GIS Data Inspired Art

By Aaron Bodbyl-Mast, Ottawa County, Michigan

A unique collaboration between the art department of a local university and the county's GIS staff resulted in a sculpture for Allendale, Michigan, that brought lidar data to life. The following article tells the story of how a set of x,y,z coordinates derived from a handful of text files became art.

The completed sculpture at the dedication ceremony in Allendale Township. The lidar bronze casts can be seen on the far concrete piece.

The township of Allendale is located in Ottawa County along the Grand River. The longest river in Michigan, the Grand River flows more than 260 miles from its source near Jackson to its mouth at Lake Michigan in the city of Grand Haven. Allendale is also the home of Grand Valley State University (GVSU), a growing Division II school known for winning multiple national football championships.

Over the past decade, the township has undertaken improvements to state highway M-45, the community's major thoroughfare. The transformation of the highway into a boulevard has spurred new commercial developments. As part of these ongoing improvements along M-45, township officials initiated a beautification project for township-owned property at a major intersection along the highway. A major feature of the proposed project was a sculpture that could be viewed from the road and by visitors to the new park area. When awarding the sculpture commission, township leaders contracted a team of students from the art department at GVSU led by professor Norwood Viviano, who specializes in sculpture.

Viviano's inspiration for a major portion of the sculpture came from an unlikely place—the Ottawa County Information Technology Department. Specifically, he was looking for lidar data of Allendale Township. This data would play a key role in the concept for the sculpture. "The lidar data gave us an accurate rendering of Allendale Township at a specific time. This allows the sculpture to be relevant today and become a record of growth and change for future generations. One of the main considerations for the project was for it to remain relevant to the community for the next 50 years," Viviano said.

A TIN showing a portion of Allendale Township

Converting Lidar Data

Viviano had been toying with the idea of using lidar data for a while. For the Allendale Township project, its use made sense because one purpose of the sculpture was to capture the character of the community. He thought a representation of the actual physical landscape would accomplish this. Specifically, he decided to focus on creating a representation of the M-45 corridor.

In spring 2007, GVSU students contacted Ottawa County GIS staff members to learn what data might be available. Once they learned that the county had lidar data, things developed quickly. The county's lidar data had been obtained from a countywide aerial scan performed by Woolpert, Inc., in 2004. The county had specified that the lidar points collected meet U.S. Geological Survey (USGS) standards for use in the creation of two-foot contours. More than 90 million points were collected.

Ottawa County GIS has generated a series of elevation data products from these points and had used the data in many projects, but none like this one. "Lidar has been a rich source of data for us," said Ottawa County GIS manager Aaron Boos. "We've used it in a variety of analysis projects, and it has improved the quality of the maps we can produce. We've provided access to the data to FEMA *[Federal Emergency Management Agency]* for a floodplain study and the USGS for a new soil survey of our county. But, the GVSU sculpture project is one of a kind."

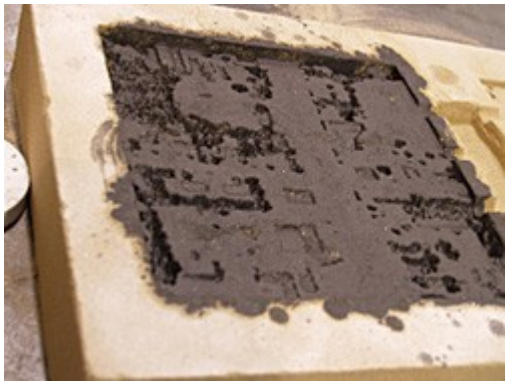
Roland MDX-40 CNC mill carving foam for a prototype

There are two primary types of lidar data: all-points lidar data that includes x, y, and z data for surfaces as well as trees, buildings, and any other object on these surfaces and the bare-earth lidar data that provides a clean extrapolation of the earth's surface without objects. Viviano preferred the all-points data, which would provide an observer with identifiable landmarks when viewing the sculpture.

After the initial excitement over the project's concept, obstacles soon developed. One major problem was converting the data into a format usable for Form Z, the Apple-based three-dimensional software Viviano and his students employed. After some initial fruitless attempts, Viviano found that a Virtual Reality Modeling Language (VRML) format was required for the conversion.

To convert the lidar data, the author, a GIS technician with Ottawa County, created shapefiles from the all-points data. Each shapefile was checked to ensure any outlying points were removed from the file. Shapefiles were then converted to a triangulated irregular network (TIN) file in ArcScene. The TIN was exported from ArcScene as a WRL file (a VRML format). To comply with the file size limit for each WRL file, data was supplied to GVSU in a series of one-eighth-mile square tiles.

The Sculpting Process



The sodium silicate-bonded sand mold before the final cast

Once the files were exported, the GVSU team began creating a prototype mold for the sculpture using modern industrial equipment. The files were converted from VRML files to STL files in Form Z to create appropriate surfaces for subtractive rapid prototyping.

"We used a Roland MDX-40 CNC milling machine to carve 1/8-mile lidar quadrants as 10-inch by 10-inch tiles. The project has a total of 36 tiles," said Viviano. "The tiles were carved directly in foam, allowing seamless processing in the foundry. The foam is a great pattern for the sodium silicate-bonded sand-molding process. Once a two-part sand mold is made of the pattern, the foam pattern is removed, and bronze can be poured directly into the negative space. Finishing the bronze is simple with an application of patina to give it a darker color with highlights and a sealant for protection."

A Work of Art Is Born

The lidar cast before it was placed in the sculpture

When the bronze tiles were completed, they were integrated into the larger sculpture. "The students approached the sculpture as if it were a community quilt, soliciting donated items from the community. Everyday objects became memorialized in bronze along with the lidar data, creating a permanent record of the present-day Allendale Township," explained Viviano.

The geography of the township is not only reflected in the bronze tiles, but it also inspired the shape of the sculpture. The top edge of the sculpture matches the course of the Grand River along the northern border of the township. This edge also features a fountain that draws its water from the Grand River.

The bronze model of Allendale Township is a focal point for the sculpture and has provided a medium for members of the community to connect to the work of art. "The lidar data proved to be the most significant visual element locating the sculpture within the community. During the dedication, most members of the community attempted to locate the site by way of the lidar map, creating immediate ties to the sculpture," said Viviano.

Allendale Township supervisor James Beelan said the sculpture is the result of a unique group effort. "It's great cooperation between county, local government, and the university," he said.