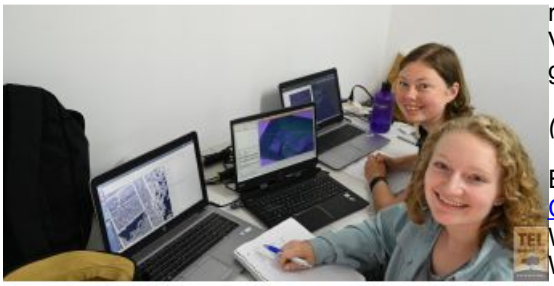
Portable Lidar Technology Provides Archaeology Students with New Insights

How can modern geospatial technology be used to preserve the past? Archaeology students from Wheaton College in Illinois, USA, have utilized a long-range Lidar sensor during an excavation project in Tel Shimron, Israel, to conduct daily high-resolution scans of the area. The scans gave the students a high-precision record of what they uncovered every day as the basis for further analysis. Velodyne Lidar provided its portable Ultra Puck sensor to enable a new generation of archaeologists to reconstruct life from thousands of years ago.



(This article contains a video)

Earlier this year, McKenzie Blank, a chemical engineering student at Wheaton College, Illinois, USA, worked with archaeology professor Dr Daniel Master of Wheaton on an archaeological dig at Tel Shimron in Northern Israel. The Wheaton students typically spent about 10 hours a day at the ancient dig site, where they were joined by scholars and students from institutions from around the world. The six-week dig entailed a lot of early mornings. Most days, students had to get up before dawn to beat the heat of the day. The day started with hauling the tools to the excavation site. The students then separated into small groups to excavate 100 x 100m plots or ‘grids’, which were subsequently broken down into smaller 10 x 10m plots called ‘squares’.

The team were keen to use their newly acquired portable Ultra Puck from Velodyne Lidar to gain accurate daily 3D renditions of the entire excavation area as a record of soil and artifact removal. Since the Lidar system had never been adapted for use at an archaeology site before, the team experimented and fine-tuned the approach until the required degree of accuracy was achieved. As a result, the archaeological crew succeeded in creating dense 3D point clouds of the archeological dig site. Using the point clouds, the team were able to produce highly detailed representations of the ground surface, which gave them new insights into the history of Tel Shimron and the surrounding area.

Recording the Day-to-day Changes during the Dig

The archaeologists had initially considered traditional Lidar as a data collection method, as it offers high-accuracy 3D recordings of the excavation site through high-density point clouds. However, that method seemed to be of limited use for the complex excavation trench in this particular project due to difficulties in discriminating between the subtle debris layers that form the fundamental building blocks of the stratigraphic sequence. Furthermore, it was unsuitable for recording the day-to-day changes during the dig.

To overcome these limitations, a pilot project was organized in collaboration with the Tel Shimron Excavation project. Daily scans of the excavation trenches were performed using a system based on a Velodyne Ultra Puck VLP-32C. The raw data was processed using simultaneous localization and mapping (SLAM) algorithms and georeferenced from fixed points outside the excavation area. Using a customized subtraction algorithm, the daily scans were then compared in chronological sequence to create a point cloud which recorded all angles (top, sides and bottom) of every mass of material which had changed from one day to the next.

Tel Shimron Excavation project.

Understanding the Ancient World

The Tel Shimron Excavation project seeks to understand the ancient world through rigorous archaeological investigation in order to provide resources for the study of Levantine history and culture over the last 5,000 years. Prof Daniel Master: “One group investigated a Jewish village from the time of Jesus, another group aimed to investigate how Tel Shimron interacted with the Hellenistic world of the third to second centuries B.C.”

Digitally Preserving Historical Information

Experienced archaeological supervisors identified each change in the OCHRE archaeological database, a platform that facilitates the use of the Online Cultural and Historical Research Environment (OCHRE) worldwide to record, integrate, analyse, publish and preserve cultural and historical information in all its digital forms. Connecting these auto-generated point clouds to the OCHRE data combines the field archaeologists’ expertise with the precision of Lidar. This method makes it possible to record each day’s work from all angles with millimetre precision.

The Lidar team at work in the GIS trailer.

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