1B Photogrammetry: Overview

- Goal: Produce detailed spatial raw data (3D point clouds) with registered imagery (.bmp) for three bridges using videogrammetry

- Input:
  - 1080p Video for reconstruction
  - 2400 Hi-resolution images for damage detection

- Output: Accurate 3D Point Clouds

1B Photogrammetry: Input

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SEEBRIDGE
SEMANTIC ENRICHMENT ENGINE FOR BRIDGES

Acworth Bridge: 067-52520
3 Videos (iPhone 6s): 72 min

1B Photogrammetry: Output

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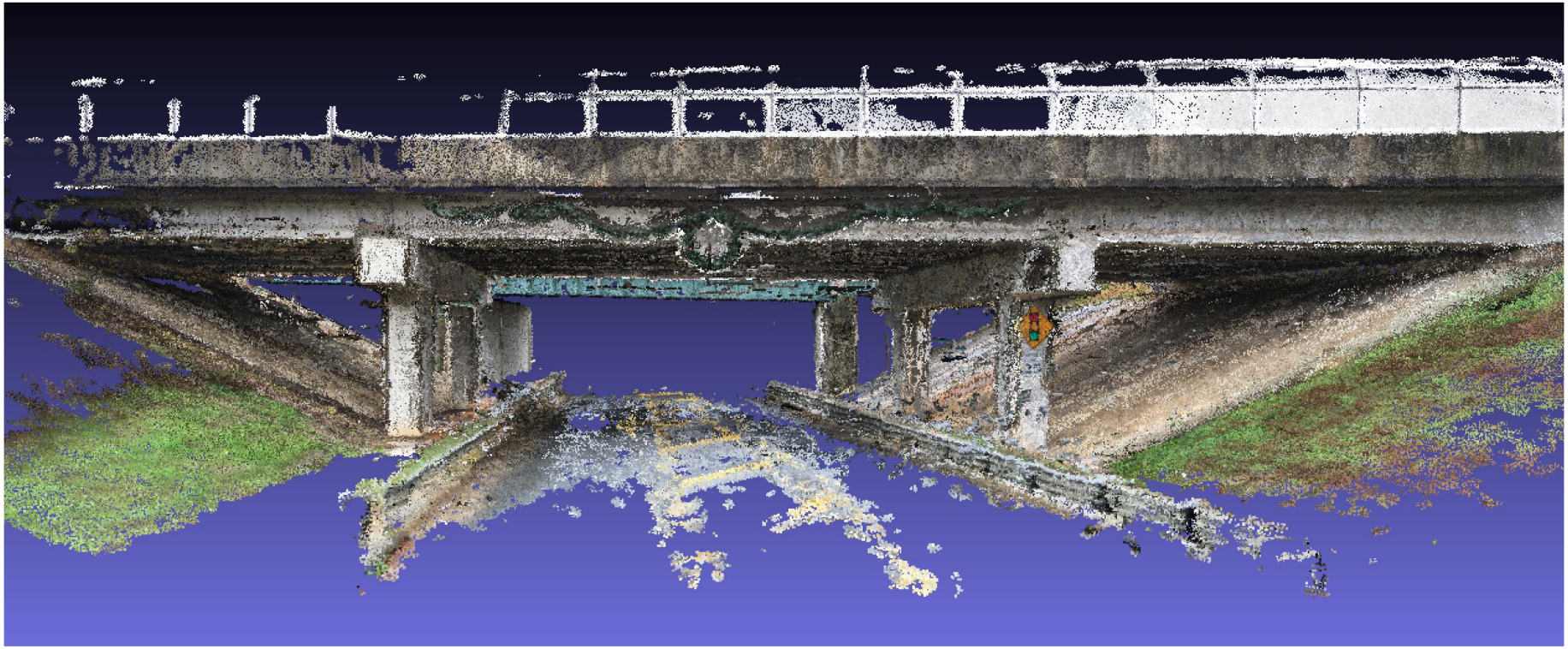
SeeBridge
Semantic Enrichment Engine for Bridges

Acworth Bridge: 1.5 GB



1B Photogrammetry: Input

Gwinnett Bridge 1: 135-01150
2 Videos (iPhone 6s): 58 min

1B Photogrammetry: Output

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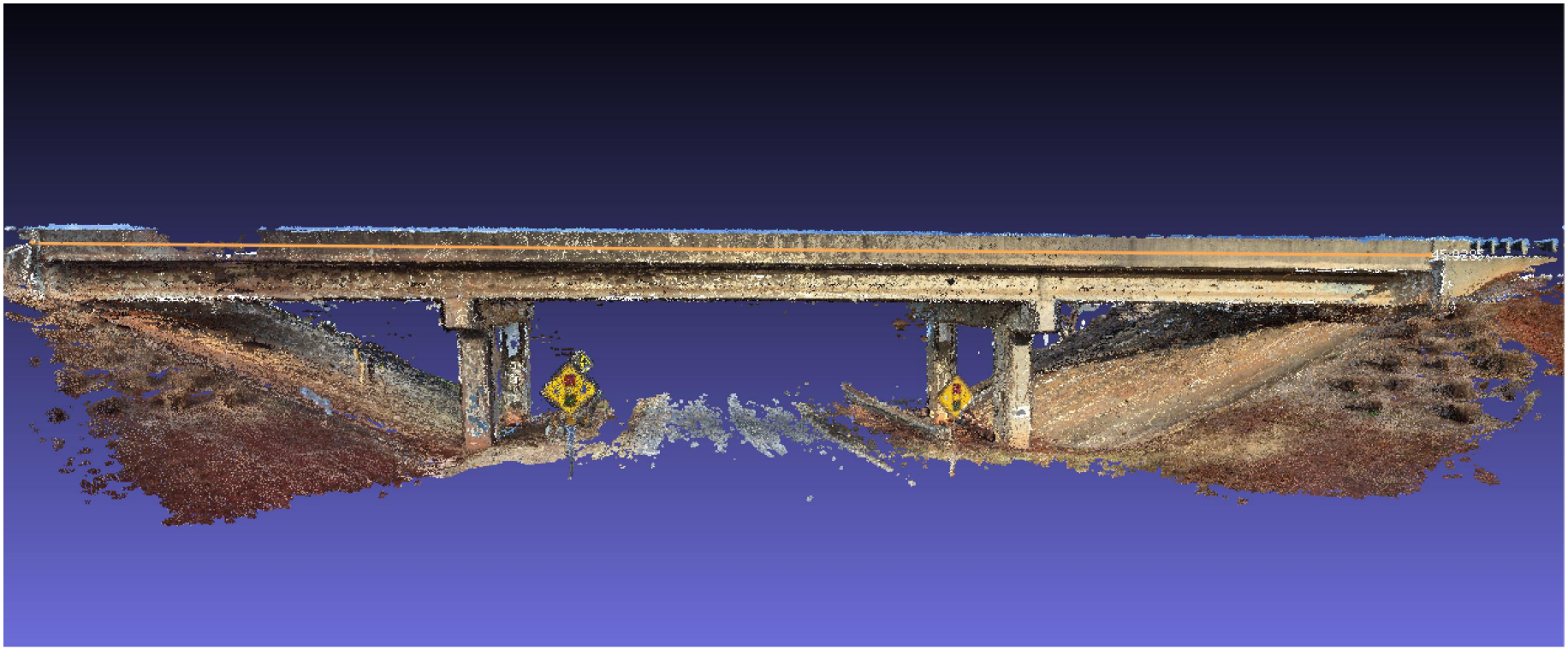
Gwinnett Bridge 1: 1.2 GB



1B Photogrammetry: Input

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Gwinnett Bridge 2: 135-50880
1 Video (iPhone 6s): 65 min

1B Photogrammetry: Output

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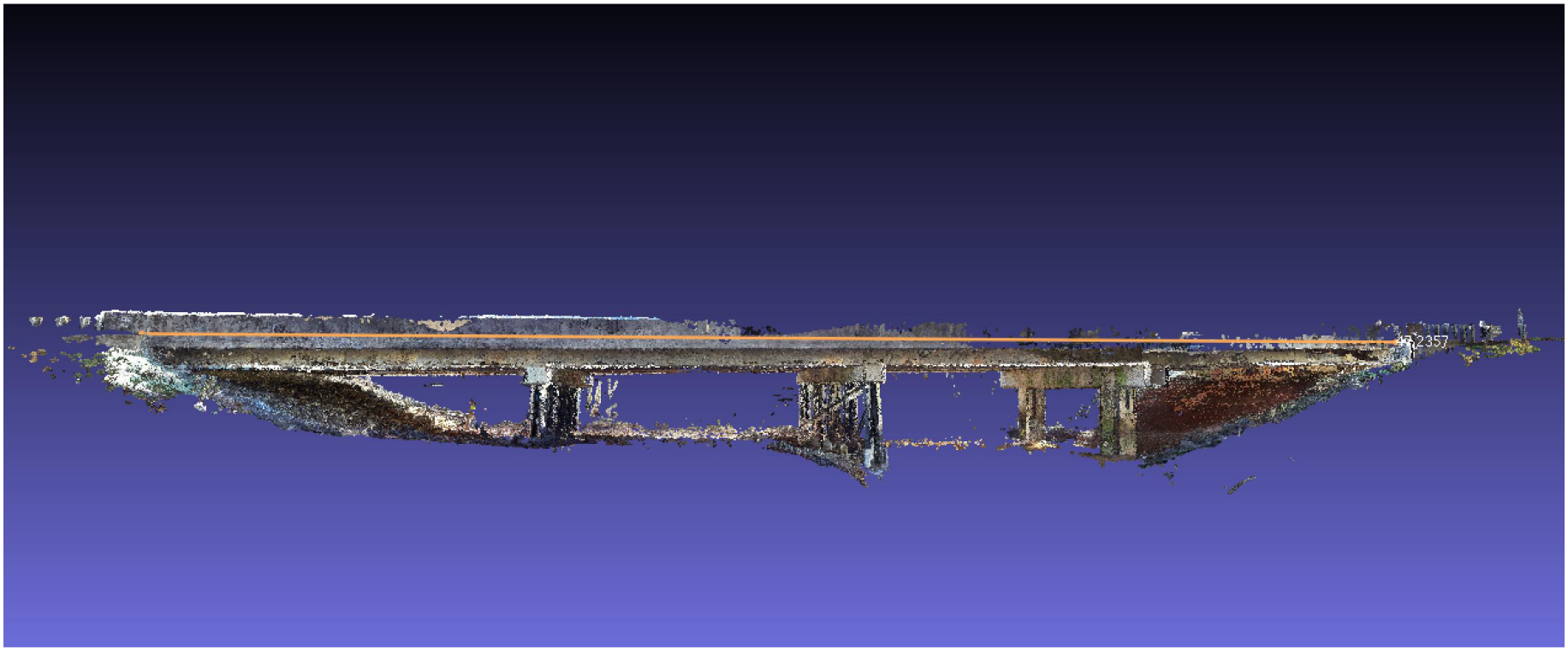
Gwinnett Bridge 2: 1.4 GB



1B Photogrammetry: Process

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SEMANTIC ENRICHMENT ENGINE FOR BRIDGES

- Bridge Selection
  - All concrete or primarily concrete
  - Good illumination level
  - Accessible for video walk under (i.e. not over water, low traffic)
  - Relatively short span (spanning 2-3 lanes traffic)
  - Relatively narrow width (2-3 lanes traveling)
  - Relatively low (under 25')

- Capture Challenges
  - Capture resolution
  - Capture pattern
  - Traffic Control/Lane Stoppages
  - Drones

1B Photogrammetry: Technology

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- Proprietary SfM algorithms
  - Reconstruct cell phone videos
- Registration
  - Automatically register clouds based on geometry

1B Photogrammetry: Results

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SEEBRIDGE
SEMANTIC ENRICHMENT ENGINE FOR BRIDGES

Bridge	067-52520		135-01150		135-50880	
Bridge Length	140 ft		156 ft		160 ft	
Capture	Laser	Pointivo	Laser	Pointivo	Laser	Pointivo
Capture Time	2 h 48 m	63 m	1 h 54 m	48 m	1 h 20 m	1 h 5 m
Number of Scans	27	3	21	2	47	1
Processing Time	3 h	21 Days	12 h	18 Days	8 h	20 Days
Total Point Count	2,782 M	21 M	762 M	16 M	902 M	19 M
Point Density	2 mm to 8 mm point spacing	32,750 points per sq/ft	2 mm to 8 mm point spacing	30,500 points per sq/ft	2 mm to 8 mm point spacing	29,900 points per sq/ft
Average Reprojection Error	N/A	0.085	N/A	0.16	N/A	0.18
Completeness of Point Cloud	100%	100%	100%	No deck	100%	Partial Deck
Accuracy	Control	0.36%	Control	0.27%	Control	0.15%

1B Photogrammetry: Accuracy

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Semantic Enrichment Engine for Bridges

Acworth	Lidar (ft)	Pointivo (ft)	Abs Error (ft)	Error
Deck Length	40.26	40.24	0.021	0.05%
Between Beams	17.10	17.04	0.061	0.36%
Beam Width	1.22	1.21	0.008	0.68%

Gwinnett 1	Lidar (ft)	Pointivo (ft)	Abs Error (ft)	Error
Deck Length	45.97	45.93	0.039	0.08%
Between Beams	19.42	19.37	0.049	0.26%
Beam Width	0.898	0.90	0.004	0.48%

Gwinnett 2	Lidar (ft)	Pointivo (ft)	Abs Error (ft)	Error
Deck Length	47.22	47.10	0.119	0.25%
Between Beams	11.37	11.37	0.006	0.05%
Beam Width	0.75	0.74	0.016	0.15%

1B Photogrammetry: Limitations

- Only Concrete Bridges
  - Requires texture to successfully reconstruct
- Point Cloud Noise
  - Requires more robust algorithms to reduce noise
- Capture and Run time – Not real-time
  - Too long to capture initial model, but could update model
    - Inspectors only onsite 20- 30 minutes
  - Heavy computational requirements
- Accuracy Tolerance
  - Capturing sub-millimetre cracks is very time consuming and requires hi-res camera
- Technical Trust with Data Capture
  - Challenge to build trust while data capture remains difficult and time consuming
  - Build trust in accuracy and efficiency