

## Section 2. Acquiring and Processing Laser Scan Data#

### 2.3 Scan Data Lifecycle#

Point cloud data sets produced by laser scanners are rarely used in raw, unedited form. Typically individual scans are registered to a common coordinate system and the unified point cloud is used to create any number of products. The products derived from scan data can vary across projects and can include polygonal models, extracted measurements and features, CAD models, videos, animations and more. Products can be derived at different stages in the processing pipeline and it is essential to document key processing steps that directly affect the quality of the final product. A summary of the processing work flow is provided here.

#### 2.3.1 Collect Scans

- During data collection, it is advised to record the project and scan level metadata detailed in **Section 3.2** below.

The process of collecting scan data is often fairly straight forward providing that key project elements such as project objectives, data resolution, and scan time have been evaluated. The scan operator will typically position the scanner and capture data at multiple locations around a subject while ensuring adequate overlap in the data between scans. According to the *Metric Survey Specifications for Cultural Heritage* (English Heritage 2009, 7.2.6) data overlap is important for the data registration process and also ensures complete documentation of the object or environment. Also, in the process of ensuring data overlap, the scan operator should try and minimize data voids or holes in the data (see *ibid.* section 7.2.7 for a discussion on data voids).

For terrestrial laser scanning of large objects or sites, it is also advised to collect a series of overview and detail scans to provide an accurate picture or context for the entire dataset (English Heritage 2009, 7.2.5). If targets are acquired, it is necessary to obtain high resolution scans of each individual target face to ensure that the data density is sufficient for target recognition by the system software. A map of all scan locations as well as target locations is also advised and required for data archiving. Project planners should also employ suitable methods for accessing hard to reach places or high areas within a site (See English Heritage 2009, section 7.2.8 for a discussion of High Level Coverage). In instances where RGB acquisition is included, additional care may be required in setting up and maintaining a uniform and well-lit environment.

For scanning smaller objects, the use of a turntable is advised (if feasible) and will greatly facilitate data acquisition. Many scan systems are integrated with turntables and processing software such that the scan data enters the software roughly co-registered based on the identification of the central vertical axis of the turntable. If a turntable is not feasible or if an object is too large to be placed on a turntable, then the process of collection is similar to that used for scanning large objects where the scanner is repositioned manually around the object with efforts made to ensure adequate overlap between scans and to minimize data voids. If RGB acquisition is a priority, then it is advised to set up and maintain a uniform and well-lit scanning environment.

#### 2.3.2 Register scans to common coordinate system

- During data registration, it is advised to record the registration metadata detailed in **Section 3.3** below as well as save the individual transformation matrices for each scan.

Registration is the digital reassembly of the scanned object or structure from a series of individual scans. The process of registration involves combining multiple scans into a single coordinate system. Registration is performed by identifying common features or tie points between scans. The tie

points can either be targets that were acquired and identified in the field or a series of manual pick points identified by the user in the software. Once all scans have been registered then a final global registration is performed to fine-tune the quality of the overall registration. The overall quality of the registration is reflected in the standard deviation value for the global registration which in all projects should ideally be less than the accuracy of the laser scan system that was used.

Registration can also involve georeferencing the point cloud to a real world local or global coordinate system. If a series of control points were collected in the field, these control points are typically entered into the processing software and the point cloud is then registered to the control. The process of georeferencing a point cloud is not required although most traditional structure or site surveys will include it as part of their workflow.

For more information on the different registration methods, please see Section 7.3.2 of the *Metric Survey Specifications for Cultural Heritage* (English Heritage 2009).

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