Visualisation of 3D/4D models in Geosciences

Visual3D

Network of infrastructure (NoI)

Luleå University of Technology
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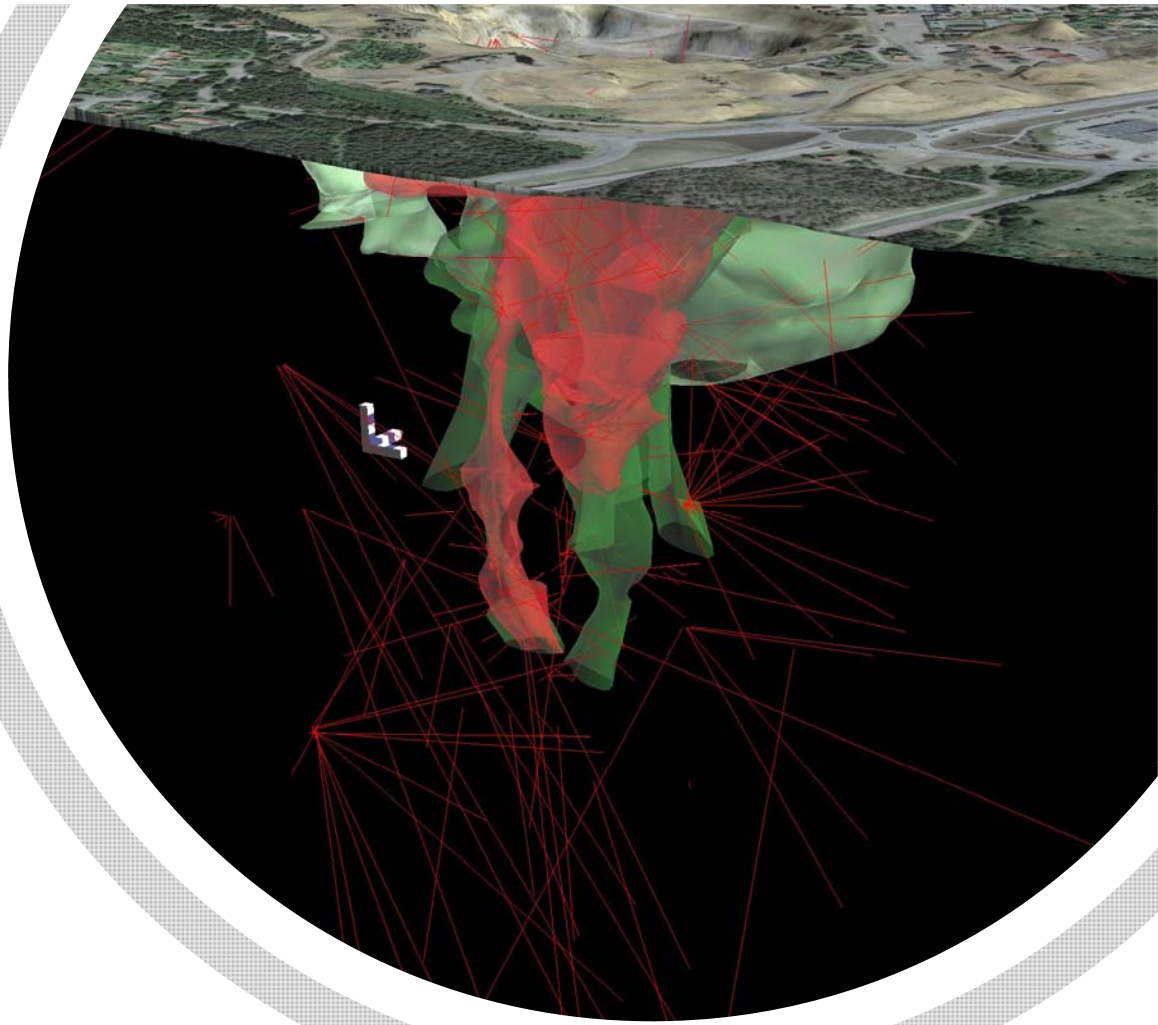
duration of project from 2017 to 2020 (three years)



Modified from Kampmann et al. (2016) Mineralium Deposita

EIT Raw Materials is supported by EIT,
a body of the European Union

Structure of this presentation:

1. What is a EIT RM network of infrastructure (NoI)?
2. The Visual3D NoI:
   - Partners and objectives
   - Output so far
   - Future project
3. Virtual Reality @ Luleå University of Technology

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What is a network of infrastructure (NoI)?

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- EIT Raw Materials funds partners to hold workshops and idea camps (ca. 2 / year)

- Mainly funding of travel costs, only limited funding of working hours

- **General purpose:**

- Sharing of knowledge and available infrastructure between the partners
- Outreach to potential external users and clients
- Planning of future collaboration in e.g. upscaling projects

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The Visual3D network:

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- A NoI for visualisation of 3D/4D geological models.
- Bringing together partners with 3D-4D-visualisation infrastructure and 3D-4D-modelling experience.
- Collaboration interlinking Virtual/Mixed Reality hardware, geological modelling software and expert knowledge in model visualisation and output.
- Simplifying communication of geological models within and between the mining industry, geological surveys and the academic community.
- Improving evaluation and analysis of Earth science data and simulations by providing access to Virtual/Mixed Reality environments for visualisation and analysis of geomodels.

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General facts related to the Visual3D network:

Leading partner: Luleå University of Technology

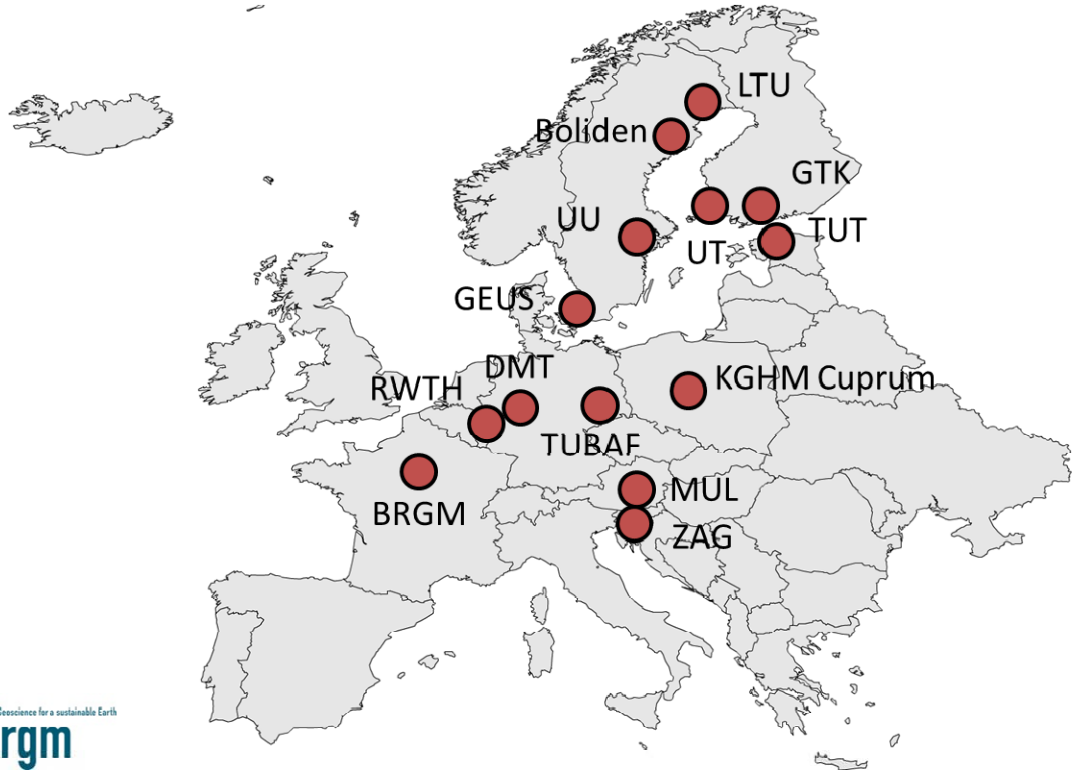
Contact person: Tobias Kampmann (tobias.kampmann@ltu.se)

Duration: April 1, 2017 until March 31, 2020

Primary aims:

- Outreach and increase number of infrastructure users
- Host workshops and idea camps
- Kick-start funding ideas and proposals for up-scaling projects

Visual3D partners:



Output from project so far:

- Workshops on geoVR (April 2017, Vienna and September 2017, Luleå)
- Database of available 3D-4D and geoVR infrastructure within the NoI
- NoI website: www.visual3d.info

Infrastructure database:
Partner, hardware, used software, developed software, recent/ongoing projects

Partner	Available hardware	Used software	Developed software	Examples of recent/ongoing projects
RWTH Aachen University	Picasso 3-D immersive flipchart	Virtual Reality Toolkit (VISTA)	GemPy	Virtual Reality and Immersive Visualisation
	Powerwall (VR studio)			Automation of visualization of geophsical and geological datasets
	AixCAVE (five-sided VR projection environment)			
Boliden Mines	-	Bentley Microstation	-	3D quantitative mineral potential targeting in the Kristineberg area
		MapInfo Discover 3D		
		Leapfrog		
		Datamine		
		GoCAD + Mira Mining Suite		
The French Geological Survey (BRGM)	Photogrammetric cameras and rig	3DGeomodeller	GDM-MultiLayer	RGF "Référentiel Géologique de la France" (provide up-to-date and sharable geological information in 3D)
	Zeb-Revo handheld laser scanner	GDM-Multilayer	3DGeomodeller	Storing and delivering numerical geological models on demand for everyday Earth Sciences applications
		Isatis	plugin Facet for Cloud	Mapping Naturally Occuring Asbestos on free rock face
		Surpack		Monitoring of rocky hillslopes to constrain rock fall hazads
		Cloud Compare		
		LIME		
		R statistical - geostatistical package		
		ArcGIS/QGIS		
DMT	-	Geovia Surpac	Boxmodel (Surpac-ba	Numerous projects on mineral resource and reserve block models for a variety of commodities, metals (basic and precious metals), bulk minerals, e .g. phosphate, solid energy (coal, lignite, oil shale) or geothermal energy
		Hexagon Minesight		
		Itasca Flac3D		
		Schlumberger Petrel		
		Paradigm Skua		
		CAE Datamine		
Bergakademie Freiberg	Virtual Reality Lab/Studio	Paraview	CAVE VR-software (I	Mining-ReX (Mobile robot development for underground exploration)
	X-SITE (Virtual Reality CAVE)	Blender		VR-based Visual Analysis of Filtration Processes
	HTC Vive (HMD)	VisualSFM		iDeepMon (upscaling project to develop technology for the automated inspection of mine shafts)
	Oculus Rift (HMD)	Agisoft Photoscan		
		Meshlab (mesh post-processing)		
Geological Survey of Denmark and Greenland (GEUS)	Photogrammetry Lab	GOCAD	3D WebViewer protot	Geological Mapping in Greenland
	3D-projector and silver screen	Move	2.5D Geothermal subs	Analogue projects for oil companies
	Oracle Spatial 11g and PostgreSQL database	SocetSet		Structural mapping for mining exploration companies
	Handheld 3D scanner	StereoBlend		3D database development
	3D printer (Stereolithography & Fused deposition modeling)	FME (Feature Manipulation Engine)		Development of a prototype for 3D visualization on the internet
	360 degree camera	MeshLab		
	"Gear VR"	Petrel		
		WebGL		
		Unity3D		
		LightWave 3D		
		Blender		
		CloudCompare		
Geological Survey of Finland (GTK)	3D projectors and glasses (active shutter technology)	GoCAD + Mira Mining Suite	-	Lapland mineral systems and exploration models project
		Geovia Surpac		Developing Mine Camp Exploration Concepts and Technologies - "Brownfield exploration"
		Geosoft Oasis		GECCO (Common-Earth modeling in heterogeneous areas
		BGS Groundhog		XSODEX (Sodankylä Deep Exploration incl. magnetotelluric and seismic data)
		Interpid Geomodeller		
		ArcScene		
		Geovia Gems		
		GeoVision		
		ISATIS (Geovariances)		
		MOVE		
		Target (ArcGIS)		
KGHM Cuprum	3D Monitor (AOC D2769VH 27")	Gemcom Surpac	-	3D modelling of sediment-hosted copper deposits
		Datamine		3D modelling of potassium salt deposits
		Studio 5D Planner		Hydrogeological interpretation of archive data
		Visual MODFLOW Flex		

Purpose: Basis for communication of expertise, challenges and possible synergies and future joint projects within the network and with other users. Database is available on the network homepage

Impact

- Platform for fruitful communication between leading European experts in geomodelling and VR/MR in geosciences

- Identified challenges in the field will lead to several proposals for e.g. upscaling projects

- Examples of our direct outreach to potential collaborators:
- Statoil (3D-4D modelling of petroleum reservoirs)
- Samuraj (VR solutions, software and game development)
- National Research Council of Italy (Links between analogue and 3D geomodelling)
- Robotic Eyes (MR solutions involving MS hololens)

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Outreach:

EGU European Geosciences Union General Assembly 2017
Vienna | Austria | 23-28 April 2017

FEM 2017 11th FENNOSCANDIAN EXPLORATION AND MINING
31 October - 2 November 2017 • Levi • Lapland • Finland
Congress & Exhibition Centre Levi Summit

robotic eyes
See more!

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Examples of available 3D/4D and VR infrastructure

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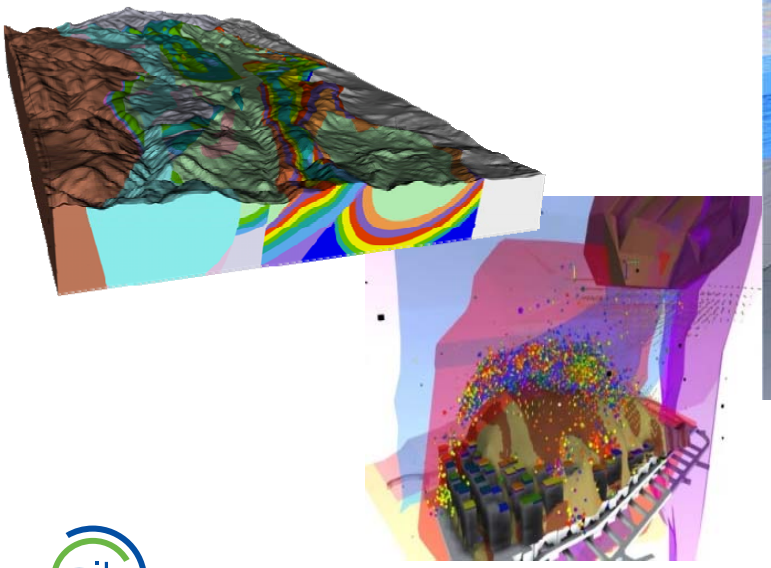

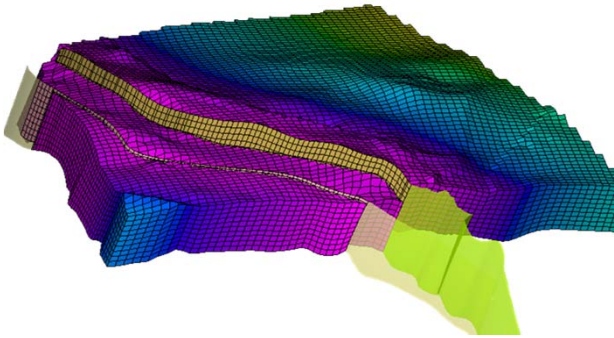

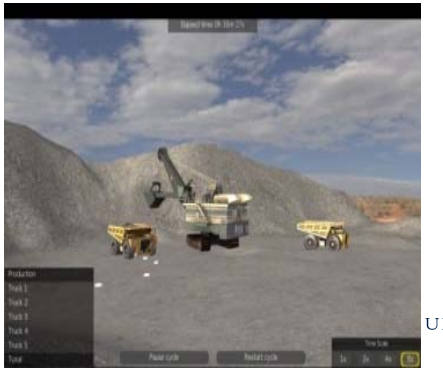

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Future projects: VR database/handbook of European mining and exploration activities

- Raw Materials VR Database
  - Aims of the project
    - Generating a database with VR data on European exploration and mining activities
    - 3D-visualization of raw-materials-related information for education and public awareness creation purposes
  - Project outcomes
    - Library/ database of 3D-visualised raw materials related information: around 100 sets of information
    - Tour through European (and Australian) raw materials sites
  - Target groups for project outcomes:
    - Students in higher education
    - Society

Future projects: VR database/handbook of European mining and exploration activities

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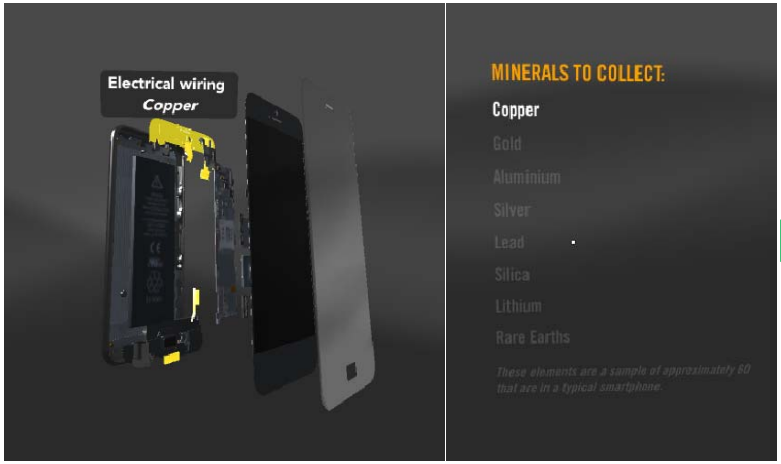
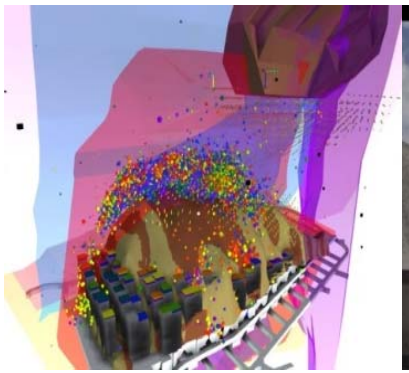
- Existing solutions at UNSW:
- UNSW has been a world leader in VR technologies for mining over the last 15 years
- From flat screen, to curved screen, to VR headsets





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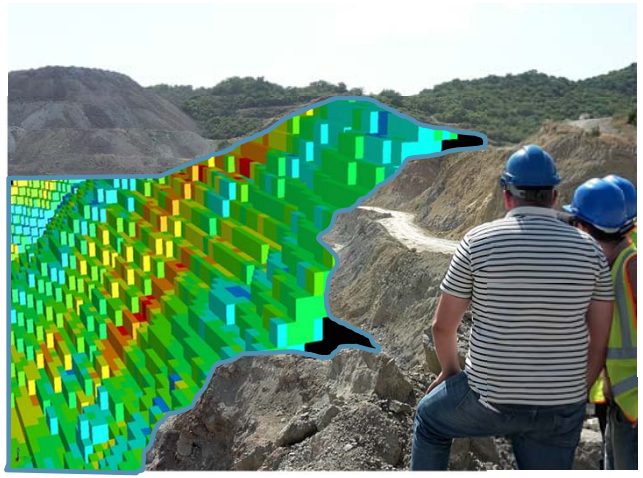
Future projects: Mixed reality solutions for exploration and mining involving hololens technology

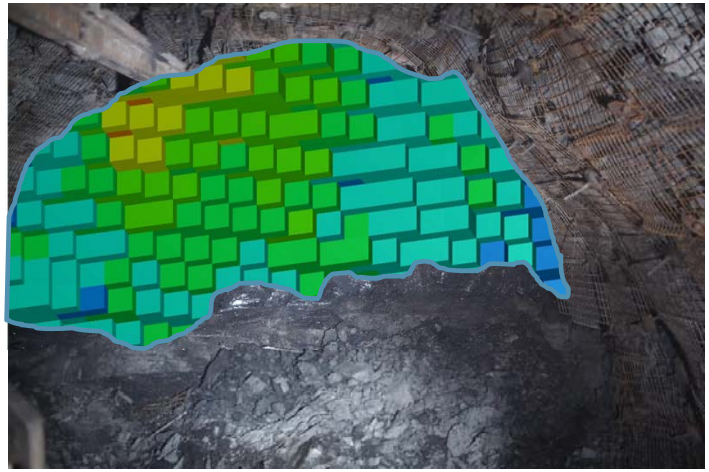
- The development of mining projects comprises a lot of disciplines: Geology, Mining, Metallurgy etc.
- And a lot of parties with different interests: Investors, Financial institutions, Governmental authorities etc.

Team work → Visualisation → Better Understanding

Open pit mining



Underground mining

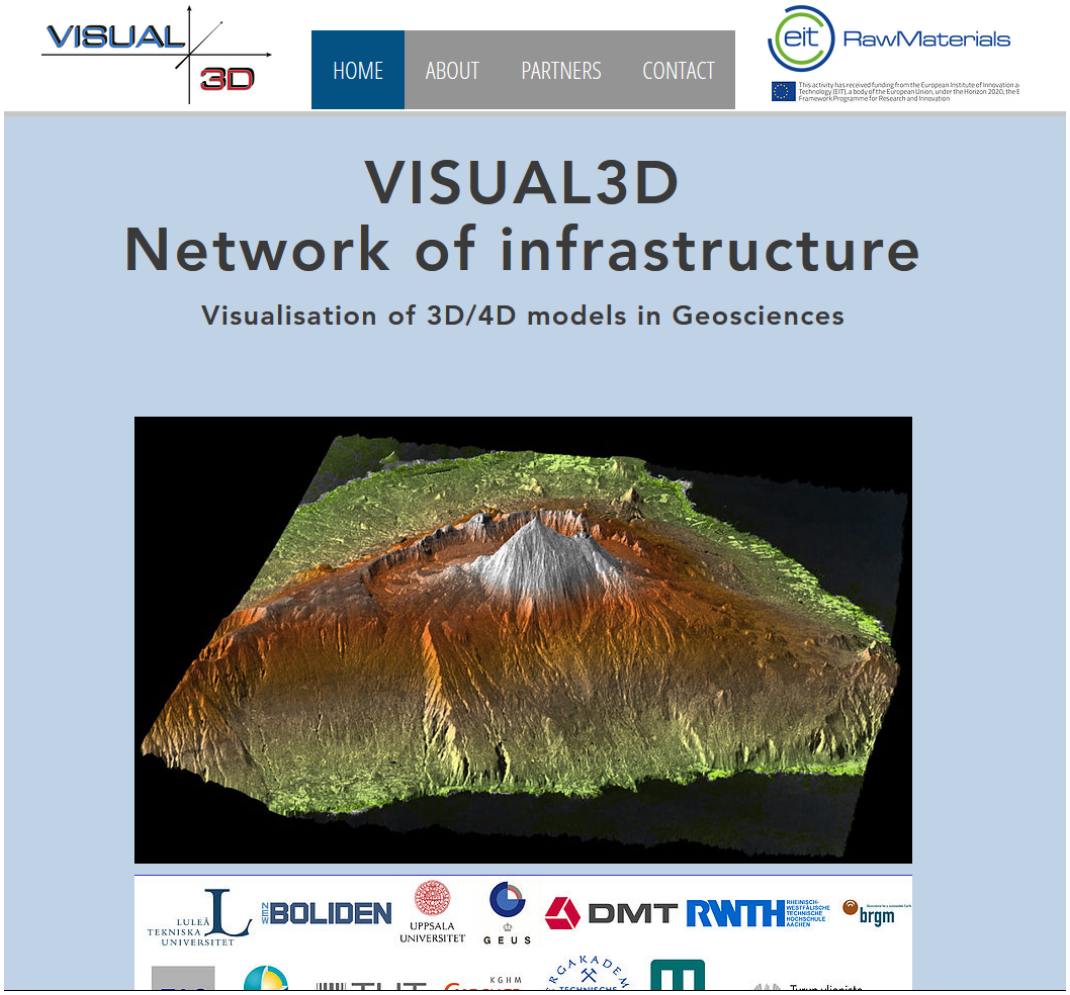


Geotechnical risk assessment

Additional information:

- **Visit our website:**

www.visual3d.info



Virtual Reality @ LTU

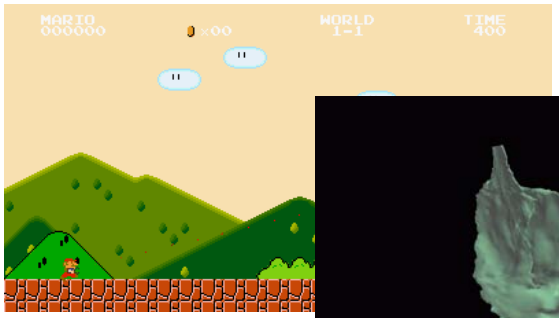
Why VR?

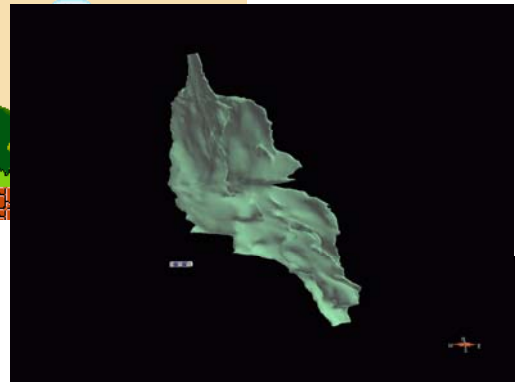
- Regular computer screen: depth cue is motion parallax
  → constant rotation of data required to perceive depth

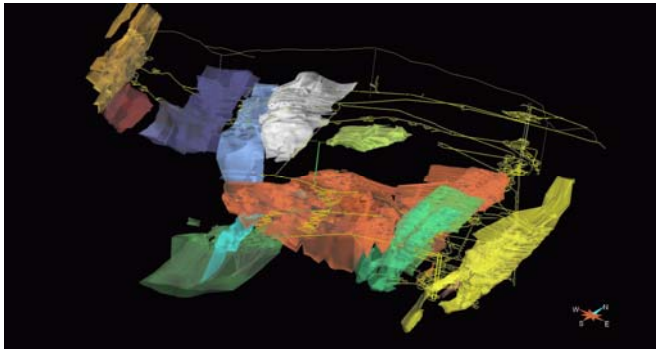
But: motion interferes with detailed examination or

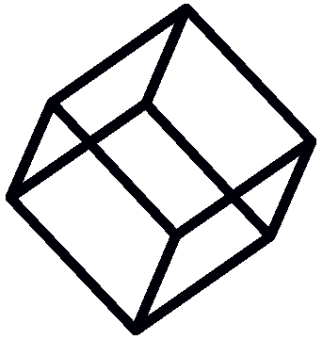
measurement of the displayed data

- Advantage of the way the brain already interprets visual information → evaluating and analysing Earth science data and simulations, including use of peripheral vision to provide global context, bodycentric judgements about 3D spatial relations
- More natural environment, more efficient exploration of 3D data









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Virtual Reality @ LTU

VR studio

- Inauguration: 16th March 2017
- Hardware:
  - 6 x 2.1 m screen (250’’)
  - 2 x 4K back-projection
  - wireless hand- and head-tracking
  - active 3D shutter glasses
- Software:
  - GeoVisionary
  - Unity
  - 3D Studio Max

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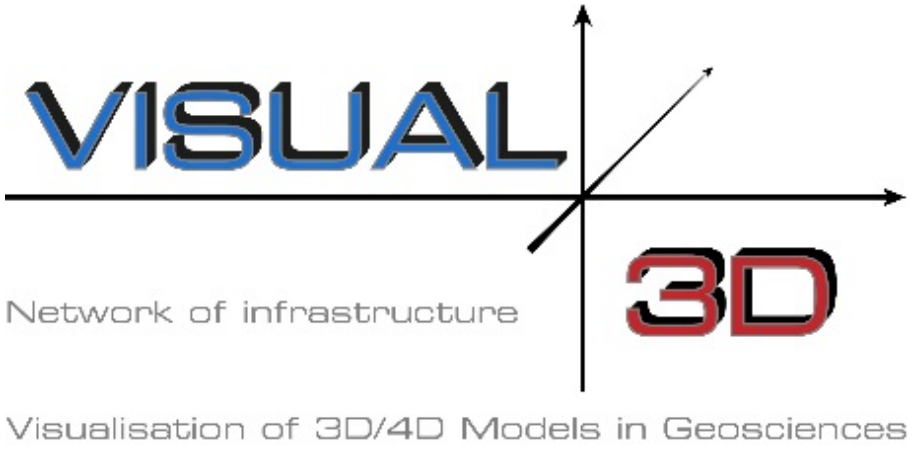

Thanks for your attention!

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