

3D Data Acquisition - 2

Lecture Notes

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Version

Version 2.0

Date: 2025-04-29

Learning outcomes

At the end of this lecture, the learner is expected to be able to

- Explain 3D geospatial data acquisition technologies
- Describe the ways of using data acquired with different sensors (UAVs, ALS, TLS, Tacheometry)

Expected competences when entering the lecture

- 3D Data Acquisition - 1

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BIRGIT – training on Building InfoRmation
models integrated with Geographical
InformaTion

With the support of the Erasmus+ Program of the European Union Strategic Partnerships N° 2021-1-SE01-KA220-VET-000028000

Summary

The lecture explains 3D geospatial data acquisition surveying technology: 3D Laser scanning. It covers terrestrial and aerial laser scanning.

Expected Workload

17 slides with course learning content, 2 hours



Revision History:

Revision	Date	Author(s)	Status	Description
0.1	2023-09-09	V. Cetl, D. Markovinović	Draft	Table of content
0.2	2023-09-20	S. Šamanović	Draft	Photogrammetry included
0.5	2023-11-16	V. Cetl, D. Markovinović	Draft	First complete version
1.0	2024-01-15	V. Cetl	Final	Final after revision
2.0	2025-04-29	V. Cetl	Final	Updated EU logo and disclaimer. Edited by T. Näslund



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Introduction

There are different 3D Data Acquisition surveying methods. The most used at the moment are: Tacheometry, Photogrammetry and 3D Laser Scanners.

3D Data Acquisition – 2 Lecture notes cover 3D Laser Scanners.

3D Laser scanning

In a nutshell, laser measurement tools are based on the principle of reflection of a laser beam. To measure a distance, the device emits a pulse of laser in the direction of an object, for example, a wall. The time necessary for the laser beam to get to the object and go back determines the measurement of the distance.

3D Laser Scanning is a non-contact, non-destructive technology that digitally captures the shape of physical objects using a line of laser light (Figure 1). It is a process of capturing precise, three-dimensional information from a real-world object, a group of objects, or an environment, using a laser as a light source. By projecting laser light onto the object, the scanner creates point clouds – millions of precisely measured XYZ points that define the object's position in space.



Figure 1. Laser scanning

3D laser scanners create “point clouds” of data from the surface of an object. In other words, 3D laser scanning is a way to capture a physical object's exact size and shape into the computer world as a digital 3-dimensional representation.

There are several types:

- Terrestrial Laser Scanner (TLS) (Figure 2)
- Airborne Laser Scanner (ALS) (Figure 3)
- Mobile Laser Scanner (MLS) (Figure 4)

The common name for all methods is LiDAR (Light Detection and Ranging)

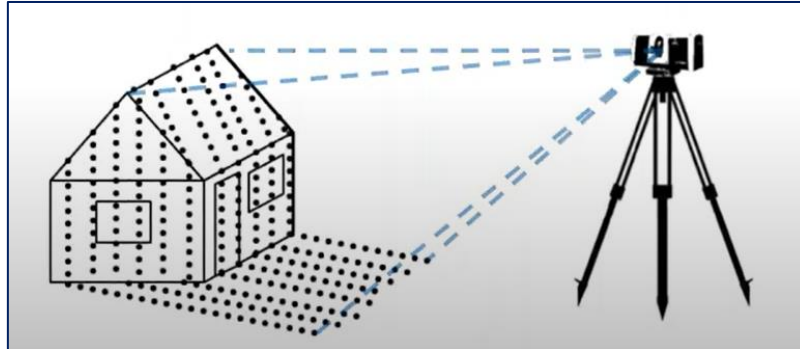


Figure 2. Terrestrial 3D Laser scanning

Terrestrial laser scanning (TLS), also referred to as terrestrial LiDAR (light detection and ranging) or topographic LiDAR, acquires XYZ coordinates of numerous points on land by emitting laser pulses toward these points and measuring the distance from the device to the target.

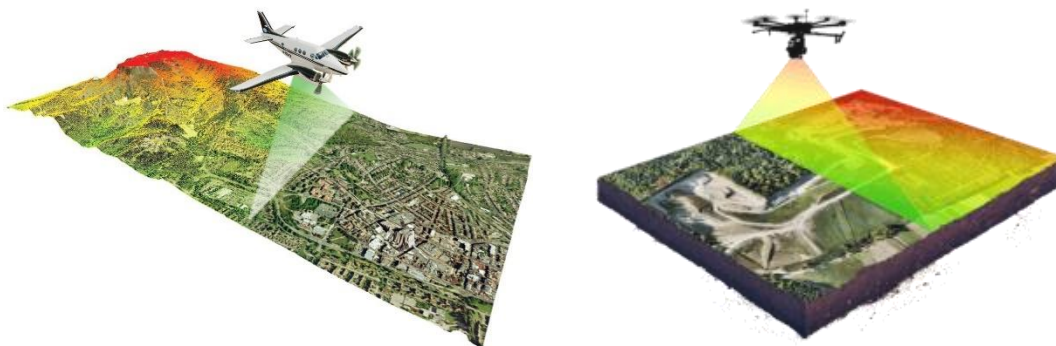


Figure 3. Airborne 3D Laser scanning

Airborne laser scanning is used to collect high-resolution data for the generation of a digital surface or digital terrain model. Depth of the Earth's surface in water-covered areas (In clear water, a LiDAR system can measure up to about 50 meters deep).

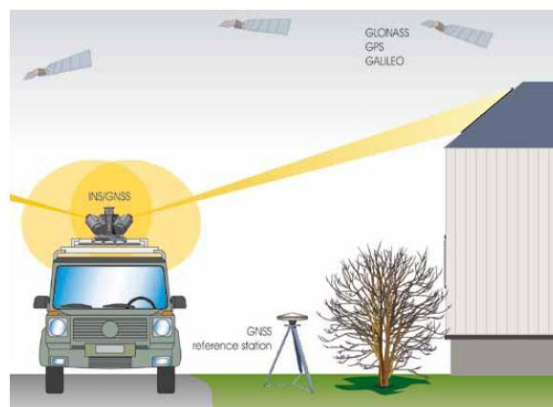


Figure 4. Mobile laser scanning



Mobile Laser Scanning System (MLS) designates the acquisition of 3D data by means of one or several laser scanners mounted on a mobile platform (e.g. automobile). There are also Handheld Laser Scanners, also referred to as handheld mobile terrestrial laser scanning (HMTLS).

Georeferencing

Georeferencing is the process of assigning locations to geographical objects within a geographic frame of reference. It is fundamental to geospatial technologies in general, and geographic information systems (GIS) in particular.

Georeferencing means transforming the point cloud data collected by different laser scanner into a global coordinate system for three-dimensional (3D) scene reconstruction (Figure 5). It defines the transformation of data from a local instrument system into an official coordinate system of an object where dot clouds collected from all points of view are aggregated to allow further data processing.

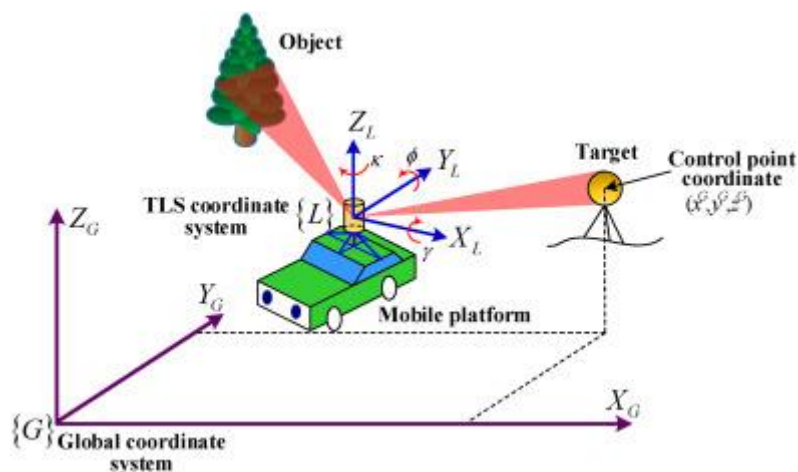


Figure 5. Georeferencing

3D Laser scanning usage

The applications of 3D laser scanning are almost unlimited. Laser scanning is very suitable for three-dimensional tunnel, bridge and facade measurements, archaeological documentation, modelling of piping, volume measurements and more. The most common uses for laser scanning at medium range are listed below:

- architecture
- civil engineering
- BIM
- agriculture
- archaeology
- infrastructure
- 3D video games
- reconstruction of accidents
- healthcare



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