Massive Point Cloud Visualization with CesiumJS, 3D Tiles, and Cesium ion

Patrick Cozzi
@pjcozzi
pcozzi@agi.com

cesium.com
Today

• Trimble Historic Pharsalia Cabin
• Draco compression
• Autonomous driving
• Time-dynamic point clouds
Massive raw point cloud data

Content pipeline for 3D tiling

3DTiles

Open specification for streaming massive heterogeneous 3D geospatial datasets
OGC Community Standard candidate

Massive raw point cloud data

Visualization and analytics

CesiumJS

Open-source JavaScript library for 3D maps
Trimble Point Clouds

- 6.4 billion points
- 72 scans with Trimble TX8 scanner
- Tiled in 72 minutes (16 cores, 32 threads)

https://cesium.com/blog/2018/02/05/historic-pharsalia-cabin-point-cloud/
Draco Compression – Early Results

- Visualization benefits
  - Point-cloud-aware compression; better than gzip
  - Fast, parallel decoding
  - GPU quantization
- Started by Google
- Open standard extension by Khronos

Mesh results: https://cesium.com/blog/2018/04/09/draco-compression/
Draco Compression – Early Results

- Using a subset of the Trimble Historic Pharsalia Cabin

<table>
<thead>
<tr>
<th></th>
<th>3D Tiles + Gzip</th>
<th>3D Tiles 16-bit Quantization + Gzip</th>
<th>3D Tiles Draco + Gzip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total tileset size</td>
<td>1.83 GB</td>
<td>1.58 GB</td>
<td>0.64 GB</td>
</tr>
</tbody>
</table>

Blog coming soon: https://cesium.com/blog/
Point Clouds for Autonomous Driving

youtube.com/watch?v=VGKAI7PzXgw
1. Aerial laser scan by Dublin and NYU collected **1.4 billion points**

2. Cesium ion tiled the LAZ files into 3D Tiles in 520 seconds (16 cores, 32 threads) generating:
   - Intermediate LODs
   - Quantization
   - Adaptive spatial subdivision

```javascript
var tileset = new Cesium.Cesium3DTileset({ url: ... });
tileset.pointCloudShading.attenuation = true;
tileset.pointCloudShading.maximumAttenuation = 8.0;
viewer.scene.primitives.add(tileset);
```
Just 1.3% of the 3D tileset!
1. Machine Learning algorithms, open datasets, or other semantic datasets create geometry tiles

2. The intersection of the geometry, e.g., bounding boxes, classifies the environment

```javascript
var classificationTileset = new Cesium.Cesium3DTileset({
  url : ...,
  classificationType : Cesium.ClassificationType.CESIUM_3D_TILE
});
```
Time-Dynamic Point Clouds

• Streaming millions of points per second from autonomous vehicle LIDAR
Thanks!

Patrick Cozzi
@pjcozzi
pcozzi@agi.com

The **Cesium team** rocks!

[Image of the Cesium team]

CESIUMJS thanks

AGI

Bentley

RAFAEL

cesium.com
Bonus Slides
Classifying with custom volumes
Measure distance between 3D model and point cloud
Or between point cloud and terrain
About Patrick. @pjcozzi

- Started Cesium

- Started 3D Tiles
  - Co-creator of glTF

- Author in computer graphics

- Teach computer graphics

Geospatial, Graphics, Open-Source Service