

Surveying and mapping the universe—in 3D

—by Tony Rogers

*As laser scanning technology advances at an unprecedented pace with never before seen capabilities and applications the question facing the market is no longer ‘can we scan it?’ but rather ‘what do we do with our scan results?’ How is point cloud software helping surveyors around the world?—**Tony Rogers**, co-founder and Director of Pointtools (in photo).*

Laser scanners are continually being developed to offer improved functionality with operational ranges of up to six kilometres, quoted accuracies of 2 millimetres, and rates of data capture rapidly approaching the one million points per second milestone.

It is now possible to scan objects much quicker, at a greater distance, and with scanners offering increasing portability and affordability, their use is becoming more and more widespread.

At the same time advances in laser scan processing “point cloud” software are allowing the vast amount of data to be quickly turned into truly useful information such as 3D computer models and fly-through 360 degree visualizations.

Surveyors are now mapping everything from diamond mines in Africa to glacial movements in the European Alps, and volcanic formations in New Mexico. In fact, this last example was

a proof-of-concept project to explore the viability of laser scanning even further afield.

Researchers from Navajo Technical College, together with representatives from NASA and New Mexico Tech, laser-scanned a volcanic formation in New Mexico, gathering 240 million individual measurements. Using specially developed point cloud software, the data was processed to create an immersive and interactive 3D computer model from which NASA scientists can assess the potential of laser scanning for future missions into space.

Using a Faro LS 120 laser scanner, the survey party mapped the Four Windows lava tube in the El Malpais National Park, collecting eight individual scans, each composed of 30 million points. The project was designed to understand the viability of laser scanning lava tubes and other formations on the Moon and Mars.

“This project was a proof-of-concept for NASA to determine what kind of data could be acquired by sending a rover vehicle, equipped with laser scanner, into a lava tube or cave on the Moon or Mars,” commented H Scott Halliday, Course Leader at Navajo Technical College.

“From the Pointtools model we can make an evaluation of the type of structures that can be picked up and conclude whether it is possible to determine the presence of water, ice, and/or micro organisms. This was great experience for the students, and both NASA and New Mexico Tech have been impressed with the results.”

High tech laser mapping can and is being used to help digitally preserve cultural heritage sites around the world. Using software from Pointtools to process millions, sometimes billions, of 3D measurements captured by laser scanning



Scanning lava tubes in El Malpais National Park, New Mexico

The value of CyArk's work was highlighted recently in Africa. In 2008, a CyArk partner in Uganda laser scanned a portion of the Kasubi Tombs, the royal tomb of the last four Bugandan kings

commented Justin Barton, Production Manager at CyArk.

The added portability of new-generation laser scanners means that scanners are being mounted on aeroplanes, helicopters, mobile mapping vehicles, boats, quad bikes and even robots.



3D-R1 robot scans the South Crofty mine [photo @ Bernie Petersen]



Back pack laser scanner



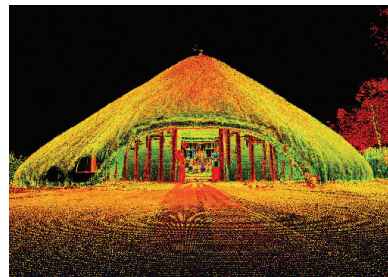
The 3D-R1 "in action" in Mexico

instruments, heritage preservation specialist CyArk is creating animated videos, architectural drawings, and 3D visualizations of sites such as Mount Rushmore, the Leaning Tower of Pisa, and an ancient Egyptian temple at Thebes (modern day Luxor). The computer-generated models provide visually stunning content for educational and tourism materials and serve as a foundation for conservation, restoration, and management works.

CyArk is a non-profit entity that digitally preserves cultural heritage sites by collecting, archiving, and providing open access to data created by laser scanning, digital modelling, and other state-of-the-art technologies. CyArk is currently working on projects to document the four missions of the San Antonio Missions National Park in Texas, and has just completed a joint venture project at Mount Rushmore involving the U.S. National Park Service and Scotland's Centre for Digital Documentation and Visualisation.

and a UNESCO World Heritage Site. Earlier this year, the wood and thatch structure of the tomb was destroyed by fire; the now invaluable scan data is being reviewed by the experts in charge of rebuilding the structure.

"The superior rendering abilities of Pointools enable us to create stunning



A scan of Kasubi Tombs in Uganda

3D visualizations for education and outreach work, while the highly accurate models, such as brick-by-brick elevation, provide information for conservators and restoration experts,"

A laser scanning robot called 3D-R1 has been designed for use in dangerous or inhospitable environments such as old underground mines. In addition, highway mapping has been revolutionised by survey vehicles such as StreetMapper that can map to an accuracy of 1 cm while travelling at normal road speeds.

The capabilities of, and opportunities for, laser scanning will continue to develop at fast pace, with manufacturers competing and surveyors pushing into new areas. However, what must remain fundamental in the quest to map the universe is an understanding of the limitations of data. The billions of captured laser scanned measurements only have value when they are processed into meaningful information, and that information is applied to more informed decision making.