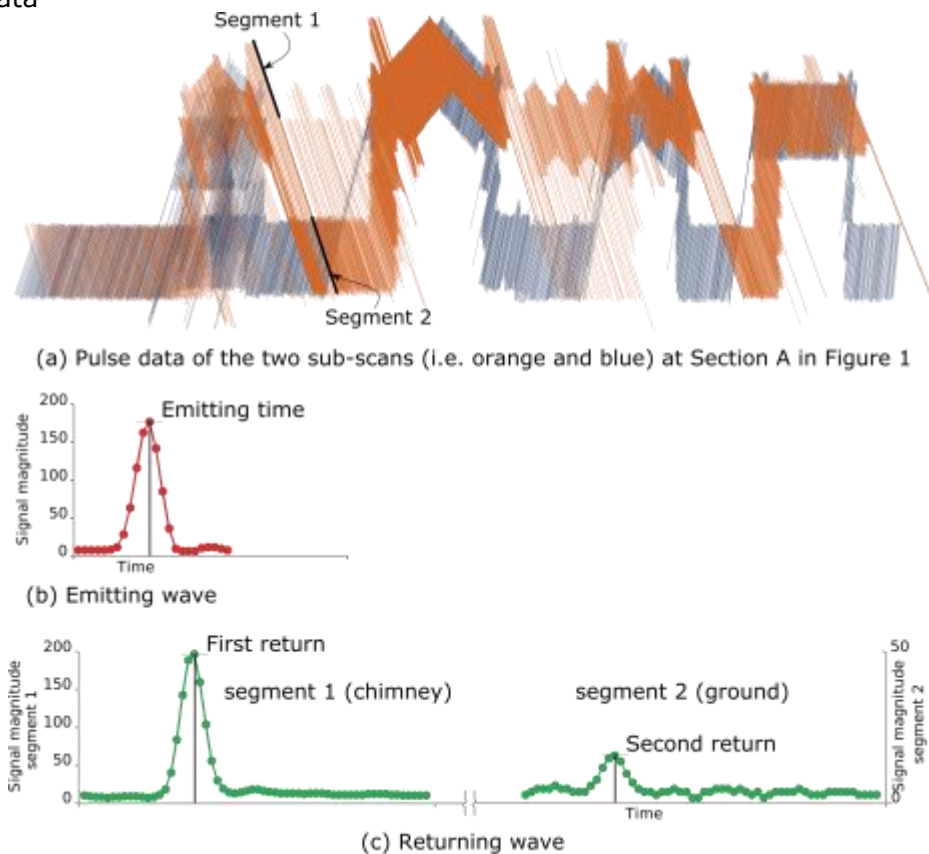


Figure 4: Sample full-waveform data

4.3. RGBi Orthophotos

Ortho-rectified imagery data of 5cm resolution are presented in 4 bands: red (R), green (G), blue (B), and infrared (i). The images are stored as 500m x 500m GeoTIFF files. This [info sheet](#) from USDA provides further information about the 4-band imagery data.

Format	Reference	Software
TIF, TFW	GeoTIFF	ArcGIS , FME Desktop



Figure 5: Sample ortho-rectified images

4.4. Oblique imagery data

Oblique images captured by two separate cameras (SLR1 and SLR2) are stored as JPEG files. One directory is designated for data from each camera. The images within each directory are grouped by flight paths. In addition to the JPEG files, the directory contains metadata (e.g. camera's geo-location, high-resolution timestamp, etc.) as auxiliary ASCII files.

Format	Reference	Software
JPG	JPEG format	Various software



Figure 6: Sample oblique images – two consecutive shots from camera SLR1 and camera SLR2

4.5. Geo-referenced RGB Imagery Data
4555 frames of RGB imagery data are structured as flight paths.

Format	Reference	Software
TIF	GeoTIFF	ArcGIS , FME Desktop



Figure 7: Sample geo-referenced RGB images – two consecutive shots

4.6. Colored Infrared (CIR) Imagery Data
Geo-referenced CIR imagery data are structured as flight paths. [This factsheet](#) from USGS explains the derivation and usage of CIR imagery data.

Format	Reference	Software
TIF	GeoTIFF	ArcGIS , FME Desktop

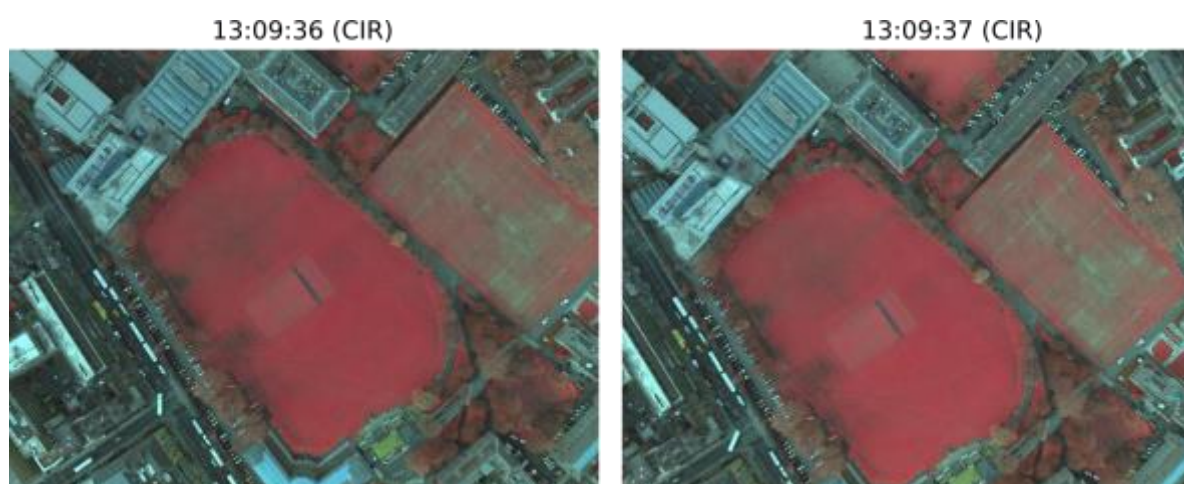


Figure 8: Sample geo-referenced CIR images – two consecutive shots

4.7. Video data
The video dataset is composed of 19 files in MOV format. The videos are in temporal order but are not directly related to other datasets in flight structure.

Format	Reference	Software
MOV	Apple's movie format	QuickTime

Please click [here](#) for a sample video data.

4.8. Other datasets

- Reports:
 - Project report
 - TopEye Area Statistics and Qualities (TASQ) report and data
 - Ground Control Point (GCP) report
- Flight trajectory: ASCII format
- Camera parameters
 - Time data: timestamp of each image file (ASCII format)
 - Mosaic: 20cm-resolution mosaic (ECW format)
 - Calibration files: ASCII
 - tphoto_files: ASCII
 - dtm: (BIN format)
- Ground survey
- Planning for ground survey
 - Ground Control Point (GCP) validation
 - Coverage and density validation