Integrating Real & Virtual Field Experiences for Geoscience Education

Virginia Toy, Jan Thomann, **Alex P. Clarke**
jthoman@uni-mainz.de, alex.clarke@uni-mainz.de

Rhein-Main Universitäten

JG|U
JOHANNES GUTENBERG UNIVERSITÄT MAINZ

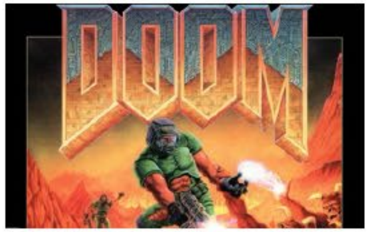
Motivations for Blended Learning

- During the COVID19 pandemic, we developed virtual field trip resources. These had some advantages over in-person fieldwork:
  - Not restricted by having to stand (safely) on the ground.
  - Lots of measurements can be collected very quickly.
- We wanted to integrate virtual & in-person fieldwork to create a best-of-both-worlds exercise.
- We had the opportunity to develop a virtual fieldwork environment using Unreal Engine.

Video Games are Familiar to Students

- Video game controls (WASD and "mouselook") are familiar to the target audience.
- The tools to create these games (e.g. Unreal Engine, Blender) are available to the public and often free.
- Unreal Engine provides all the functionality to make modern-looking video games.

1991

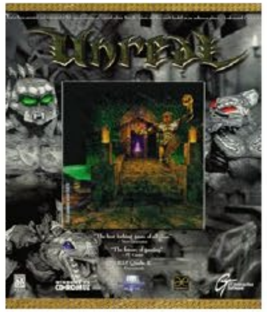


3d Rendering in Videogames

1997

WASD input as standard

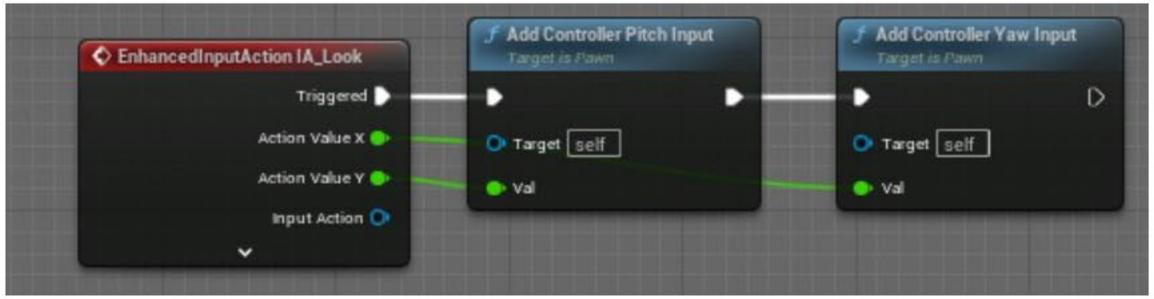
1998



Unreal Engine

Findings from Pilot:
Requirements to Build an Unreal Fieldtrip

- Little programming background needed due to modern tools.
- But requires high quality source material (e.g. outcrop pictures/ models).
- Simulated lighting is very important for highlighting (or obscuring) key features.



Camera Rotation setup in the Unreal Engine

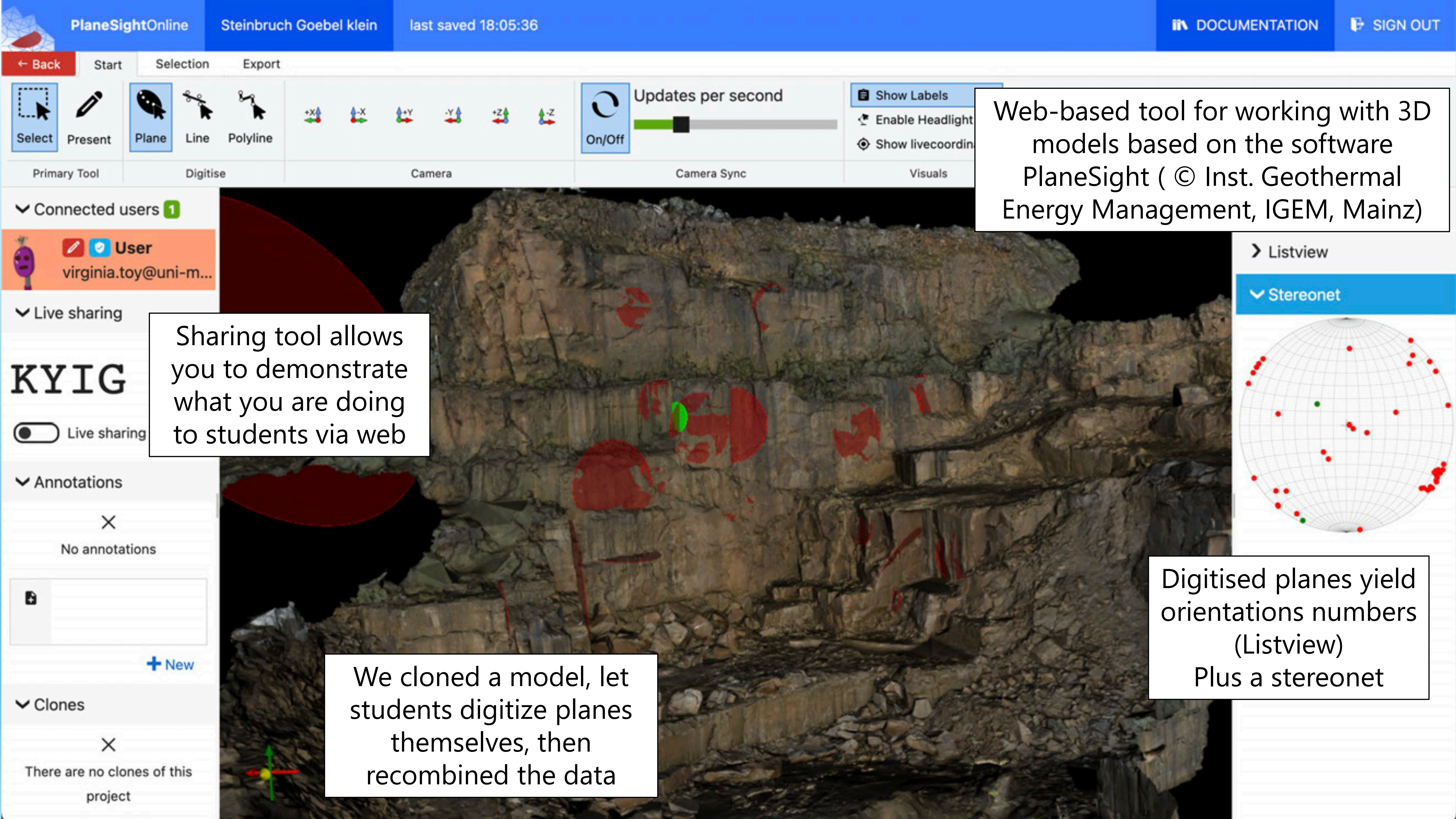
The same model unlit in the editor (left) and lit in the level (right).

Virtual Tools Supplement In-Person Teaching

- Our goal is to combine virtual and in-person field experiences.
- On a **real** field trip to a quarry our bachelors students characterised discontinuities in a sandstone (analogue geothermal reservoir rock).
- The following week in class they revisited the outcrop virtually.

Virtual Tools Supplement In-Person Teaching

- Our goal is to combine virtual and in-person field experiences.
- On a **real** field trip to a quarry, our bachelors students characterised discontinuities in a sandstone (analogue geothermal reservoir rock).
- The following week in class they revisited the outcrop virtually.



PlaneSightOnline
Steinbruch Goebel klein
last saved 18:05:36
DOCUMENTATION
SIGN OUT
← Back
Start
Selection
Export
Select
Present
Plane
Line
Polyline
Primary Tool
Digitise
Camera
Updates per second
On/Off
Camera Sync
Show Labels
Enable Headlight
Show livecoordin
Visuals
Web-based tool for working with 3D models based on the software PlaneSight (© Inst. Geothermal Energy Management, IGEM, Mainz)
Connected users 1
User
virginia.toy@uni-m...
Live sharing
KYIG
Live sharing
Sharing tool allows you to demonstrate what you are doing to students via web
Annotations
No annotations
+ New
Clones
There are no clones of this project
Listview
Stereonet
Digitised planes yield orientations numbers (Listview)
Plus a stereonet
We cloned a model, let students digitize planes themselves, then recombined the data

Field Measurements

PSO Measurements

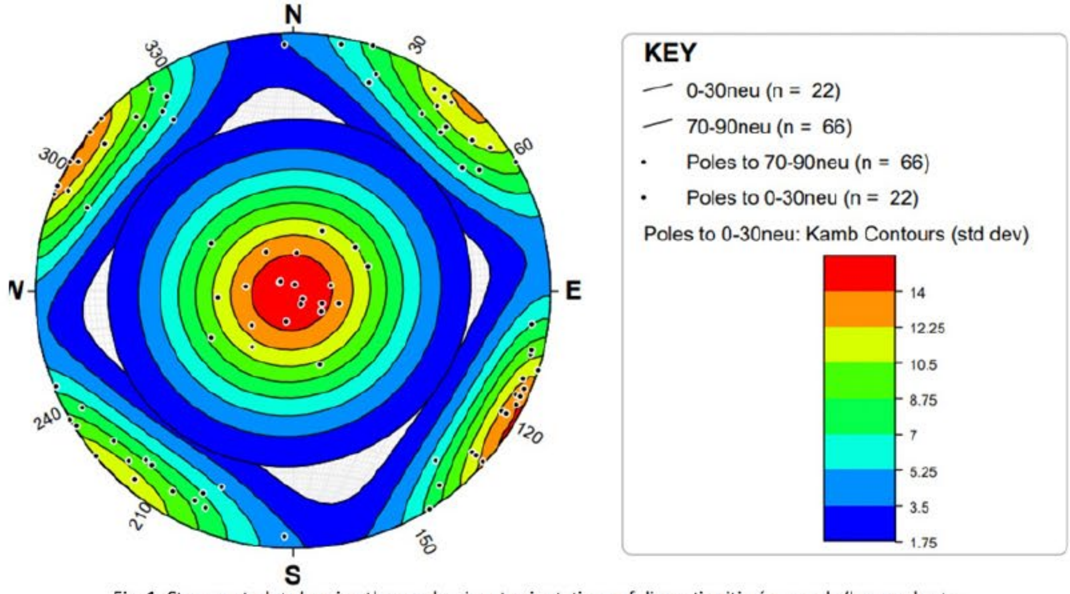


Fig. 1: Stereonet plot showing the predominant orientations of discontinuities´ normals (here poles to measured planes) observed in the outcrop (own measurements from different groups made in the field using a compass across a scanline); created by using Stereonet 11

Sector stereonet plot	Dip direction (°)	Dip (°)	Main types of discontinuities
Centre	150,83	81,08	fractures, bedding
NE	37,33	5	joints, fractures
SE	117,86	3,75	joints, fractures
SW	225	2,5	joints, fractures, ripple marks, clay-rich layers
NW	301,14	2,14	joints, fractures, faults

Fig. 2: Average orientation of observed discontinuities (poles to measured planes; average vector of each of the five major groups of orientation lines)

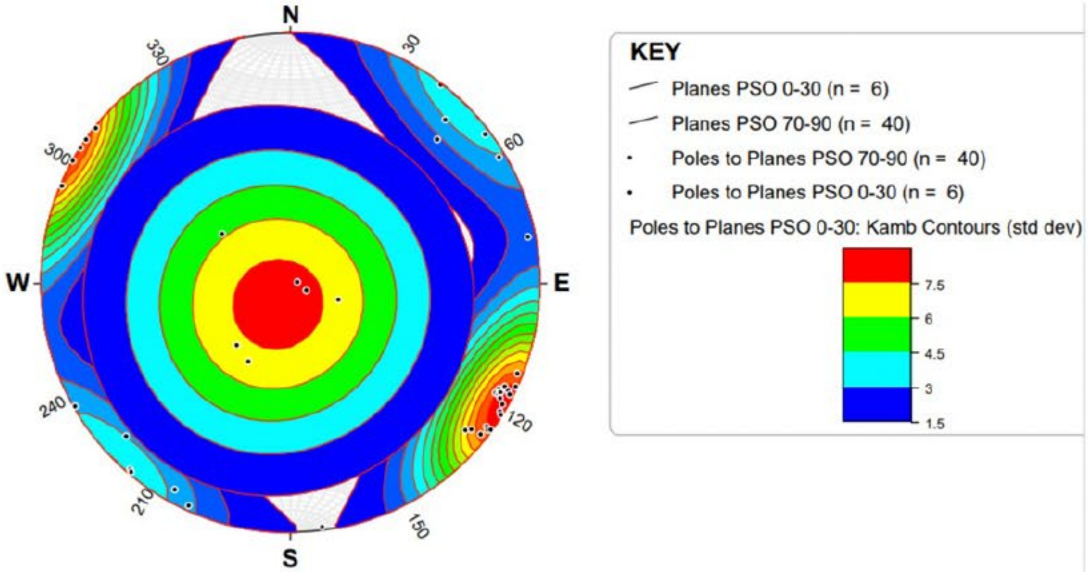


Fig. 3: Stereonet plot based on data derived from a PSO model (photogrammetric model of the outcrop); created by using Stereonet 11 (poles to measured planes depicted); types of discontinuities not available for this dataset

Sector stereonet plot	Dip direction	Dip
Centre	130	75
NE	45	2
SE	120	3
SW	221	2
NW	302	1

Fig. 4: Average orientation of observed discontinuities (poles to the measured planar features; data based on PSO model)

Student Feedback:

- Student opinion was mixed…
  - Half the students loved it!
  - Half the students couldn't even make it work!
- Ensure something can be learned from the exercise through other aspects of the work.
- Biggest complaint was that the key to return to the top-level menu wasn't what they expected. This highlights:
  - Familiarity with user interface expectations is a strength unless we break those expectations.
  - Students don't always comment on what we want them to.

JG|U

Outcomes:

- Our reliance on student laptops caused problems. In future, we would use a computer lab.
- Approximately half of the class encountered technical difficulties.
- We also had problems with server capacity for PSO.
- Nevertheless, 75% of the class were able to submit a report that coherently discussed the concept of orientation bias and the quality of the field vs. virtual measurements.
- Virtually revisiting an outcrop students have already visited worked well.
- We encourage others to try similar blended-learning execises.

Goal of teaching principally achieved!

JG|U