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Incorrect use of wearable mobile LiDAR: Example of Mersin Soli Beach and Ankara National Library Underpass

Atila Karabacak*[1], Murat Yakar [2]

[1]*Mersin University, Vocational School of Technical Sciences, Department of Architecture and Urban Planning, Mersin, Türkiye,*
[2]*Mersin University, Faculty of Engineering, Department of Geomatics Engineering, Mersin, Türkiye*

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Abstract

Scanning was carried out on the Mersin Soli coast with Wearable Mobile LiDAR (GML) to determine the shore edge line without using a Ground Control Point (GCP) and without creating a closed route. As expected, deviations from the sea and errors up to decimeters were observed since the GCP was not used. In a second study, it was used in the 3D modeling of the Ankara National Library subway underpass. In the study, scanning was carried out using GML without using a Ground Control Point (GCP) and by creating a closed route. The study was unsuccessful as a result of not using GCP and having a symmetrical appearance in the field.

1. Introduction

Mersin has the most beautiful beaches in Turkey. It is important to determine the coastal edge line quickly and accurately with GML. In this study, we know that GML data is corrupted by reflections from water, and it was also determined that the data was corrupted in this study (Karabacak and Yakar, 2023a).

3D modeling of the Ankara National Library subway underpass can be done quickly with GML, of course, this requires using GCP and differentiating the scene. In this study, the scene was not differentiated and it was investigated how to get results without using GCP.

2. Method

Nowadays, the demand for high accuracy 3D data is increasing rapidly. With advances in sensor technology and the continuous improvement of computing power, geo-referenced technologies can today bring unique functionality and flexibility in spatial modeling. Laser scanning is one of the most important technologies in this regard (Yılmaz and Yakar, 2006a; Yılmaz and Yakar, 2006b; Ulvi et al. 2014; Alptekin and Yakar, 2020a; Alptekin and Yakar, 2020b; Karataş et al. 2022a; Karataş et al. 2022b; Yakar et al. 2016; Kanun et al. 2021).

The WML we used in this study is the Gexcel Heron Wearable 3D Mobile Mapping System. The system has been used for 8 years. The system, which uses the SLAM algorithm, can be used anywhere a person can walk. System Building, cave, mine, cultural heritage etc. It is used to measure all kinds of natural and artificial objects. The system can capture 3D point cloud and 5K panoramic images.

The portable Mobile laser scanner tested in this study is the Heron wearable Lidar device produced by Gexcel. It is a 16-channel Velodyne Puck LITE laser scanner that emits infrared laser beams at a wavelength of 903 nm and provides 300,000 dots per second in single rotation mode from 360o horizontal view and 30^{o} vertical view. Range measurements are carried out on the time-of-flight principle with a maximum measurable distance of 100 m. The laser scanner sensor is combined with an XSens MTI, IMU, whose data is used in system orbit estimation. When performing the survey, the scanning head is mounted on a telescopic carbon fiber pole, connected to a battery and a control unit. According to the manufacturer's specifications, the system provides a local accuracy of 3 cm and a final global accuracy of 5 cm. The system is also affected by the presence of loops and closures. features may be affected by the SLAM algorithm and accuracy may decrease to 20-50 cm (Paksoyteknik, 2023; Yakar and Karabacak 2023; Karabacak and Yakar, 2022; Karabacak and Yakar, 2023b; Karabacak and Yakar, 2023c).

* **Corresponding Author**

*(*atilakarabacak@mersin.edu.tr*) ORCID ID 0000-0002-1096-3949
(*myakar@mersin.edu.tr*) ORCID ID 0000-0002-2664-6251

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2.1. Mersin Soli Beach 3D Modeling Studies

The measurement with GML appears in figure 2 (figure 1). In the route solution given below, the red line appears to be a place where the route is disrupted and goes to different spaces. Here, the SLAM algorithm is affected by the sea (Figure 2).

An attempt has been made to prevent this route disruption with different parameter options.

The 3D model and orthophoto were created with dm precision as shown below. Deviations are greater in the vertical, this was seen as a result of examining the 3D model (Figure 3).

Figure 1. Field study

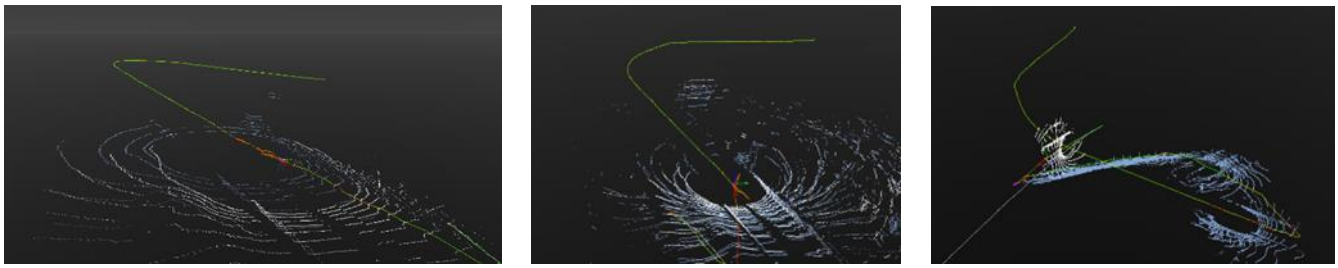

Figure 2. Route distortion

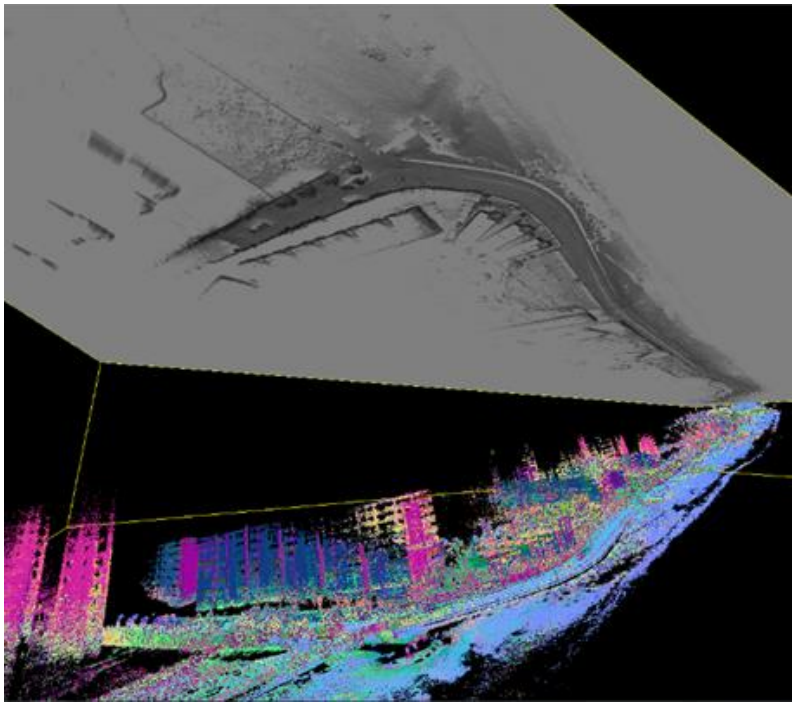

Figure 3. Orthophoto and 3D model

2.2. Ankara National Library Underpass 3D Modeling works

The study was carried out in the Ankara National Library underpass [13]. In the study, GCP was not specifically used and the system was tested without specially differentiating the environment. Working with GML was completed in approximately 9 minutes.

In the study, the SLAM algorithm disrupted the study by going to different spaces since there was no differentiation in the scene. Errors occurred at the meter level [14].

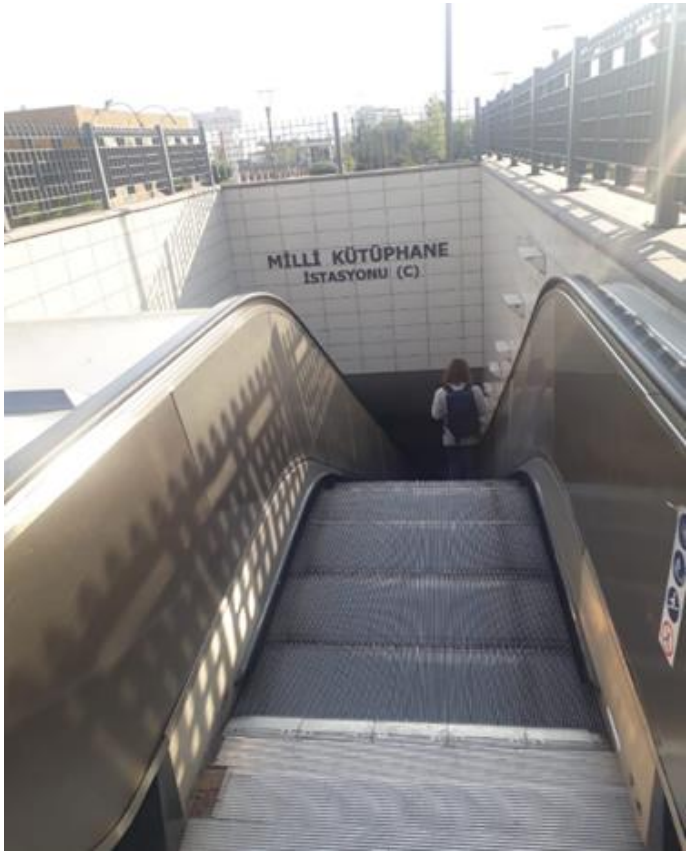

Figure 4. Ankara National Library Underpass

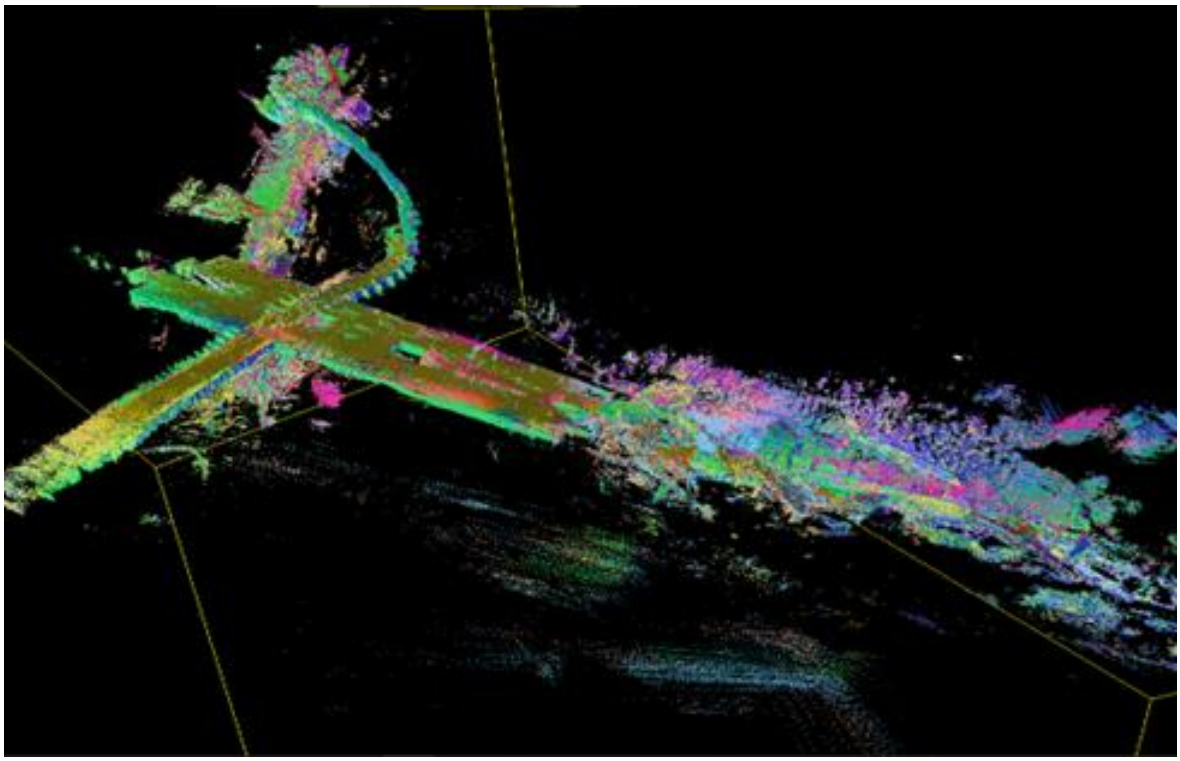

Figure 5. Ortophoto and 3D model

3. Results

In the study carried out on the beach, errors up to dm were observed, corrupting the sea SLAM algorithm. In the study carried out in the underpass, the symmetrical environment disrupted the SLAM algorithm and resulted in errors of many meters.

4. Discussion

Since the GCP point was not used, the SLAM algorithm gave errors in these difficult conditions in both studies. Since different reflections at the seaside disrupt the SLAM algorithm, errors can be reduced by using the GCP point, and it will also reduce the error rate on closed routes.

We tested that since the underpasses were made symmetrically and there were no different objects in the scenes, it made it difficult for the SLAM algorithm to work and distinguish, and it was observed that it confused the direction of the GML route solution. The resulting product is worthless in terms of engineering but valuable in terms of science. Different objects should be placed in places with the same appearance, such as underpasses, and it is necessary to use GCP.

5. Conclusion

As a result, using GML without using GCP is far from giving reliable results since the water surface at water edges disrupts the SLAM algorithm. We recommend using YKN in places such as underpasses etc. and scanning with GML by differentiating the place.

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