# 3D LASER SCANNING OF SILLE OPEN MUSEUM VALLEY

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**ABSTRACT:**

The early permanent settlements in Konya and its province go back to prehistoric times. So many findings of the cultures of the Paleolithic, Neolithic, Kalkolithic, Early Copper and Bronze Age were discovered within the period of time in the province of Konya. Konya has been an old permanent settlemet province, a cradle for many civilizations since people started to run a settled life in 7000 B.C. Konya is considered one of the oldest settlements of the world history. The town of Sille near Meram and the reservoir 8km from the town center of Konya have become the Konyans' second-favorite destination for excursions. Formerly a Greek settlement it is now a center for carpet-weaving. St Helena's, one of Sille's two Byzantine churches, is said to be the oldest church in the world but only the foundations remain. Sille is an open museum with mosques, fountains, baths, churches, engraving church, bridges, and other historical places. Sille is a treasure that makes hosting for different societies during 5000 years history and it is also a trade and culture centre.
There have been many research projects undertook the scanning of historical sites and artifacts both for documentation and analysis purposes. In this study laser scanning of the Sille valley have been completed. The study area is 2 km long and 200 m wide. Scanning time is about 1 week. And combination of the point clouds is also about one week. In this presentation sille valleys laser scanning procedures and results will be given.

## 1. INTRODUCTION

A 3D scanner is a device that analyzes object to collect data on its shape and possibly its appearance The collected data can then be used to construct digital, three dimensional models useful for a wide variety of applications. These devices are used extensively by the entertainment industry in the production of movies and video games. Other common applications of this technology include industrial design, orthotics and prosthetics, reverse engineering and prototyping, quality control/inspection and documentation of cultural artifacts. There have been many research projects undertook the scanning of historical sites and artifacts both for documentation and analysis purposes. In this study laser scanning of the Sille valley have been completed. The study area is 2 km long and 200 m wide. Scanning time is about 1 week. And combination of the point clouds is also about one week. In this presentation sille valleys laser scanning procedures and results will be given.

## 2. SITE DESCRIPTION

The tiny village of Sille, where the first rock carved monasteries of the world were built, is an ancient settlement, leaning on the two slopes of a valley located in the 12km of the Northwest of Konya. In this area there are many monumental works such as a church dated back to 327 BC, rock churches remaining from earlier periods, and baths and mosques from the Otoman period. Besides, the most of the historical settlement composed of civil architectural monuments. Today the whole area of 33 ha, is under a conservation scheme as "Urban Conservation Area".

Sille was announced as an Archaeological Conservation Area of Urban and 1st Grade approved by the Konya Conservation Council of Cultural and Natural Assets with a decision dated of 19.06.1995 and registered of no.2292. The area was kept out of the urban development in the Master Development Plan of Konya with the scale of 1/25000 (Konplan2020) and defined as "Urban Conservation Area". (Erdem, 2003).


Figure 1. Sille valley

## 3. TERRESTRIAL LASER SCANNING

Terrestrial Laser Scanning is a new and efficient method for digitizing large objects and entire scenes. Since some years several manufacturers offer different systems which are designed and developed more or less for specific tasks. In

general each surveying task can be divided in three major steps: data acquisition, data treatment and finally the visualization. For Laser Scanning this categorization is also valid. ( Staıger, 2003)

Today the scanner systems on the market can be divided in three different types

-Camera Scanner:
-Panorama-Scanner:
- Hybrid Scanner.

In this study ILRIS 3D (OPTECH) scanner have been used. ILRIS 3D is a camera scanner
Optech ILRIS-3D had been developed specifically for topographic and open-cast mining applications on the one hand, and for industrial applications, especially the measurement and modeling of industrial plants and facilities, on the other. Thus the instrument was designed and constructed with long-range capabilities from outset.
ILRIS-3D instrument provided an increased range (beyond 1000m to highly reflective targets); an improved accuracy; an integrated CMOS-based camera giving a 6 megapixel image; and an integrated handle for carrying purposes. Optech also introduced the ILRIS-$3_6$D version of the instrument. This instrument was equipped with a motorized pan-and tilt base that allowed the scanner to cover a $360^0$*$360^0$ FOV. For this to be implemented, the motorized base unit moves the scanner unit of the ILRIS-3D with its $40^0$*$40^0$ in a series of steps that are measured by angular encodes. Each $40^0$*$40^0$ FOV scan patch or window overlapped on its neighbors by $5^0$. (Shan, J., and Toth, K. C., 2009)


Figure 2. Optech laser scanner

The software tools needed in 3D scanning comprise a large number of modules. Software for scanner control is used to define which parts of an object are scanned at which resolution. Software for treating the huge data volumes of point clouds must allow visualization, data cleaning, filtering, point thinning and registration (Boehler 2002)
In this study Polyworks point cloud software have benn used to process of point cloud data.
PolyWorks is a comprehensive software package that quickly generates high-precision polygonal models and NURBS surfaces from 3D digitizer and image data.
PolyWorks also offers a unique reverse-engineering module that produces class A polygonal models and rapid NURBS surfaces that are the most usable in CAD/CAM/CFD/FEA software suites

## 4. CASE STUDY

The location of Sille valley is near the Konya province. The scanning was made about one week. The valley was scanned from fiften stations. The number of measured points was approximately 6 million scanning interval is 20 cm.
To obtain 3D images to 3D polygonal model, PolyWorks Version 10.0 InnovMetric software was used. Firstly, the binary data provided by Optech ILRIS-3D were parsed using Optech Parser 4.2.7.2 to obtain a point cloud in IXF format processed by Innovmetric PolyWorks 10.0. Secondly the translated images were imported into PolyWorks InnovMetric software.and then merged into one polygonal model.

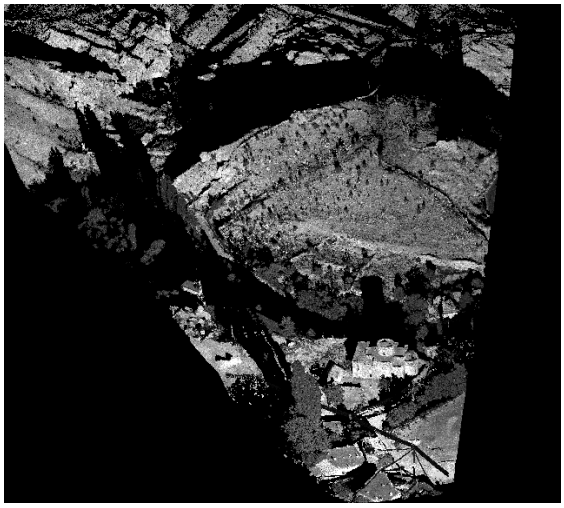

Figure 3. Point cloud of Sille valley

## 5. CONCLUSION

Terrestrial laser scanning is a technology that in recent years has become increasingly popular for documentation which provides very dense 3D points on an object surface with high accuracy. The most important advantage of the method is that a very high point density can be achieved, in the order of 5 to 10 mm resolution. In order to analyze the character and shape of the scanned surfaces it is necessary to convert the irregularly distributed point data into 3D surface information using surface reconstruction. The reconstructed surface can subsequently be visualized using a variety of 3D visualization techniques. From the reconstructed 3D surfaces, it is also possible to generate 2D profiles or elevation contour lines for use in regular GIS or CAD packages.

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