

**SECONDARY SCHOOL SGGES** SREDNIA GRADBENA, GEODETSKA Land Surveying and Economics Ljubljana

**AUTHORS** Anja Judež, Nina Kranjec

**SUPERVISOR** Marinka Potočar

# Lidar Based Path Analysis in Tivoli, Rožnik in Šišenski Hrib Landscape Park





In the research we analysed the suitability of LIDAR digital terrain model (DTM) for the analysis of paths in the Landscape park Rožnik, Tivoli in Šišenski hrib in the Centre of Ljubljana, the capital city of Slovenia. The area was decreed as a landscape park in 1984. The decree includes no information regarding the management of the park, nor does it set any standards of behaviour one should uphold when visiting the park.



## **Problem overview**

Large mass of the paths in the park presents a unique problem in the protected area of the park. Undirected movement of visitors of the park has a **direct impact on the natural environment** as is an area where spontaneously generated random paths are the most exposed to erosion and striped roots.

• Different types of paths were analysed.



In the park there is a need for planning and designing various activities, good and reliable information about the position and large mass of paths in the park. We set up 3 hypothesis:

- With the help of LIDAR digital terrain model we can effectively identify the paths (accurate representation of linear structures).
- It allows us to produce height profiles and assessment of the difficulty of the path.
- Visitors in the park have too much freedom and cause a chaotic movement everywhere.

# Data

- LIDAR digital terrain model with a pixel size of 0.5 m.
- GPS measurements.
- Survey results.







Principles of LIDAR technology. The laser scanner measures a bundle of 3D-vectors (polar coordinates), which are positioned by DGPS and oriented by IMU (Inertial Measurement Unit). (Credits: Ž. Kokalj)





Left: Landscape park on a colour orthophoto image (2006). Right: Hillshaded DTM reveals important details. The length of all paths in the park is estimated to be 85 km.

# Methods

- Topography and paths' analysis based on analytical hillshading of DTM.
- Recording routes in park with GPS device and field photography of the routes.
- Comparison of routes recorded with GPS and lidar DTM extracted routes.
- Lidar DTM suitability analysis.
- Creation of profile graphs for different types of paths.
- Survey with hikers that use paths in a landscape park.

# Conclusions

We confirmed all three hypotheses through the research paper.

- Lidar DTM is suitable for the analysis of different types of paths.
- Lidar DTM is suitable for profiling and assessment of the difficulty of the paths. Information about the difficulty of the paths can help us create learning pathways.
- The survey showed that most visitors are unaware of the problem of spontaneous paths.

Our findings could be used as a part of planning strategies for park management of the Municipality of Ljubljana city.



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