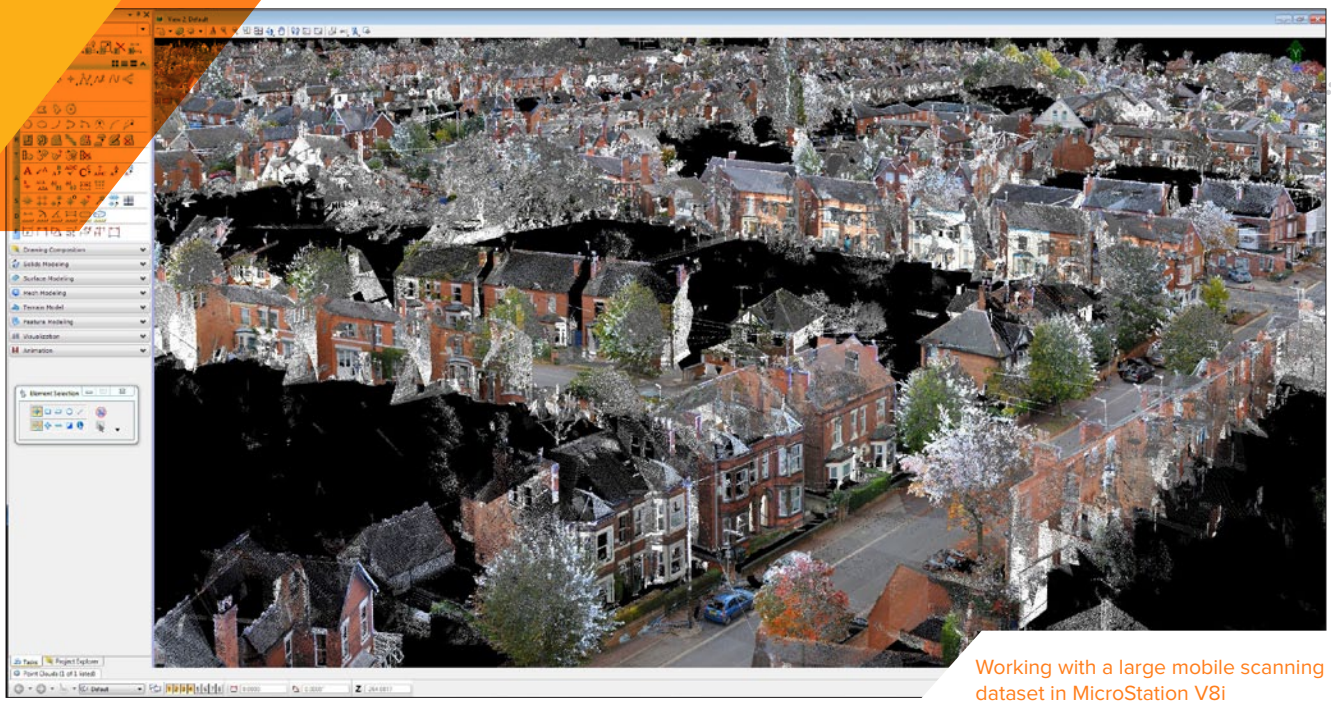


Working with a large mobile scanning dataset in MicroStation V8i

Point Clouds and a Year at Bentley

BY FARAZ RAVI

It was almost a year ago now that my company, Pointools, was acquired by Bentley Systems. A lot has happened since then, but the activity and enthusiasm around point clouds continues unabated here at Bentley. The commitment to enable point cloud workflows for our users is as strong as ever and has resulted in innovation in features and advancement of the technology.

With applications for point clouds in demand by almost every industry that Bentley serves, the first priority was to enable a base level of capability in the platform. This provides access to point cloud features in MicroStation and also the many vertical products that share the same platform technology. Products focused on everything from road design to substation design have been enhanced with point-cloud functionality for over two years now.

The point-cloud features in MicroStation are generic and provide enough capability for users to incorporate point clouds into their workflows. A point-cloud file can be attached to the design model and visualized correctly against other geometry in the viewport. There are a range of display options, including intensity (with full dynamic range), RGB color, shading by height or classification all working to enhance visual clarity and aid understanding.

Point clouds are a fundamental data-type in MicroStation V8i and they behave predictably and consistently with other element types with some additional protection to avoid unintentional repositioning or snapping. This approach is not simply a matter of ease-of-use and convenience; it's based upon the central idea that point clouds are, in themselves, valid model types, that can be directly exploited by users for many tasks without conversion to vector geometry.

The API for point clouds is already exposed in the MicroStation V8i SDK so enterprises (or individuals) with a software development capability can now build their own task-specific tools. One of our challenges in building higher level point-cloud functionality directly in MicroStation V8i is achieving consistent results for differing goals with data acquired by vastly different technologies. But now, advanced users can take advantage of the SDK and with a known set of data acquisition parameters and defined objectives achieve meaningful results for very specific project tasks. I've presented at hands-on BDN (Bentley Developer Network) events; as an example within an hour we go through building an add-on to check clearance

Bentley Pointools V8i, In-viewport visualization of real-time clash detection

between two communications masts and re-coloring points to show the results.

Key to the cohesive platform approach is that users work with a single point-cloud file format (the POD format) and a single underlying technology. This minimizes time-consuming data conversion, you only convert once, and it also provides consistent behavior across products. One of the major projects we've undertaken this year is extending this to ProjectWise.

ProjectWise is Bentley's solution for managing data for collaborative engineering workflows. As a file transfer based system, it was immediately obvious that we would have to take a difference approach for point clouds since transferring multiple gigabyte POD files across a network was not feasible. Instead we extended the architecture of ProjectWise to provide efficient streaming of point clouds into MicroStation V8i sessions.

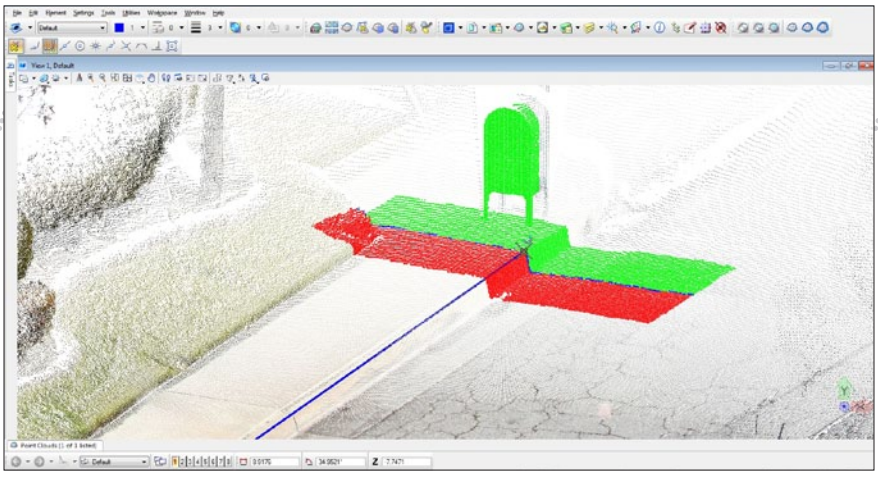
> "With mobility for point clouds we can start extending their application to construction and even operational stages of an asset's lifecycle."

The requesting logic in MicroStation V8i is intelligent to minimize the data being transferred and ProjectWise can efficiently and incrementally serve that data across a network to the user session. Multiple users can work concurrently with the same engineering data across an enterprise. What appeals to me about this solution is that users can fully leverage the mature and proven engineering content management infrastructure of ProjectWise for point clouds. This contrasts with having a special point cloud server solution for which enterprises have to install new server technologies where the user is left to integrate the data flow manually and possibly also to implement or duplicate rights management, version control and so on.

This new capability is provided by ProjectWise Point-cloud Services, a bolt-on service that enables the streaming of point clouds. The user or administrator places a point-cloud file on ProjectWise much the way any other file is stored, and ProjectWise recognizes that this file should be streamed. Then, when the user of MicroStation (or any MicroStation-based product) attaches that file via the standard ProjectWise dialog box, the point cloud starts to stream into the viewport. Note the consistent 'fundamental data-type' philosophy - from a user's perspective working with point clouds in ProjectWise is a seamless experience.

So it's quite simple and there's not much more I can say about features, but the implications are hugely significant. Point clouds are often consumed by specialists in dark corners of an engineering office for specific tasks. In my experience, very few organizations are getting close to extracting their full potential across disciplines and departments for two key reasons. Firstly, specialist tools and products have been needed; this is no longer true with native support in MicroStation. And secondly, data cannot be managed or shared; and this challenge is addressed by ProjectWise with virtually no retraining or additional network infrastructure requirements.

Enabling information mobility for our users in infrastructure is a driving force within Bentley and this impacts our strategy on point clouds. I believe it's only when as-built point-cloud models are able to move fluidly through an asset's entire lifecycle that we will unlock their true value. The predominant use of point clouds today focuses on feasibility, planning and to a limited extent design. With mobility



Visual Explorer highlights area around cursor for enhanced interpretation in Descartes

for point clouds we can start extending their application to construction and even the operational stages of an asset's lifecycle.

ProjectWise is an important part of making this happen. Since many infrastructure professionals already run MicroStation V8i and ProjectWise, most of what's needed is already on the desktop. We're going to start hearing more about the use of point clouds both during and after construction not just before, with point clouds effectively becoming part of the stream of engineering data being shared in a typical infrastructure project.

Whilst the core point-cloud capabilities in MicroStation V8i are adequate for most users or consumers of the data, advanced point cloud workflows are supported by Bentley Descartes. Since Descartes is a layered application, it is available to users of all platform-based products to leverage in their particular design environment for their particular discipline.

There's been a lot of innovation in Bentley Descartes to enable our users to extract greater value and enhanced understanding of point clouds. The visual explorer is a good example, recognizing that it can sometimes be difficult to visually read edges in point clouds, visual explorer highlights data around the cursor to enable the user to clearly identify geometry features. Couple this with a range of extended snapping options and it becomes easy to pick out the edge of a sidewalk for example, even in a perspective view.

Bentley Descartes also includes tools for editing point classifications and generating sections and drape lines based on the point cloud to aid vector digitization or modeling. Bentley Descartes is where our high-level horizontal feature development for point clouds is focused.

We haven't stood still on Pointools Edit either, geared towards the stand-alone pre-processing of point clouds data for downstream use, as well as creating valuable image and movie output, Pointools Edit has been repackaged as Bentley Pointools V8i. The product has taken a number of bold steps forward. A new streamlined user interface, a new system for editing layers and extensions to the animation system are just some of the advances. But perhaps the most important innovation is the new real-time clash detection system. As the description suggests, it's quick enough that clashes are identified and displayed in the viewport (and listed in a browser) as objects are moved or rotated in by the user. Coupled with the ability to animate objects along a path, the clash detection capability will prove valuable not only for evaluating static situations but also testing path feasibility, for example when installing machinery on a factory floor, moving an escalator into place in a construction project or even transporting a space shuttle through a city (should that ever happen again).

Clash detection in Bentley Pointools V8i provides fine-grained detailed results, highlighting in the viewport the precise area of clash and dimming the surrounding region to clearly focus on the area of interference. The analysis can be performed on a point cloud against other point clouds or against vector models. Bentley Pointools V8i will be available in the next few months, and MicroStation users will also gain access to point cloud clash detection as we continue to integrate Pointools technologies into the Bentley platform.

Pointools software has always been hardware agnostic and supported as many laser scanning and other generic formats as possible. Now, as part of Bentley, we continue this commitment to broad support of different formats and we have added a number of laser scanning formats and standards that can be converted to POD. We also continue to support and encourage hardware vendors to provide POD export directly from their processing applications thus expanding data exchange options for our users.

So it's been a busy first year for the Pointools team and our supporting colleagues at Bentley. I don't see our second year being any less focused or productive which is great news for Bentley users.

Faraz Ravi is the Director, Product Management for Point Clouds at Bentley Systems and former CEO of Pointools, a UK-based company producing solutions for point cloud workflows.