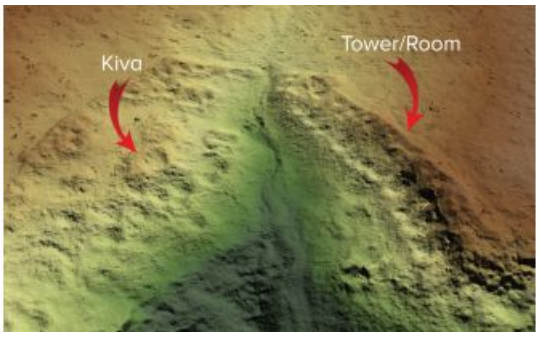
Ancestral Structures in Colorado Identified using Drone-based Lidar System



Culturally rich Canyons of the Ancients National Monument, Colorado, are managed by the Bureau of Land Management as an integral cultural landscape containing a wealth of historic and environmental resources. The Monument holds the distinction of having the highest density of archaeological sites in the USA. Most of these sites represent Ancestral Puebloan and other Native American cultures. Local Crow Canyon Archaeology Center and the Canyons of the Ancients National Monument have worked at Sand Canyon, an ancestral Pueblo site in the area, for over 20 years. They required improved ways to better visualize the site to inform ongoing preservation. A recent UAV Lidar survey by Routescene Inc. provided impressive results to accelerate understanding. Unexpectedly, the survey brought new discoveries of potential additional structures.

Using the Latest Technology to Increase Knowledge

The project presented technical challenges due to the density of vegetation covering the site obscuring the numerous archaeological features from above. It was decided that the best way to collect the data to extract a bare earth terrain model for the archaeologists was to use Lidar on a drone. A ground survey is labour intensive and time-consuming. Flying the site would maximize the area covered in a short time without compromising the sensitive site. Routescene's turnkey UAV Lidar solution was chosen as a suitable system for penetrating heavy vegetation to achieve high-resolution data.

The team implemented Routescene's survey workflow starting with survey and project planning. Once on location, the team established ground control and undertook a reconnaissance of the site. Deploying the Routescene LidarPod, flown using a DJI M600 Pro, the drone executed the planned flight plan and returned to the take-off point after each flight. Three flights were performed to cover the entire site, each flight took 10 minutes, and a total of 24 flight lines were flown to ensure 100% data overlap.

During the survey itself, marshals were stationed to ensure members of the public did not enter the survey site. The LidarPod operators monitored in real-time in-flight the quality of the data being collected using Routescene's QA Monitor software. After each of the three flights, the raw Lidar data was inspected to ensure the highest quality was achieved. This prevented unnecessary repeat visits to the remote site.

Data processing was a critical step. More than 3.2 billion points were collected during this survey and it was important the high-resolution data was maintained during analysis.

Using their proprietary software, LidarViewer Pro and their Bare Earth tool, Routescene extracted the bare Earth points to create a model. This process virtually removes all the vegetation from the site to expose in detail the structures that the archaeologists were interested in. The resolution of the final output was an impressive 400 points/m2. The process can be viewed on YouTube at https://bit.ly/2CUnTmS.

Background to the Archaeological Site

Pueblo is the term used in the South Western United States to refer to both ancient and present communities of Native Americans and comes from the word first used by Spanish explorers to describe them. The Sand Canyon Pueblo, one of 70 villages in the central Mesa Verde region of Southwestern Colorado, was occupied by an ancestral Pueblo community between

1240 AD and 1280 AD.

The age of the Sand Canyon community was defined using tree-ring analysis of wood samples. This confirmed the settlement was one of the last villages to be constructed, being used until the depopulation of the region by ancestral Pueblo people around 1280 AD.

This pueblo was built with a wall enclosing architectural units including an estimated 90 structures known as kivas, which were used by families as dwellings. There were also about 14 towers and 500 rooms constructed of stone and wood.

Surprising Results

Although the Sand Canyon Pueblo was studied, mapped, and excavated between 1984 and 1995 using traditional survey techniques, the Crow Canyon Archaeological Center required much more detailed, high-resolution data and could instantly see the value of performing a UAV Lidar survey on the site.

Mark D. Varien, executive vice president of the Research Institute at Crow Canyon Archaeological Center, stated that they were excited by the final results presented. The Lidar image provides the best tool for visualizing this ancient site in detail to better monitor the future condition of the site and has provided baseline data for the Canyons of the Ancients land managers to plan on-going preservation.

Varien said, “The impact of this survey approach is truly astonishing. It illustrated how the tool could be used to record undocumented sites with unprecedented precision. It removed the need for a painstaking ground survey and the speed of delivery of such detailed results is impressive. It has accelerated our understanding – the results indicate the Pueblo was more extensive than we had previously imagined. We are now able to concentrate our future work in a small finite area – to study the new-found kivas in more detail.”

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