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Project Summary

Organization
The Sanborn Map Company, Inc.

Solution
Reality Modeling

Location
Santa Clara County, California, United States

Project Objectives

- Demonstrate the accuracy of HD maps in the context of a 3D reality model of the Silicon Valley area.

- Generate the 3D reality mesh from aerial oblique imagery of the target area.

- Overlay the 3D mesh with HD map data that includes a highly detailed inventory of the roadway features required for safe navigation by autonomous vehicles.

Products Used
ContextCapture Center, Descartes

Fast Facts

- Sanborn's Advanced Technology group developed proprietary technology for creating standardized, high-precision 3D base maps for self-driving vehicles and markets to be imported in driving simulators, providing a safe, efficient alternative to actual road tests.

- ContextCapture Center enabled Sanborn to generate the 3D reality mesh that allows automakers to visualize the context for HD maps at a 7 to 10 centimeter resolution.

ROI

- ContextCapture Center's automated process enabled Sanborn to accomplish 3D reality modeling in a fraction of the time, saving about USD 100,000 compared to traditional methods.

- Using Bentley's 3D reality modeling software provided an affordable alternative to tying up three of Sanborn's 3D modelers for six months.

Sanborn Map Highlights HD Map Data Overlaying 3D Reality Mesh for Use in Autonomous Driving

ContextCapture Center Creates 3D Environment for Company's Urban HD Map

Precise Maps for Driverless Cars

An industry leader in geospatial solutions and technology, The Sanborn Map Company, Inc. is helping to make self-driving cars a reality by creating high-definition (HD) maps used by test-drive simulators for autonomous vehicles. Sanborn partnered with auto manufacturers in a USD 100,000 project that demonstrated the precision of purpose-built HD maps. Using aerial oblique imagery of the target area in Santa Clara County, California Sanborn generated a 3D reality mesh with Bentley's ContextCapture Center software, then overlaid proprietary HD base map data that is accurate within an absolute range of 7 to 10 centimeters. Visualizing the high-precision HD map in the context of a high-resolution 3D urban environment elicited auto company requests for repeat demos internally and with department of transportation regulatory authorities. Bentley applications allowed Sanborn to quickly create 3D reality meshes that would ordinarily take three modelers six months to complete. This made the technology more affordable, allowing Sanborn to provide exceptional value to clients.

Safe Test-drive Environment

Major auto manufacturers are racing to release self-driving features that give their vehicles some autonomy in specific situations, such as braking to avoid imminent collision. To achieve the goal of a driverless vehicle, manufacturers need to demonstrate that their cars can safely operate in any situation. The RAND corporation estimates that a driverless car would have to drive more than 11 billion miles to prove it is 20 percent safer than a human-driven car. A thousand test cars driving non-stop, 365 days a year would take 50 years to cover that many miles. Simulating the test drive in a virtual world would prove the point in a matter of hours.

"Self-driving cars are no longer a futuristic idea," said Sharad V. Oberoi, Ph.D., director of IT and software engineering, with Sanborn Map. "Major auto manufacturers have already released, or are soon to release, self-driving features that give the car some ability to drive itself. Through the 3D mesh generated using ContextCapture Center, Sanborn's Advanced Technology group has been able to showcase the quality of

the HD map data, including true-ground-absolute accuracy, to its partner automotive firms. Automating the production of city-sized 3D model with ContextCapture Center made the project much faster than previously possible."

Founded in 1866 to produce fire insurance maps, Sanborn evolved with the changing market for imaging and mapping services and today is a first mover in the emerging market for HD maps. Sanborn's Advanced Technology group has developed proprietary HD mapping technology that creates standardized, high-precision 3D base maps for self-driving vehicle models and markets. The HD maps contain more detailed information with true-ground, absolute accuracy than is available in conventional resources such as GPS maps. Compared to current mapping systems that can locate a car's position within 1 meter, HD maps can position a vehicle within less than 10 centimeters.

Sanborn provides precise real-world context for HD map data by creating 3D reality models of the environs, drawing upon its expertise in aerial oblique imagery, aerial LiDAR data, and mobile (driven) LiDAR data. For image processing, the map company uses ContextCapture Center, Bentley's reality modeling software for 3D models of any scale. ContextCapture Center generates the 3D engineering-ready reality mesh that Sanborn's HD map data overlays to create the purpose-built, map-based data sets automotive makers need for their virtual worlds.

High Definition, Precision, Resolution

For the automakers' project, Sanborn acquired aerial oblique imagery of the Silicon Valley area, including Santa Clara, Sunnyvale (Heritage District), Palo Alto, and surrounding locations, to construct a sizeable target area for mapping. The oblique imagery was acquired in a single, multi-pass flight plan using five digital cameras to collect four oblique views and one straight-down (nadir) view. These images were processed using Context Capture Center to quickly produce 3D mesh models of Santa Clara County's complex urban environment. The software automatically aero triangulated the images to identify the position and orientation of each

image, then reconstructed the images as a highly accurate georeferenced 3D reality mesh.

The 3D reality mesh provided precise real-world context for Sanborn's HD maps. With many densely packed triangles, draped textures, and snap points, the 3D mesh created the fine details, sharp edges, and accurate geometry required by the automotive partners. The georeferencing made it possible to identify the precise locations that intersect with Sanborn's HD map data (collected in absolute XYZ space). The project team overlaid the 3D mesh data with Sanborn's HD map data to provide all the critical information a driverless vehicle needs to safely navigate roadways and intersections.

Combined with Sanborn's HD maps, which are accurate within an absolute range of 7 to 10 centimeters, the high-resolution 3D mesh provided a meticulously detailed inventory of physical assets for the roadways, such as lane markings and dividers, road edges and shoulders, and traffic signals and signage. Inclusion of surrounding buildings, generated by ContextCapture Center and enhanced using Bentley Descartes, produced a city-sized reality model for a more genuine driving experience. Together the HD maps and 3D mesh were integrated into virtual reality simulation tools for testing autonomous vehicles. Using the FBX (Filmbox) format made the process seamless.

Testing the Testing Grounds

The HD mapping technology allowed Sanborn to create data sets for multiple environments and levels of complexity in the autonomous driving tests, including freeway, complex urban, and complex parking. For some sections of the city, Sanborn's geospatial developers loaded the 3D mesh into a web interface, so the automotive partners could see the quality of the 3D reality view. Sanborn also developed web-based analytics that the partners could use to review and discuss vector and point data superimposed on the 3D reality

mesh. Within the 3D viewing interface, it was possible to precisely measure distances, volumes, surface areas, and other parameters.

Showcasing the complex HD maps in a 3D urban setting provided context for high-precision features such as road lanes, and traffic signs and signals as well as surrounding buildings. The project highlighted the level of road intelligence that could be achieved in a 3D reality model. As they explore the virtual landscape for autonomous driving tests, several automotive partners are using Sanborn's 3D demonstrations internally as well as in meetings with department of transportation regulatory personnel.

Affordable Resource

Using ContextCapture Center enabled Sanborn to quickly produce the high-quality 3D reality mesh that provided context for the company's proprietary HD map datasets. The reality modeling software saved up to six months of modeling time, since the software automatically performed a process that would have required a team of three 3D modelers six months of continuous work to complete. At a cost of about USD 100,000 that approach would have been too costly and time-consuming for both Sanborn and its automotive partners.

By making a modest investment of time and resources, Sanborn showcased HD maps for autonomous driving and received positive responses from the participating automakers. With a premier collection of oblique imagery, Sanborn is poised to expand its HD map offering for autonomous vehicles, which have a promising future. Among the much-touted benefits, self-driving cars promise less stress for drivers, more mobility for non-drivers, and less congestion and fewer accidents on roadways. Given the opportunities, Sanborn's proprietary technology could fuel a lucrative market.

3D reality mesh of Santa Clara County generated with ContextCapture Center.

3D reality mesh generated automatically from a multi-camera aerial oblique imagery with ContextCapture Center.

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