New 3D learning materials for teaching in geosciences

Tuomas Junna, Aleksis Karme, Sonja Silvennoinen, Seija Kultti, Emilia Koivisto, Annika Åberg, Susanne Åberg

Overview

- Goals:
  - Improve teaching
  - Make lab & field education more effective
  - Further familiarize students with 3D models and associated workflows
  - Visualize subsurface structures and their above ground expression
  - Create a workflow that allows all teachers to create their own digital models

- Products: Videos, 3D models and VR environments

Teaching possibilities

VR booth in the hallway of UH science campus

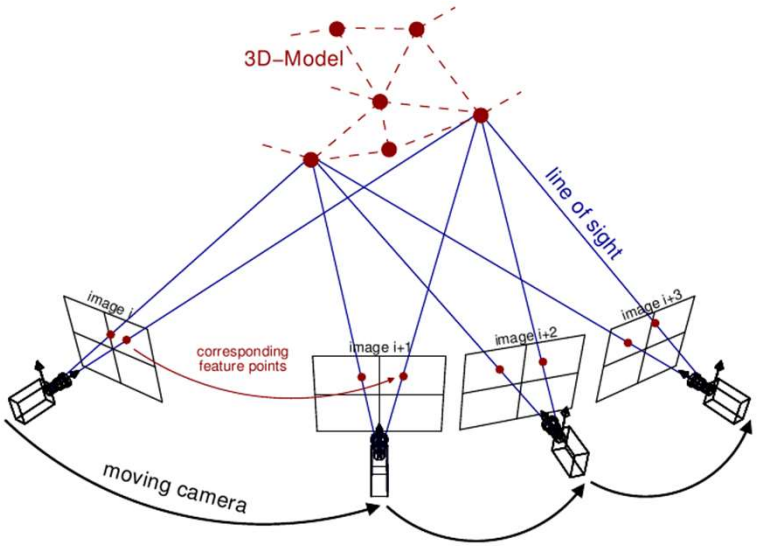
- Makes it possible to practice field techniques while on campus
- Preliminary field exercises carried out in VR allow more efficient learning on the field
- Allows access to restricted/ hazardous areas
- Streamlined workflow aims to make teaching material creation easy for staff
- Full potential is yet to be discovered

  → Suggestions and feedback

Student involvement

- Majority of field course sites are revisited every year
  - Students can familiarize themselves in advance
  - Data collection and processing can be integrated into course work
  - Ever expanding amount of data and models
  - VR sites can be revisited and used as examples on other courses
- Ever expanding dataset includes not just visual representations, but also geophysical data, measurements, lab results…

Structure-From-Motion Photogrammetry



van Riel, Sjoerd. (2016). Exploring the use of 3D GIS as an analytical tool in archaeological excavation practice.

GigaPan

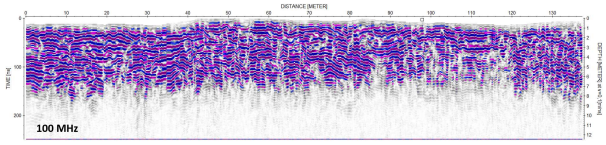
Robotic camera mount

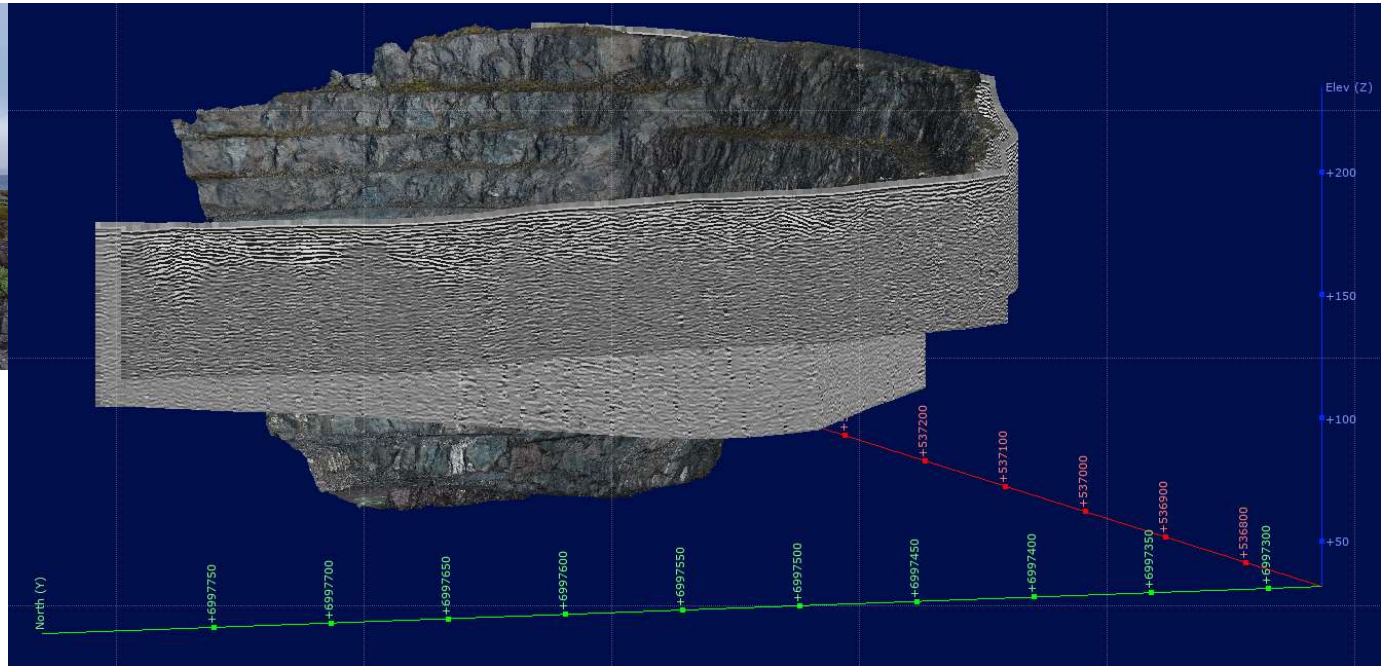
High-resolution panoramic images made by stitching together 100's – 1000's of images

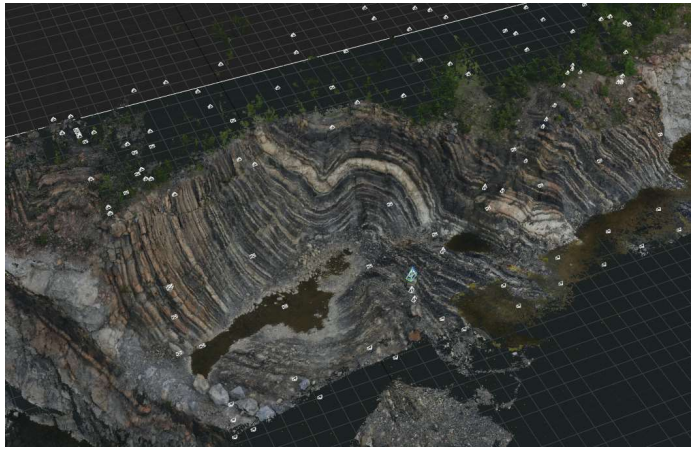
View and annotate at gigamacro.com (http://viewer.gigamacro.com/HYGeo/)

- 400mm zoom lens
- DSLR camera
- GigaPan
- Tripod

Ground Penetrating Radar



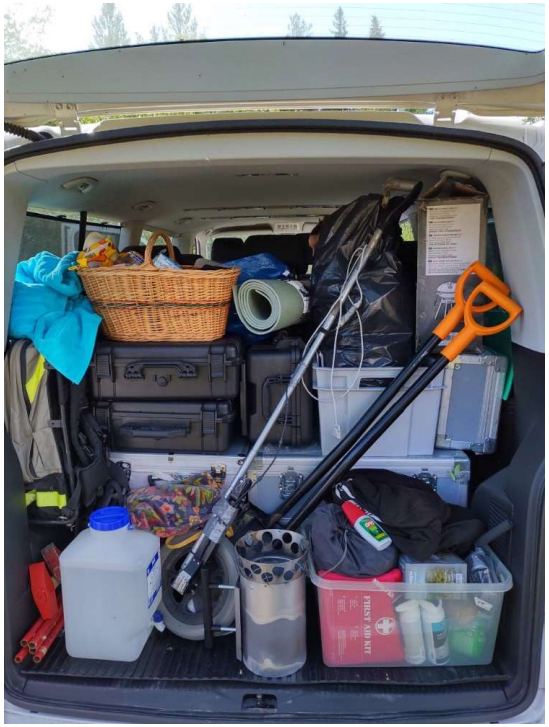




- DEM + 3D model + 360 panorama + gigapan panorama = VR

Hardware

- DJI Mavic Air drone - Photogrammetry, video
- Gigapan Epic Pro - Panoramic imaging
- Røde Videomic Pro
- Canon Eos 6D DSLR -Photogrammetry, video
- High powered desktop with a discrete GPU



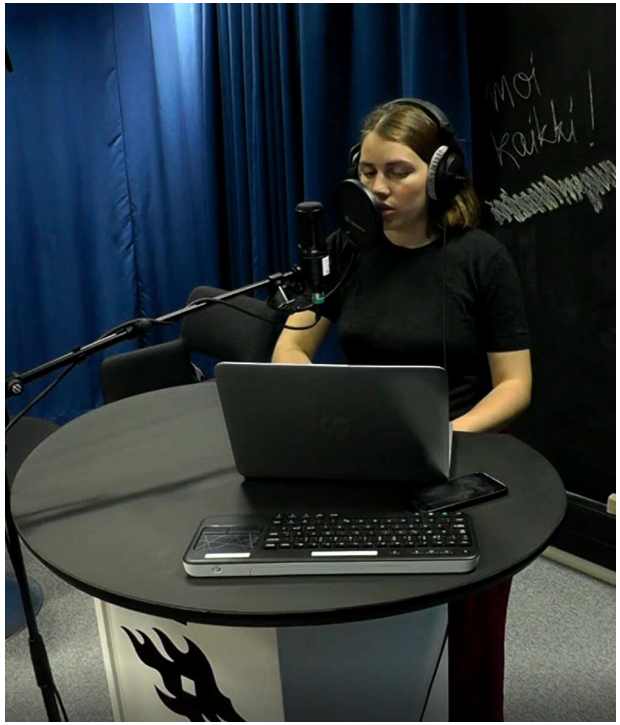
Software

Software in use:	Function:	Some alternatives:
• Reality Capture Pro (€)	• Photogrammetry	• Agisoft metashape (€), Meshroom, Pix4D (€)
• Kolor Autopan Giga (€) • Gigapan Stich (HW incl.)	• Panoramic stiching • Panoramic stiching	• Hugin, Autostich, Microsoft ICE, Photoshop (€)
• Cloud Compare • Meshroom	• Model manipulation, merging, spatial referencing…	
• Vrifier (€)	• VR implementation	

Lessons learned - Video

- Good planning and scripting is essential
- Well planned projects are fast and easy to edit
- Biggest technical challenge is sound quality
- University rooms often too noisy for voiceover recording

  → **Unitube studio** or private premises



Lessons learned – Photogrammetry

- Amount of light is essential, especially for video
- Practice is necessary to know what kind of footage works
- It is better to wait for stable lighting than it is to edit a doomed model and then come back
  → Have a loose schedule!!!
- Automate large scale, low resolution 3D mapping flights (Pix4D mapper, maps made easy etc)
- Take as much material from manual flights as possible

Technical and fiscal challenges in 3D

- Specialized software commonly prohibitively expensive → Freeware when possible
- Free solutions are often labour intensive and difficult → Workflow optimization
- Free solutions rarely work natively with different data types → Workflow optimization
- Combining high resolution and large spatial coverage is problematic → Workflow optimization
- Access to large datasets on AD-networked and private computers while remaining laptop compatible remains a challenge → Potree structures, 3rd party hosting
- Amount of raw data → **UH datacloud pilot**

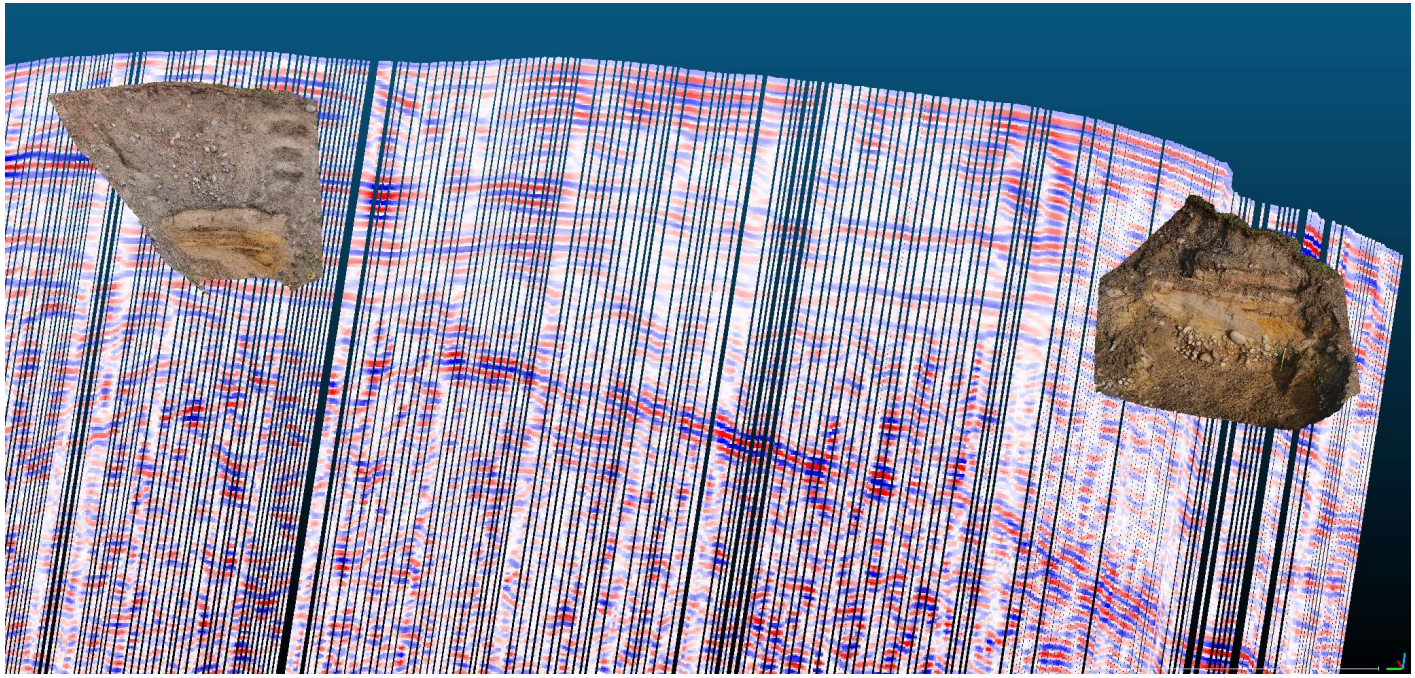
As digital learning materials become more common, a university wide hosting server would be a far better option than everyone maintaining singular servers or buying 3rd party hosting!

Examples

High resolution textured mesh from a single outcrop.

This can be readily hosted by 3rd party services.

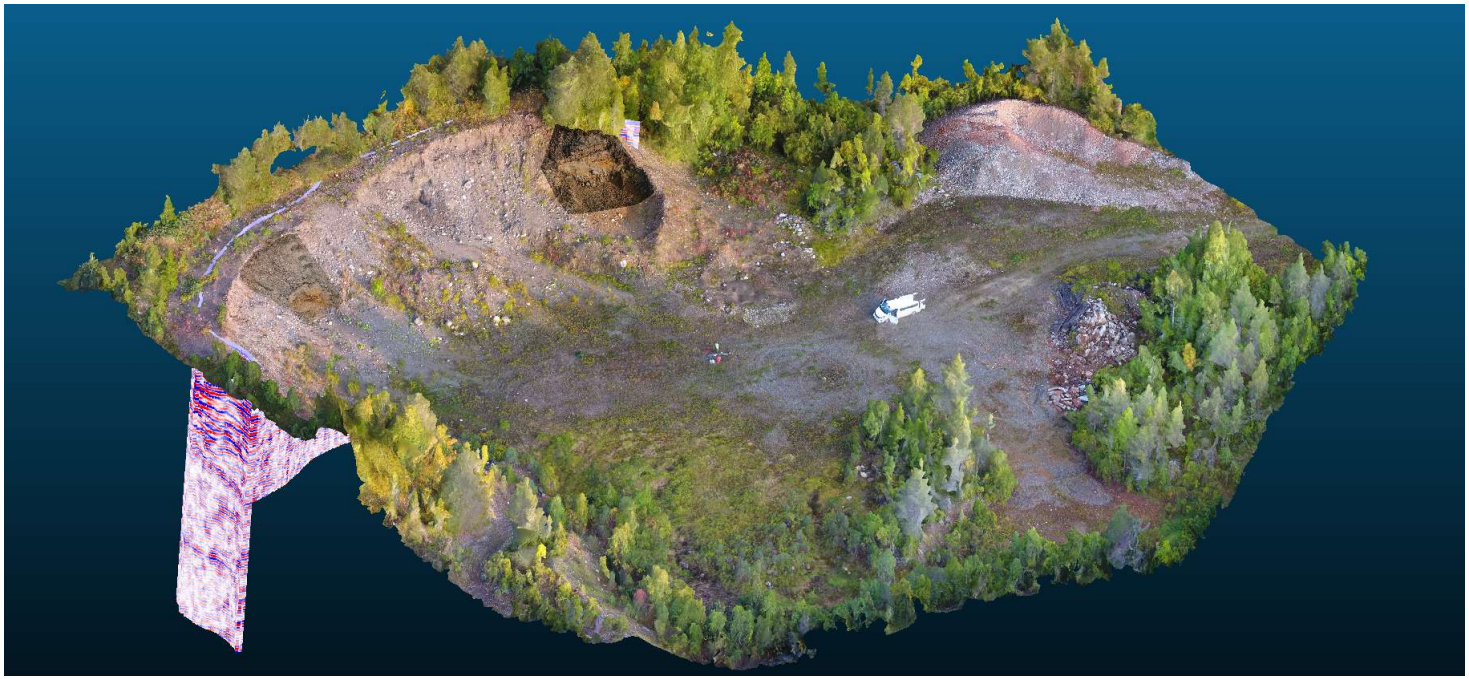
Examples



High resolution Textured meshes combined with GPR point cloud visualization.

Run in cloudcompare

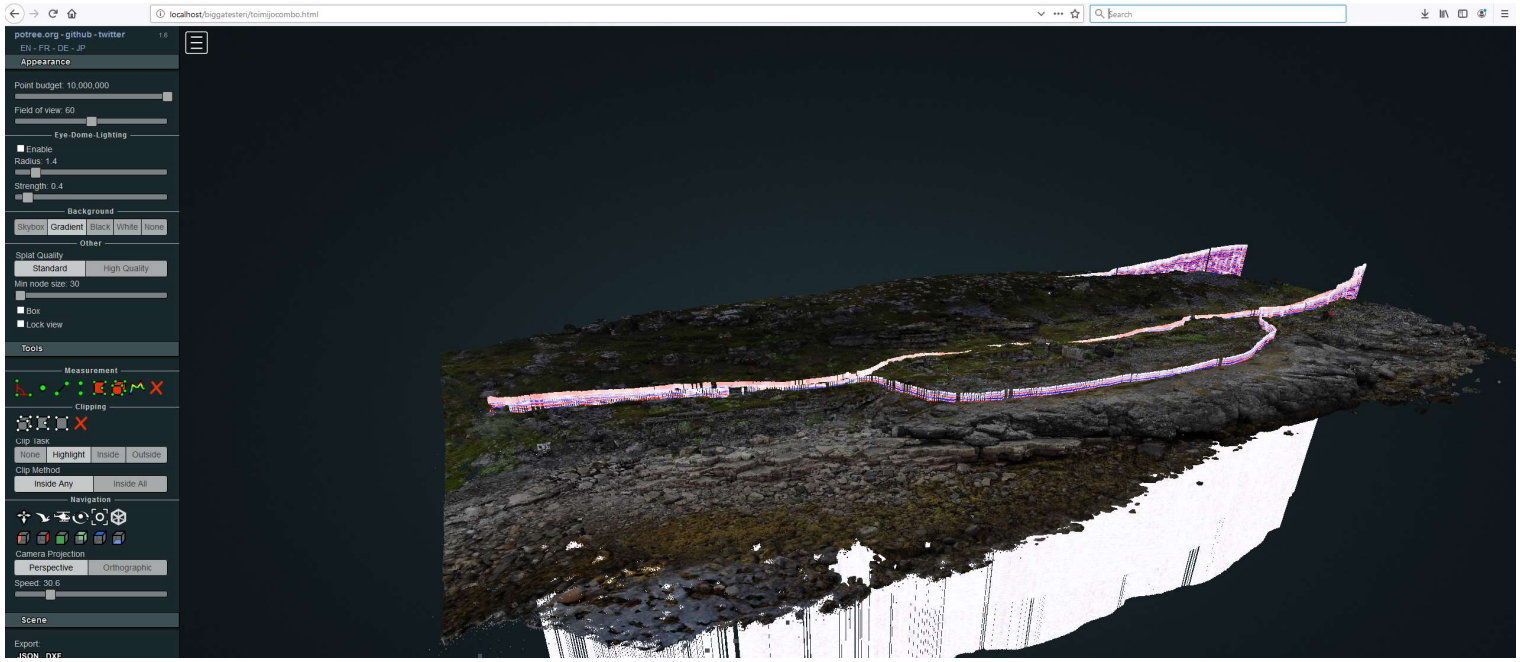
Examples



High resolution textured meshes, low resolution mesh and GPR point cloud.

Cloudcompare, computer intensive

Examples



100 million point cloud run in browser using the potree structure

Very easy, laptop safe but requires a server to host the data!

Thank you

Correspondance: tuomas.junna@helsinki.fi

Follow: https://blogs.helsinki.fi/geotieteidendigiloikka/

3D-models: http://sketchfab.com/HYGeo/

Gigapans: http://viewer.gigamacro.com/hygeo

Teatime Research ltd: http://teatimeresearch.com

Vrifier: http://vrifier.com