Bentley®
Advancing Infrastructure

CONNECT Edition

ContextCapture

Software to Automatically Generate Detailed 3D Models from Simple Photographs and/or Point Clouds

ContextCapture CONNECT Edition provides powerful capabilities for integrating and processing reality modeling data for use in information modeling workflows.

The CONNECT Edition

The SELECT® CONNECT Edition includes SELECT CONNECT *services,* new Azure-based services that provide comprehensive *learning, mobility,* and *collaboration* benefits to every Bentley application subscriber. *Adaptive Learning Services* helps users master use of Bentley applications through CONNECT Advisor, a new in-application service that provides contextual and personalized learning. *Personal Mobility Services* provides unlimited access to Bentley apps, ensuring users have access to the right project information when and where they need it. *ProjectWise® Connection Services* allow users to securely share application and project information, to manage and resolve issues, and to create, send, and receive transmittals, submittals, and RFIs.

Create 3D Engineering-ready Reality Meshes

With ContextCapture, you can cost effectively produce 3D models of the most challenging existing conditions for use on every infrastructure project, using ordinary photographs. You can add point clouds for additional accuracy resulting in fine details, sharp edges, and geometric accuracy. You can quickly create and use these highly detailed 3D reality meshes to provide precise real-world context for design, construction, and operations decisions for use throughout the lifecycle of projects.

ContextCapture allows you to reliably and quickly produce 3D models of any scale, from objects of a few centimeters to entire cities. The only limit in the precision of the resulting 3D model is the resolution of the input data.

Affordable, Precise 3D Models

You can affordably develop precise reality meshes faster without investing time and resources in specialized acquisition devices and associated training, since ordinary cameras are all that is required.

Confidence to Model any Scale Project

You can confidently and reliably deliver highly detailed models of any scale, faster than before due to ContextCapture's use of general-purpose computation on graphics processing units (GPGPU) as well as multi-core computing. ContextCapture can process about 20 gigapixels per day, per computer.

Integrate Models into any Workflow

You can access and share these richly photo-textured 3D models of existing conditions in any CAD or GIS workflow on desktop and mobile devices, in many formats, including for native use within MicroStation® and other Bentley applications.

Image courtesy of CEDARVILLE Engineering.
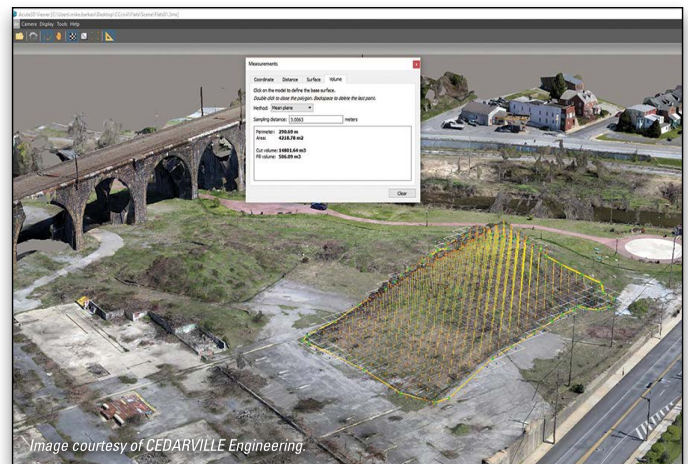
Easily perform cut and fill volume calculations in your 3D engineering-ready reality meshes.

Capabilities

Integrate Georeferenced Data
ContextCapture natively supports several types of positioning data including GPS tags and control points. It can also import any other positioning data through position/rotation import or complete block import. This enables you to precisely measure coordinates, distances, areas, and volumes.

Perform Automatic Aerotriangulation and 3D Reconstruction
Once the relative position and orientation of each photo has been automatically identified, you can make fine adjustments to the aerotriangulation results by adding control points and editing tie points to maximize geometric and geospatial precision. The optimized 3D reconstruction algorithms produce precise 3D models and photo texturing of each mesh facet with unmatched accuracy. Because it ensures optimal placement of 3D mesh vertices, ContextCapture recovers finer details and sharper edges with fewer artifacts, significantly improving geometric accuracy.

Generate 2D and 3D GIS Models
With ContextCapture, you can produce accurate georeferenced 3D models in a full range of GIS formats, including true orthophotos and the new Cesium 3D Tiles, with tiling and aerotriangulation export to KML and XML. This application includes a coordinate system database interface to ensure interoperability with your GIS solution of choice. You can select from more than 4,000 spatial reference systems and add user-defined ones. Moreover, ContextCapture automatically adapts the resolution and precision of the model to the resolution and spatial distribution of input data.

This means it can handle scenes with non-uniform resolution without requiring trade-offs in the overall efficiency in order to preserve a few higher resolution scene regions.
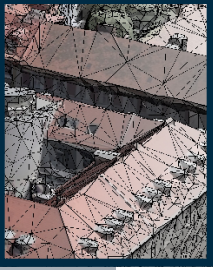
Bentley's ContextCapture provides precise real-world context that can be applied to all phases of an asset lifecycle.

Reality Modeling for Design, Construction, and Operations Workflows

DESIGN

Image courtesy of Brown University.
CONSTRUCTION
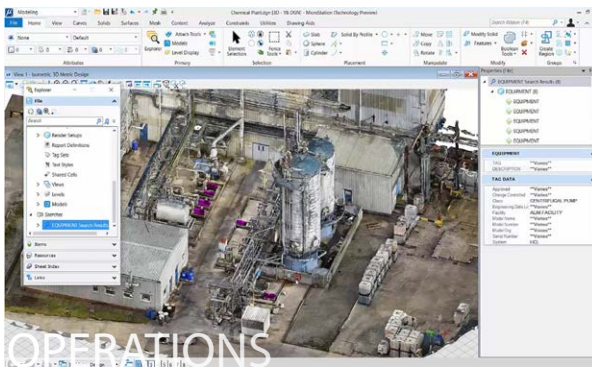
OPERATIONS

Advanced Processing for Reality Modeling Data

Work with Reality Meshes
ContextCapture Editor enables fast and easy manipulation of meshes of any scale as well as the generation of cross sections, extraction of ground and breaklines, and production of orthophotos, 3D PDFs, and iModels. You can integrate your meshes with GIS and engineering data to enable the intuitive search, navigation, visualization, and animation of that information within the visual context of the mesh.

Work with Point Clouds
Point clouds can be enriched, segmented, classified, and combined with engineering models. You can then leverage ContextCapture Editor's capabilities for advanced 3D modeling, cross sectioning, breaklines, and ground extraction to model as-built conditions quickly and efficiently and support the design process. You can better evaluate point clouds and produce more accurate engineering models as a result. Animations and renderings for presentation can also be produced.

Produce and Work with Large, Scalable Terrain Models
You can produce very large scalable terrain models from many sources including point clouds, breaklines, raster digital elevation models, and existing triangulated irregular networks. Scalable terrain models are always up to date by synchronizing with the original data sources. The value of doing this is having a global, current, integrated representation of all your data that can be used to perform analyses using a variety of display modes and to produce animations and visualizations.

Generate 3D CAD Models
Produce 3D models using a full range of CAD formats, 3D-neutral formats, digital surface models, and dense 3D point clouds to ensure your models are accessible in your modeling environment. In addition, you can produce multi-resolution meshes made of billions of triangles natively supported for use within Bentley applications, including MicroStation, Descartes, AECOsim Building Designer, OpenRoads, OpenPlant, Bentley Map®, Bentley Substation, and many others.

Publish and View Web-ready Models
ContextCapture allows you to produce models of any size that are optimized for web publishing using the ContextCapture native 3MX format or the Cesium 3D Tiles GIS open format using a web browser. This enables instant sharing and visualization of 3D models with any stakeholder.

CAPABILITIES	CONTEXTCAPTURE	CONTEXTCAPTURE CENTER
Imagery dataset size per project	Up to 300 Gigapixels	Unlimited
Scanned point clouds limitation per project	500 Million	Unlimited
Mesh export formats (3MX/3SM/DGN/I3S/OBJ/FBX/STL/DAE/OSGB/Cesium)	*	*
Colored point cloud export (POD/LAS)	*	*
True orthophoto / 2.5D Digital Surface Model (TIFF/GEOTIFF/KML)	*	*
Georeferencing	*	*
Parallel (cluster) processing for unlimited scalability		*
Software development kit		*

> *"The synergy between the use of unmanned aerial systems and ContextCapture produces an ideal and efficient combination for capturing and returning data in 3D."*
> — Tommaso Solfrini, CEO, Italdron
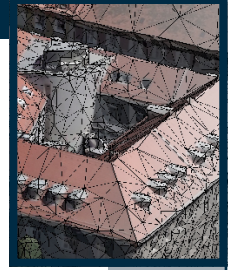
Reality Modeling Solutions to Fit Your Business Needs

Depending on your reality modeling workflow needs, ContextCapture is available as an on premise or cloud-processing service solution. ContextCapture has three main modules master, engine, and editor. The master module provides a graphical user interface that allows you to define input data, processing settings, submit processing tasks, monitor progress, and visualize results. The engine module runs on a computer in the background, without user interaction, and performs the computationally intensive algorithms. This master-worker pattern allows ContextCapture to support grid computing and dramatically reduces processing time simply by running multiple ContextCapture engines on several computers and working on a shared job queue. ContextCapture Editor is a 3D CAD module for editing and analyzing reality data and is included with ContextCapture and ContextCapture Center.

You can quickly produce reality meshes using your local machine or upgrade to ContextCapture Center to save time by employing scalable computing power to speed production of your 3D models leveraging the latest parallel computing systems.

ContextCapture Center

When creating extremely large models, take advantage of greater computational power with ContextCapture Center. It adds the capability to leverage grid computing to dramatically speed processing time by running multiple engines on several computers, and associating them to a single job queue. If you have projects larger than 300 gigapixels of imagery, use ContextCapture Center to seamlessly handle terabytes of input imagery.

You can speed production using the latest computing systems for desktop and cluster processing units, including leveraging GPU computing, multi-core computing, advanced bundle block adjustment, tiling mechanisms, task queuing and monitoring, grid computing, and ultra-large project management.

Why ContextCapture? ContextCapture is ideal for any scale of infrastructure project throughout design, construction, and operations. Its power, flexibility, and scalability turn simple photographs and point clouds into true-to-life, highly detailed 3D cities quickly and with precision. ContextCapture is used by leading design, construction, mapping, and surveying professionals including Blom, Asia Air Survey, Airbus Group, and many more in Europe, America, and Asia to generate high resolution, photorealistic 3D models.

With the ContextCapture mobile app, you can quickly create 3D models using images from your phone.

Image courtesy of Eye-bot Aerial Solutions.

INSPECTION

Reality modeling for inspection provides key information, saves time, reduces costs and minimizes risk of injuries.

Reality Modeling Cloud Service

ContextCapture Cloud Processing Service enables you to upload photos and quickly generate 3D engineering-ready reality meshes, orthophotos, digital surface models, and point clouds. Without the need for high-end hardware requirements or IT constraints, you can simplify and scale your projects allowing anyone on your team to easily document as-is situations affordably, with less investment of time and resources, reducing your costs. Using a desktop or mobile application, you can access the cloud processing service.

Console Application

ContextCapture Console enables you to instantly upload images, define your ContextCapture settings such as ground control points, and create a 3D reality mesh using the latest cloud technology.

Mobile Application

ContextCapture Mobile is an easy-to-use reality modeling app that allows you to quickly create 3D models using images taken with your phone or tablet, and display the model on your device, available on iOS and Android.

ProjectWise ContextShare is a reality modeling data sharing service that allows you to securely manage, store, and share large amounts of reality modeling data without the need for high-end hardware or IT infrastructure.

As ProjectWise ContextShare provides a connected data environment, this service includes space for your team to easily and efficiently collaborate on infrastructure projects. You can improve your workflow when you share and sync your reality modeling data instantly, across project teams and applications.

> "Bentley's ContextCapture… allows us to very easily process hundreds of images taken by drone or handheld digital camera into a 3D reality mesh that can then be consumed inside Bentley's OpenRoads products to speed our civil engineering design work."
>
> — Christopher B. Burke,
> Ph.D., PE, D.WRE, Dist.M. ASCE, NAC, President
> Christopher Burke Engineering, Ltd.

Road design leveraging a reality mesh in Bentley's OpenRoads ConceptStation.

ContextCapture At-A-Glance

Input
- Multiple camera project management
- Multi-camera rig
- Visible field
- Infra-red/thermal imagery
- Videos
- Laser point cloud (500 million points for ContextCapture, unlimited for ContextCapture Center)
- Surface constraints
- Metadata file import
- EXIF

Calibration / Aerotriangulation (AT)
- Automatic calibration / AT / bundle adjustment
- Parallelization ability on ContextCapture Center and ContextCapture Cloud Processing Service
- Project size limitation (300GPIX for ContextCapture, unlimited for ContextCapture Center)
- Control points management
- Block management for large AT (only available on ContextCapture Center)
- Quality report
- Laserscan/Photo automatic registration

Georeferencing
- GEOCS management
- Georeferencing of generated results
- QR code: ground control point automation

Scalability
- Tiling
- Cluster enabled (only available on ContextCapture Center)

Computation
- GPU based
- Multi-GPU processing based on Vulkan (optional)
- Background processing
- Scripting language support / SDK (only available on ContextCapture Center)
- ContextCapture Cloud Processing

Editing
- Quality control enabling tiles tagging (only in ContextCapture Center)
- Touch up capabilities (export/reimport of OBJ/DGN)

- Orthophoto visualization
- DEM / DSM visualization
- DTM extraction
- Cross sections
- Contour lines (with Scalable Terrain Model)
- Point cloud filtering and classification
- Breaklines extraction
- Modeling feature
- Support of streamed reality meshes
- Create scalable mesh from terrain data
- Volume calculation

Output and Interoperability
- Multiresolution mesh (3MX, 3SM and Cesium 3D Tiles)
- Bentley DGN (mesh element)
- 3D CAD Neutral formats (OBJ, FBX)
- KML export (mesh)
- Esri I3S / I3P
- Other 3D GIS formats (SpacEyes, LOD Tree, OSGB)
- 3D PDF
- AT result export (Camera calibration and photo poses)
- DEM / DSM generation
- True orthophoto generation
- Blockwise color equalization
- Point cloud (LAS, LAZ, and POD)
- Input data resolution texture mode
- AT quality report
- Animations (fly through video generation)
- QR code: 3D spatial registration of assets

Viewing
- Free ContextCapture Viewer
- Web viewing

Measurement and Analysis
- Distances and positions
- Volumes, surfaces
- Input data resolution

Bentley CONNECT
- Upload to ProjectWise ContextShare
- Reality mesh streaming from ProjectWise ContextShare
- Associate to CONNECT project
- CONNECT Advisor