Leveraging Al to analyze high-resolution point clouds and imagery

with Global Mapper Pro

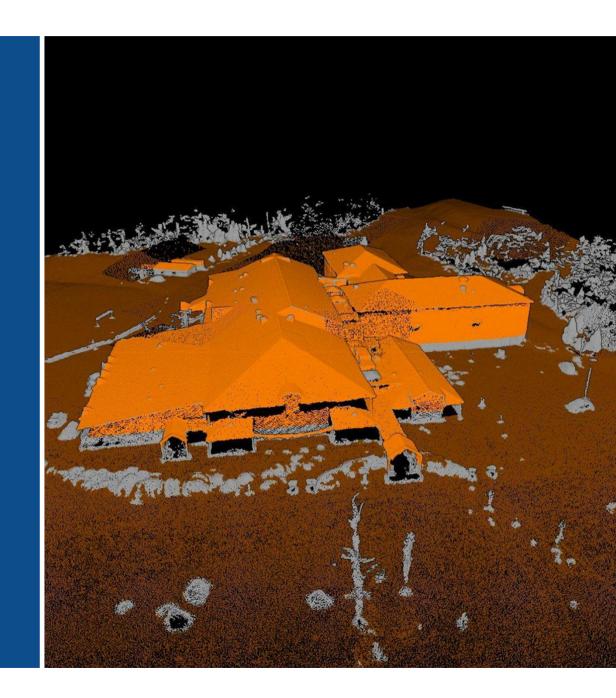




OUTLINE

Leveraging AI to analyze high-resolution point clouds and imagery

- AI-powered tools in Global Mapper software
 - Machine Learning
 - Deep Learning
- Point cloud classification
 - User-trained models
- Imagery analysis
 - Land Cover Classification
 - Object Detection
 - Model training



What are Machine Learning & Deep Learning?

	Machine Learning	Deep Learning
Definition	Computer systems that learn from data to make predictions and decisions.	A subset of machine learning that leverages layer(s) of artificial neural networks to recognize complex patterns.
Data	Machine Learning works well with smaller, structured datasets.	Requires substantial / large amounts of data
Processing	Less computationally intense.	High computation needs; deep learning can often require Graphics Processing Units (GPUs) or Tensor Processing Units (TPUs).
User Input	More user input before processing.	Minimal user input, but heavy development and engineering effort(s) required.

Machine and Deep Learning in Global Mapper Pro

Mimics human intelligence for tedious tasks (i.e. pattern recognition)

Point Cloud Classification Machine Learning

Samples	
Sample - 1	
Sample Class	Unclassified V
Signature	
Bounds	
Remove	
Sample - 2	
Sample Class	Unclassified V
Signature	
Bounds	
Remove	
Selection Mode	
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Input Layers				
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Global Mapper Pro

Automatic Point Cloud Analysis

- Machine learning-powered feature classification
- Employs geometric and semantic segmentation
- Train custom classification models with userdefined samples

• Built-in models

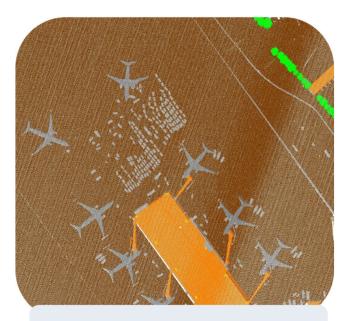
- Train these models to your data samples to fine-tune the models
- User-trained models
 - Create new models for custom classification

Automatic Point Cloud Analysis –	
▼ Input Configuration	
Input Layer(s)	
Selected Only	
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Feature Models	Same in the second
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	A State of the second
Building	and the second
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Vegetation	
+ Pole	
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(Open Training Sample Collection Window)	Contraction of the second second
	A STATE OF A
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+ Ground	AND A CALL OF A SAME
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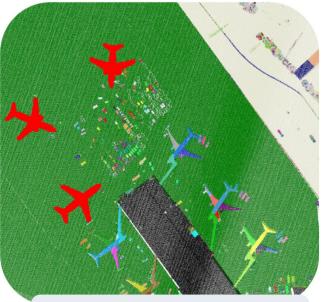


Machine Learning for Training Classification Models

Automatic Point Cloud Analysis • Global Mapper Pro



- 1. Run built-In classifications
- The **Segmentation** tool can also be used to isolate groups of points to use as training samples



2. Select clusters of points to use as training samples

 Global Mapper uses machine learning to derive point attributes and spatial structure



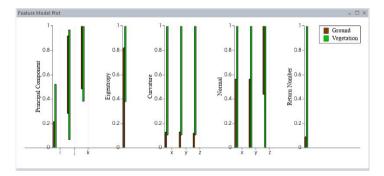
- 3. Classify with your newly trained model
- Models can be saved and shared amongst Global Mapper Pro users

Built-in Classification Models

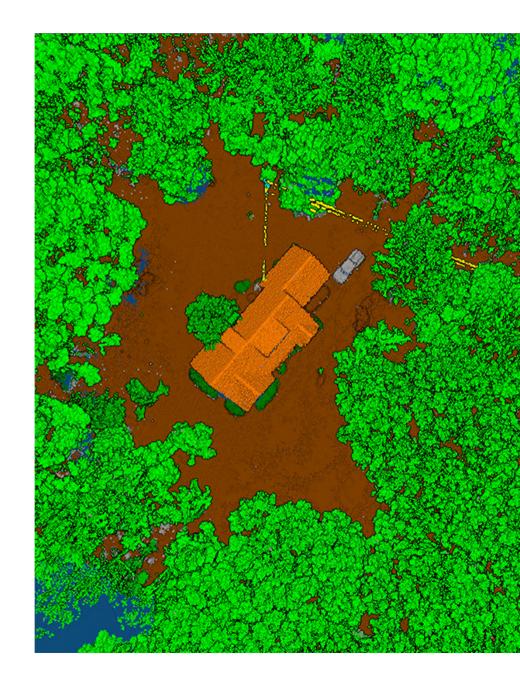
Train these models to your own data samples:

- ✓ Ground
- ✓ Buildings
- ✓ Vegetation
- ✓ Power lines
- ✓ Poles

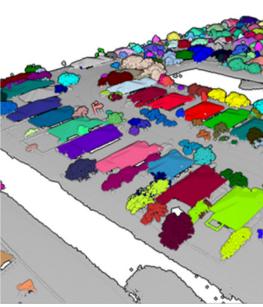
The machine learning in Global Mapper Pro determines **signature** characteristics:







Identifying Training Samples with Geometric Segmentation



Geometric Segmentation	- □ >
Input Layer(s) Lidar_Sample.laz Selected Only Specify Bounds Resolution	Filter Points 3.5 point spacings ×
Attribute Position Curvature Intensity Return Number Normal Color	Relative Weight 1 1 1 1 1 1 1
Connectivity Threshold Min Num Points Max Num Standard Deviations Max Curvature	10 3 2.5 1
Segment Segment Manager	
Restore Defaults	Help

- Spectral partitioning
- Partitioning points by unique object (cluster)
- User-defined settings and weights

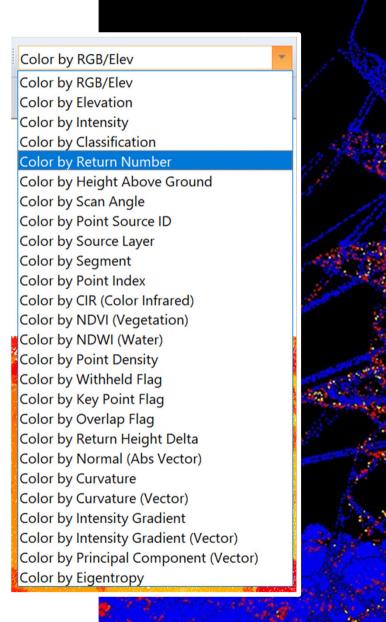


Visualizing point attributes

Color the points by attributes to determine segmentation settings

- Curvature
- Intensity
- Return Number
- Normal

BLUE MARBLE GEOGRAPHICS



Collecting Training Samples

Training Samples (Beta)		- 🗆 ×
Samples		
Sample - 1		
Sample Class	Pools	
Signature		
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Remove Sample - 2		
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Show Description Area		
Help		
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- Adjust segmentation settings to identify potential sample segments
- Collect training samples from segments or selected points
- Train a new classification model or built-in model
 - \checkmark Subclassification

Use Case: Bridge Pillars

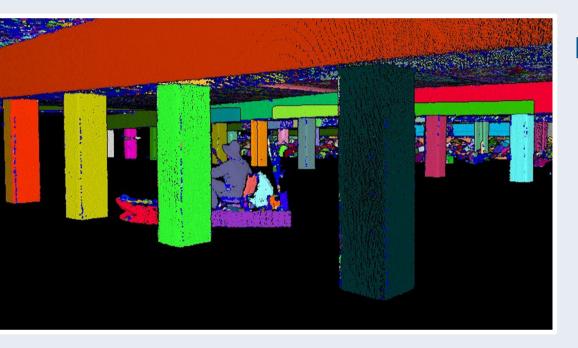


Identify Support Pillars

• Clear & consistent geometric structure



Use Case: Bridge Pillars



Identify Support Pillars

• Segmentation of pillars



Use Case: Bridge Pillars



Identify Support Pillars

- Train a new custom feature model
- Run auto-classification
- Successful custom classification results
- Point cloud processing report
 - Training model saved to file

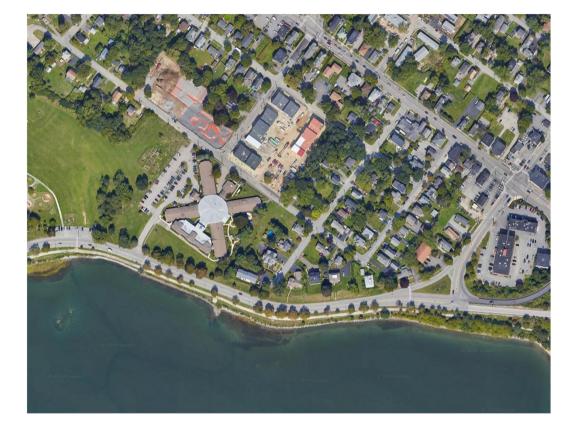


AI and Deep Learning

- Models are trained for a specific task
- Deep Learning tools in Global Mapper are currently in Beta
- 3 models currently built-in
 - Land Cover Classification
 - Object Detection
 - Building detection
 - Vehicle detection
 - Create your own model







- Under the hood: Semantic Segmentation
- Model trained on NAIP imagery
- Recommended resolution is 0.5-1 meters.
- 3 or 4 spectral bands supported



Land Cover Classification Settings			×	
Land Cover Classification	Custom Mo	dels		
Specify Raster Image Type Select the type of raster image you wish to obtain a land cover map for based on the number of bands. Select the item that is closest to your raster image.				
3 Spectral Ban				
🔵 4 Spectral Ban	ds	Aerial NAIP ~		
Description:	following typ Vegetation, Supports 3-t	AIP imagery. The output raster includes the bes of land cover: Water, Trees/Forest, Low Barren, Roads, and Other Impervious Surfaces. band RGB or 4-band RGBNir imagery. ed spatial resolution range is approximately 0.5 - 1		
Input Layers				
ILE_LCC.⊎f				
	Start Infe	rence Help		



- Under the hood: Semantic Segmentation
- Model trained on NAIP imagery
- Recommended resolution is 0.5-1 meters
- 3 or 4 spectral bands supported





Unknown Water Tree Canopy/Shrub Low-Vegetation Barren Impervious-Other Impervious-Road











Building Extraction

- Also segmentation-based
- Model trained on 3-band, 0.3 meter resolution aerial imagery
- Recommended resolution is 0.03 –
 0.3 meters
- Additional post-processing options available



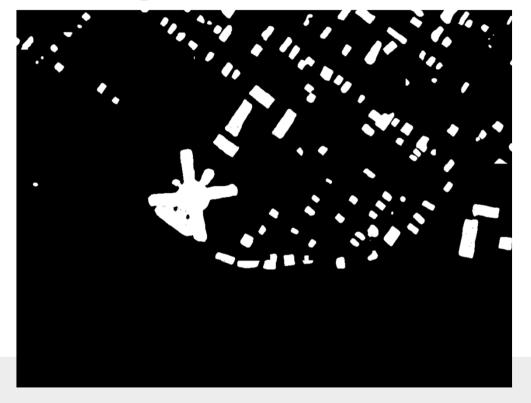
Object Detection Settings			
Building Extraction Vehicle Detection Custom Models			
Specify Raster Image Type			
Select the type of ras	Select the type of raster image you wish to obtain a building map for.		
	Aerial ~		
Description:	Best suits high resolution aerial imagery. Supports 3-band RGB imagery. Recommended spatial resolution range is approximately 0.03 - 0.3 meters.		
Post-processing			
Apply post-proces	ssing		
O Simplify (Smoo	thes the output polygons) O Regularize		
Input Layers			
■ ILE_LCC. tif			
	Start Inference Help		
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X



- Also segmentation-based
- Model trained on 3-band, 0.3 meter resolution aerial imagery
- Recommended resolution is 0.03 0.3 meters
- Additional post-processing options available

Building Extraction







Building Extraction





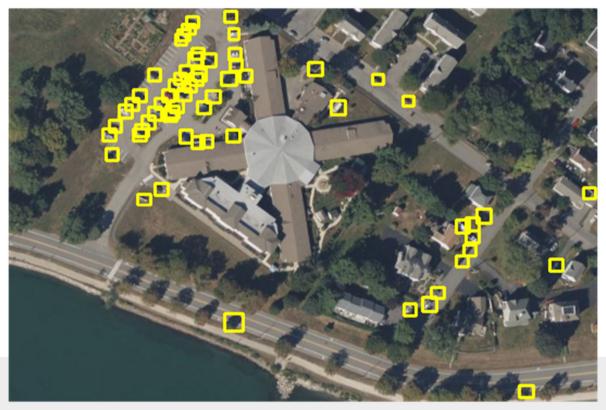
Object Detecti	Object Detection Settings			×	
Building Extraction	ding Extraction Vehide Detection Custom Models				
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Select the type	Select the type of raster image you wish to use for vehicle detection.				
	Aerial/	Satellite			~
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Input Layers					
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l					
	Star	t Inference	Help		



Vehicle Detection

- Object Detection model rather than segmentation
- Model trained on 3-band, 0.15 meter resolution aerial and satellite imagery
- Supports 3-band RGB imagery, plus alpha band

Vehicle Detection





Key Takeaways

- Deep Learning can save time and effort
- One-button solution for common data types and tasks
- Increase potential of what users can accomplish without custom development



Future Research

Coming Soon:

- Advanced settings
- Download/Save/Share models

Long-Term Plans:

- Data Fusion
- General Model?

Built-In Models			
Model	Status		
LCC Aerial 3-band	New Model		
LCC Aerial 4-band	New Model		
BE Aerial 3-band	New Model		
VD Aerial	New Model		
ResNet Backbone Frozen	New Model		
ResNet Backbone Regular			
MD Anial Einsteins	Now Madal		
Download Selecte	d Download All Updates		
Custom Models			
Model Task Type			
There are no items to show in this view.			
Export Selected Delete Selected Import Models			



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Questions?

Visit our website: bluemarblegeo.com geohelp@bluemarblegeo.com

