Lidar Pipelines for Immersive and Web3D Visualization

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Introduction

General Workflow

1. Acquisition
2. Data Processing
3. Analysis
4. Publishing and Visualization
   a. Immersive 3D
   b. Web3D
5. Future Work
Drone-based Lidar

YellowScan Puck payload

https://www.youtube.com/watch?v=DO35QIAPrtg&t=256s
The LiDAR System

- YellowScan® Core System – Mapper
- Integrated w/Vapor35
- Multi-echo LiDAR sensor GNSS RTK + PPK receiver, bi-frequency L1/L2
- Calibrated IMU
- Embedded computer
- Data pre-processing software

- 1 to 2 returns
- ~200 pts/m² @ 20 m
- Data recorded to USB stick, includes:
  - IMU and GPS real-time recordings
  - Scanner data
Processing

.las files co-registered and geolocated…

Noise removed, tiled for processing:

1. LASTools => ARCGIS
   a. HTML5: potree

2. LASTools => CloudCompare
   a. X3D
   b. HTML5: X3DOM
Derived Products

GPS: DTM (TIN), Aspect, Slope, CHM
3D Visualization

MP4: Movie Fly-throughs w/ CloudCompare

Extensible 3D (X3D): Immersive CAVE @ VT Visionarium,
...
... HTML5 + Service-based mashups!

Rendering essentials:
Colors, Normals, visual mass, lighting, ...
Classified Cloud

Interactive 3D
in HTML5
w/ mouse
potree

Initial classification results for Catawba drone scan
Web3D: Extensible 3D (X3D)

TIN, Imagery, Tree locations

Requirements

• Metadata Scheme for provenance throughout the lifecycle:
  – Acquisition
  – Transport
  – Processing

• Include points as well as quantitative, categorical, and nominal attributes per point

• A rich visual Palette to render points to visual form (e.g. Web3DS)
Visualization w/ Web3D Standards

- **Extensible 3D (X3D)** is a royalty-free and openly published ISO/IEC Standard developed by the not-for-profit Web3D Consortium [web3d.org]

- Metadata can annotate any node

- PointSets make coords, colors, and normals easy, but are not lit, texture-mapped, or collide-able.
  - ParticleSets have been demonstrated to address these

- Surfaces, lines, and points can be compressed

- Full-fledged interactive 3D scenes and webpages via OpenGeospatial Consortium (OGC) Web3D Service
HTML5 + X3D

Using 3D Compression

1) 440K points = 23MB.ply, 21MB.x3d

2) Compressed.X3D = 3.4 MB

3) Interaction through Web and WebVR
   - 50-60 fps on laptop

4) Gltf Inline also demonstrated
Future Work

Requirements: Durability, Interoperability, Accessibility

Two fronts:

- Standards Advocacy - ISO/IEC standards to support requirements
- Consumer Advocacy - Vendors to support ISO/IEC standards
Thanks

- VT Stream Lab
- Catawba Sustainability Center
- Advanced Research Computing
- Center for Geospatial Information Technology

See Also:

Annual SIGGRAPH Carto BOF -

Polys & Russalesi present X3D and Web3DS in minutes 8-27 also includes Cesium & ESRI presentations

https://youtu.be/6ttQUhnu4SQ
Join Us~!

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• VT NEWs short form:

• https://vtnews.vt.edu/articles/2017/07/outreach-dronesatcatawba.html

long form *(5 min)

• https://www.youtube.com/watch?v=DO35QlAPrtg&spfreload=5
Aerial Photo Inventory → Drone LiDAR Mission → Ground Truth

Data Collection

Inspection and Cleaning

Data Post-processing

Point Cloud Data (.las)

Data Inspection

Data Tiling & Buffering

Classified Ground / Non-ground Data

Classification

Adaptive Triangulated Irregular Network

LiDAR Returns

Adaptive Triangulated Irregular Network

Digital Terrain Model

Canopy Height Model

Digital Surface Model

Inspection (QA/QC)

Calculate Parameters of Interests

Roughness

Vegetation Covers

... ...

... ...

Estimate Parameters of Interests

Visualization

Color-coded Point Cloud Data

Point Cloud Data Visualization
Locations

Catawba Sustainability Center

32 million points, 8 columns

Stroubles Creek & Doc’s Branch

57 million points, 8 columns