



700 year old ancestral structures in Colorado identified using Routescene Inc. drone based LiDAR system

Culturally rich Canyons of the Ancients National Monument, Colorado, is managed by 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 provided impressive results to accelerate understanding. Unexpectedly, the survey brought new discoveries of potential additional structures.

Using latest technology to increase knowledge

Steve McCormack at Caddis Aerial was intrigued when this interesting and challenging survey opportunity arose from the Crow Canyon Archaeological Center and the Canyons of the Ancients National Monument. Locally based in Durango, Colorado, USA, Caddis Aerial are seasoned land surveyors who provide professional drone survey services across the Four Corners. The project presented technical challenges due to the density of vegetation covering the site obscuring the numerous archaeological features from above.

Steve McCormack from Caddis Aerial advised, “It was immediately clear 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 labor intensive and time-consuming. Flying the site would maximize the area covered in a short time without compromising the sensitive site. Routescene Inc.'s turnkey UAV LiDAR solution is the perfect system for penetrating heavy vegetation to achieve high resolution data.”

Gert Riemersma, President and CTO at Routescene Inc. confirmed, “Unlike other aerial survey methods such as photogrammetry, LiDAR can “see through” brush, vegetation and woodland, penetrating the canopy and undergrowth to the earth itself. Our 3D mapping solution is stellar for this work, having been used for this purpose many times by customers. We knew it would provide excellent results for the Crow Canyon Archaeological Center and the Canyons of the Ancients National Monument.”

The team implemented Routescene's rigorous 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 its' 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 3 flights the raw LiDAR data was inspected to ensure the highest quality was achieved. This prevented unnecessary repeat visits to this 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 of the 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 bare earth terrain 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.

Background to the archeological site

Pueblo is the term used in the Southwestern 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 A.D. 1240 and 1280.

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 about A.D. 1280.

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, "We 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. The LiDAR data has provided baseline data for the Canyons of the Ancients land managers to plan ongoing preservation."

“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.”

List of images and video

Video:	<p>“Canyons of the Ancients” - Mapping Sand Canyon Pueblo with the Routescene UAV LiDAR Solution</p> <p>To view the video click on the following link: https://www.youtube.com/watch?v=OWYXXUFkn4g&feature=youtu.be</p>
Attached image caption:	Final bare earth terrain model in which the round indentations identify the kivas and the towers and rooms appear as mounds of stone debris.

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Editors Notes

About Routescene® www.routescene.com	Routescene® is a global operation that offers authoritative insight across all aspects of data management and have industry recognition as data visualisation experts. Routescene understands the problems the survey industry needs to solve and have combined intelligent thinking with experience to design a reliable and practical solution to deliver fast geospatial data capture, analysis and visualisation to improve commercial decisions and performance.
About Caddis Aerial www.caddisaerial.com	Caddis Aerial LLC, seasoned land surveyors, provide professional drone services for local, national and international customers. Caddis Aerial provides a myriad of professional services, including: aerial mapping photogrammetry; utility line and tower inspections; aerial inspections (roofs, bridges, dams, material stockpiles, etc.); architectural 3-D renderings; avalanche study support; archaeological and environmental inspections; geographical monitoring and more.
About Crow Canyon Archaeological Center https://www.crowcanyon.org/	<p>Crow Canyon Archaeological Center believe that the study of the past is an intrinsically worthwhile endeavor that creates more informed and sustainable societies. Through a better understanding of human history, we discover what the past can teach us about the challenges we face today as a society.</p> <p>The mission of the Crow Canyon Archaeological Center is to empower present and future generations by making the human past accessible and relevant through archaeological research, experiential education, and American Indian knowledge.</p>