Interactive 3D Visualization and Dissemination of UAV-SfM Models for Virtual Outcrop Geology

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November 22, 2022

Abstract

The potential of high resolution 3D datasets is being increasingly realized in an expanding number of geoscience applications. However, sharing of these datasets and interpretations requires end-users to have specialty software programs and high-end processing computers. Although user-friendly technological advances, such as uninhabited aerial vehicles (UAVs or drones) and structure-from-motion (SfM) photogrammetry, provide geoscientists with tools to easily collect, process, and analyze 3D models at multiple scales, dissemination of results to the general public commonly revert to conventional 2D formats, such as (static) 2D maps, figures, and rigid animations/videos. To facilitate dissemination of complete 3D datasets and interpretations to a wider audience, we review three modern platforms that enable visualization, sharing, and publishing of various 3D formats. We demonstrate the capabilities and limitations of each visualization platform by presenting a 3D digital outcrop model (DOM) of an extensive exposure of fluvial channel belt deposits in a 1 km2 area of Dinosaur Provincial Park (Alberta, Canada) generated from UAV-SfM photogrammetry. Each visualization platform provides intuitive controls and accessibility on standard desktop computers through web-based browsers (e.g., Sketchfab and potree) or a standalone executable file developed through videogame engines, such as Unity or Unreal Engine. Proprietary viewers allow straightforward sharing of 3D models, but limit size, detail, and resolution and also have restricted means for accommodating interpretations. Open-source platforms afford more functionality, facilitate additional 3D datasets, and can provide customized visualization experiences for end-users, but may require more advanced coding experience. Visualization platforms examined within this study offer access to large 3D datasets without the need for specialized software and advanced computing hardware. Further development and use of such platforms has potential to enhance student education and improve scientific communication through unique customizable experiences that allow for democratization of high resolution 3D datasets.

EP11C-2131

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So you have a 3D model... how do you SHARE the data?

Platforms for Interactive and Intuitive Visualization and Sharing of Large 3D Models

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BONUS MODEL

SCAN ME

Introduction

3D models are becoming **common data sources** within the geosciences.

Despite the ease of acquisition and processing (e.g., UAV-SfM), the ability to **share** and **visualize** 3D datasets remains challenging, i.e., large files and need for high-end hardware and software.

We examine **three** modern platforms that overcome these bottlenecks and offer accessible, interactive, and intuitive control of large datasets without specialist software or hardware.

Visualization Platforms

- Sketchfab
  - Web-based
  - Proprietary
  - Ideal for **meshes**
  - Subscription-based
  - Limited annotations
- potree
  - Web-based
  - Point clouds or Mesh
  - Open-source
  - Requires coding
  - 'Built in' Tools
- Unity (videogame developer)
  - Open-source
  - Requires coding
  - Mesh preferred
  - Highly customizable
  - Stand-alone executable or App files can be exported for more than 20 systems (e.g., Windows, Mac, iOS, Android, and PS4).

Challenges and Potential

There are several modern visualization platforms capable of rendering large 3D datasets (e.g. point clouds and textured meshes). Web-based services, such as **Sketchfab** and **potree** provide practical options for sharing data with end-users without cumbersome file transfer/storage:

- **Sketchfab** offers quick and easy uploads, but is limited by customizability and paid subscription.
- **potree** open-source code allows customization to functional data viewer. It is capable of rendering large datasets and may be most practical as a raw data viewer to share with collaborators or commercial partners using any common internet browser.
- Game engines (e.g., **Unity**) require significant coding and design for customizable visualizations. They may be best used presenting educational information, such as Virtual Field Trips, in which 'participants' can follow guided prompts or explore a field site on their own.

CHALLENGES
Bottlenecks

3D files LARGE
GBs 100s MB

.las .laz .xyz — *point cloud*

.obj .ply .mtx — *mesh*

File Transfer and Storage

High-end Hardware

Specialist Software

Convert

Reduce

Conventional 2D Formats

Fixed view — Static

Interaction

Modern Platforms for 3D Visualization and Sharing

Sketchfab

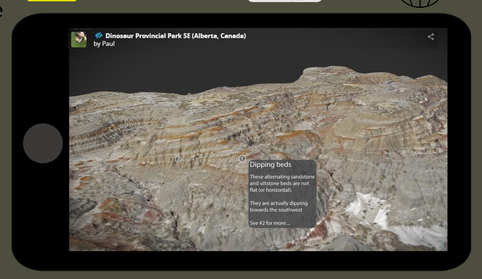
Limited customize

Subscription

< 200 MB

WWW

VR



SCAN ME

Interactive 3D mesh on Sketchfab

potree

Open-source Customizable

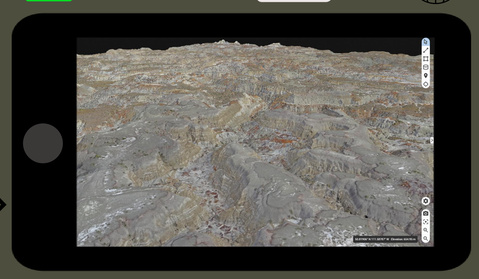
> GBs

WWW

coding

Allows Layers

Measure



SCAN ME

Interactive 3D point cloud using potree

unity

Open-source Customizable

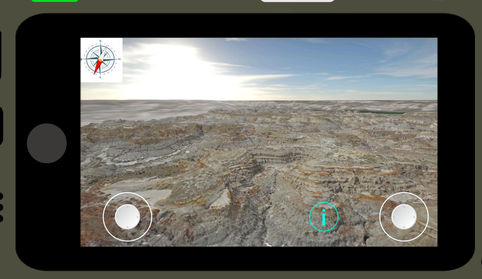
~ GBs

WWW

coding

VR

Allows Layers



SCAN ME

Fully Customized Videogame Viewer using Unity

To download desktop executable for Windows or Mac

ASK TO TRY THE iOS APP!

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