



V-Rock transporte le rocher à TU Delft

Dominique Ngan-Tillard

9-6-2025

BRING THE FIELD TO TU DELFT



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First, we built the rudimentary VR environment used as a necessary backbone for developing an engaging VR teaching tool that immerses students into the digital twin of Bellmunt's rocky environment. In this VR environment, students learn how to secure their working surroundings, before being guided through a suite of observations and measurements that are essential for characterizing a rock exposure.

Second, we optimized VROCK to offer the student a multi-scale multi-sensorial immersion and enhance their 3D spatial awareness. We also embedded into VROCK didactic elements that elevate the learning experience of the students.

THE VROCK EXPERIENCE



THE VALIDATION



To quantify the added value of the developed tool, we are integrating VROCK into three courses at both BSc and MSc levels in the field of engineering and geology. In these courses, the VROCK team quantifies the benefit of the virtual tool before and after real fieldwork. This surveying will allow us to improve the relevance of VROCK for various applications.

OUR AMBITION

Make VROCK a benchmark tool that boosts students' confidence when encountering real outcrops for the first time.

This advantage will accelerate the acquisition of more in-depth scientific skills during essential real-world fieldwork.

VROCK offers tailored teaching in a secure environment and contributes to inclusive education.

Dominique Ngan-Tillard, Pierre-Olivier Bruna, Hugo Oostman, Palash Kachhy Jeroen Boots, Yosua Pranata Andoko, Arno Freeke

XR Zone



Civil Engineering & Geosciences

Contenu

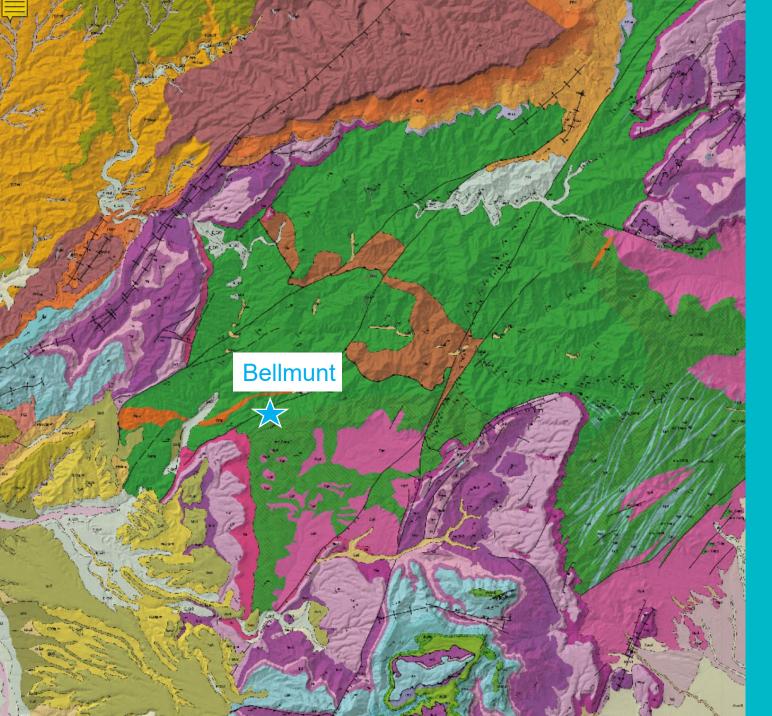


_____Objectives

De la capture d'images à la visualisation en VR

– Demo -Validation

Conclusions
Q/A



1- Objectives

V-Rock, outil de **Réalité Virtuelle** qui:

- prépare nos étudiants à leurs vrais camps de terrain
- les transporte face à un affleurement a Bellmunt, NE Spain
- leur apprend à
 - sécuriser leur environment
 - observer l'affleurement
 - recueuillir les donnés essentielles pour caractériser le massif
 - avant de les utiliser pour classifier le rocher ou mener des calculs de stabilité



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2- De la capture d'image à la visualisation en VR

- Prise de vues par drone
- Approche photogrammétrique Structure from Motion (SfM)

Filtrage, Alignment, Géoréférence des images Création d'un nuage de points dense, élimination des points peu fiables, Maillage, Nettoyage Decimation, exportation (inages texture+ maillage+ nuage)

 Extraction des familles de discontinuités

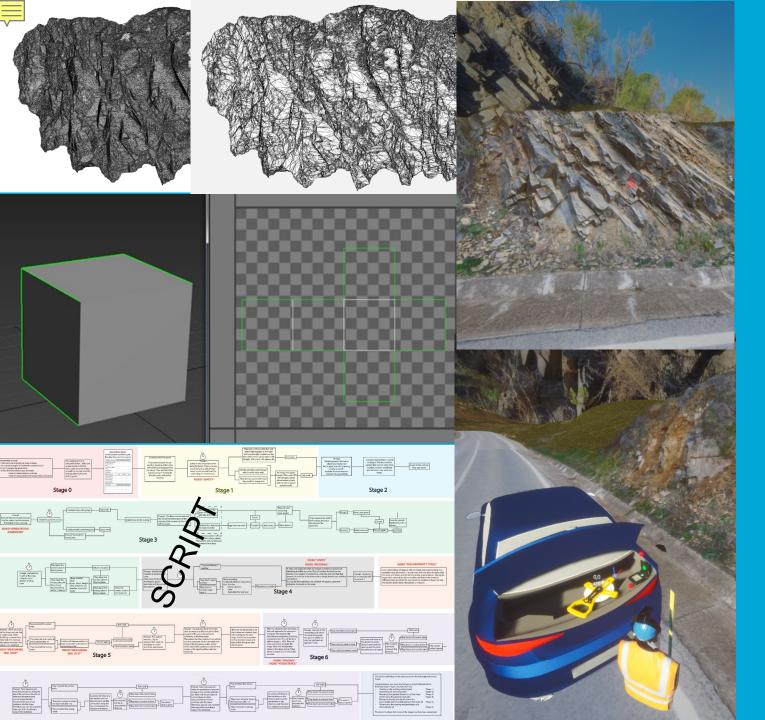


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2- De la capture d'image à la visualisation en VR

- Optimisation du modèle en VR
 - Lissage, réparation et décimation du maillage
 - Inversion des normales et fusion
 - Ajout des couleurs et autres par dépliage des coordonnées UV
 - Représentation de la Région d'intérêt en haute résolution
 - Elargissement de la scène
- Boîte à outils géologiques
- Implémentation du script



3- V-Rock demo

- Classe d'initiation aux contrôleurs
- Plusieurs perspectives
- Aide à la demande
- Travail en binôme
 - l'homme de terrain
 - la pilote du drone et son laser



Après la journée de terrain



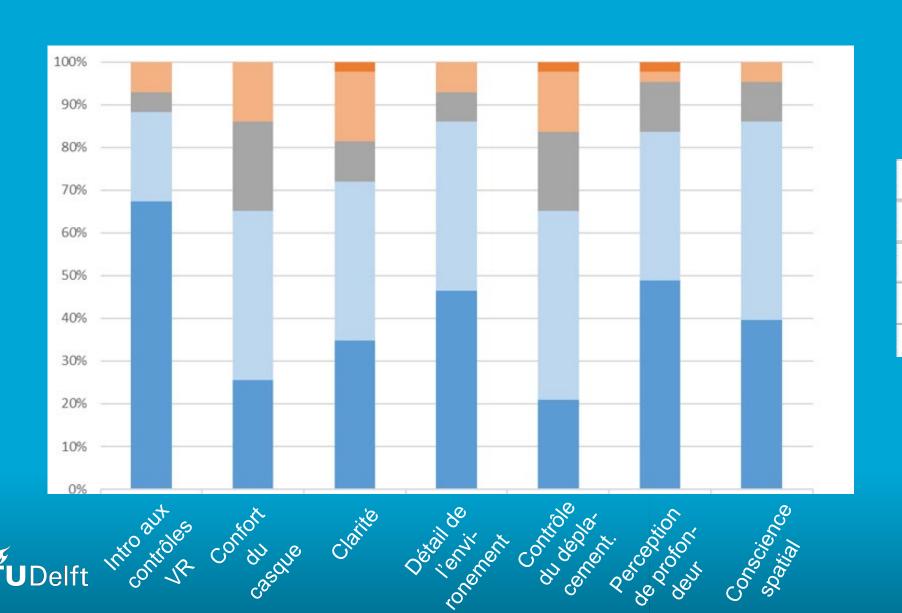
4- Validation

- Implementation en cours de mécanique des roches/ géologie de l'ingénieur- BSc/ MSc
- Enquête sur le niveau de confort et confiance des étudiants

Evaluation des performances



4- Validation – Qualité de l'expérience VR

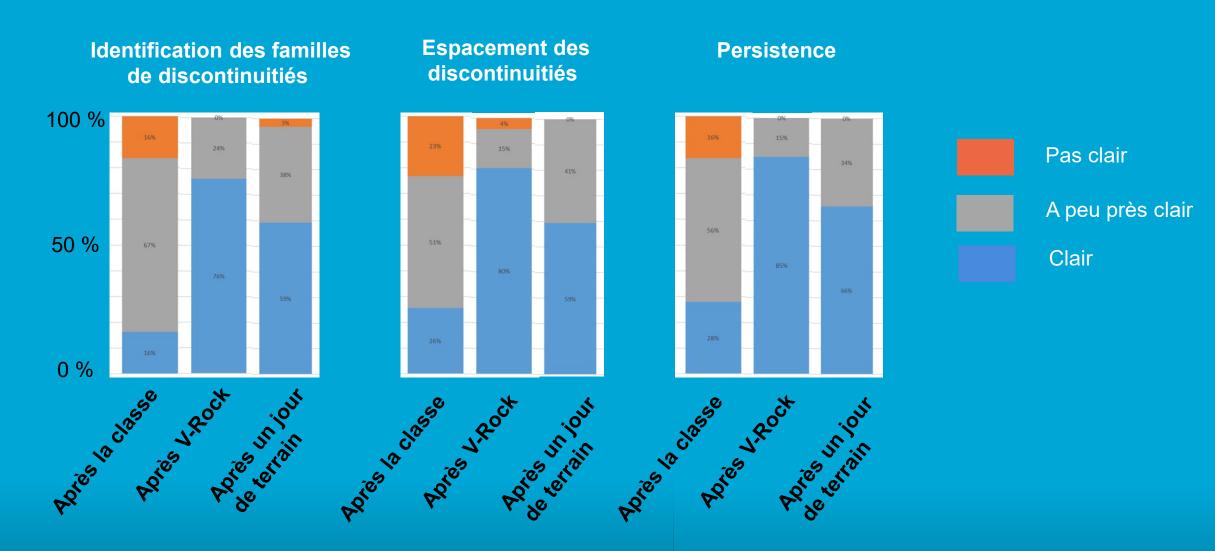


MécontentAssez mécontentNeutreAssez satisfait

Satisfait



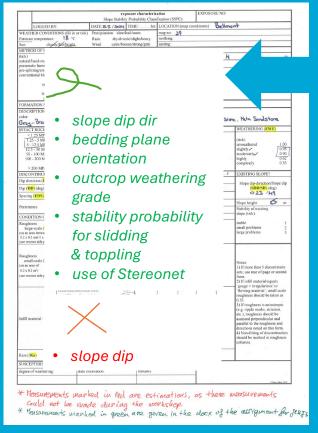
4- Validation - Niveau de confiance



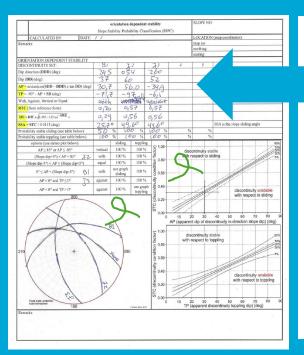


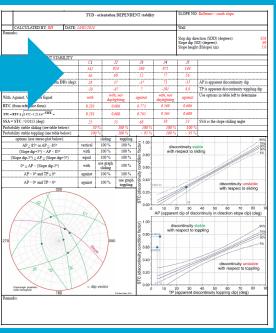


4- Validation - Didactique - Performance



| | TUD - exposure characteriz | | | | | |) | EXPOSURE NO: Bellmunt - south slope | | | | | |
|--|---|--|--------------------------|--|--|---|---|--|------------------|---|--|--------------------------------------|--|
| LOGG | ED BY: HO/I | en Da | | E: 16:30 hrs | s LOCATION (map coordinates) Beli | | | | | | | | |
| WEATHER CONDIT | | | ecipitation: | | | map no: | · (map coo | · comment | Deminin | | | | |
| Estimate temperature: | 20 °C | Ra | | y/drizzle/sl | | northing: | | | | | | | |
| | fair/bright/a | | | lm/breeze/s | | easting: | | | | | | | |
| METHOD OF E | VTION (EM | E) | | l exposure | CESSIBILIT | | | | | 6 m | | 4 m | |
| THE STATE OF THE S | | 1.00 | | on this for | | length: | | 60 m h | | | depth: | | |
| | | 0.76 | | on this for | | length | | 10 m h | eight: | 5 m | depth: | 3 m | |
| mat cri | eks: et rock: utact rock: | 0.77 0.75 0.72 0.67 0.62 | | | original field | Serm) | | | | | | | |
| FORMATION N | Carbonifere | nus slate | | | | | | | | | | | |
| DESCRIPTION (BS 5930: 1999): olor: dark grey (sand- stitistone) brown grain size: medium to fine sand stred sand stred | | | | | flaky weathering: slightly (/ziltztone); moderate (/slate) | | | and- NAME: Interlayered meta sand-stiltstone & slate | | | | | |
| NTACT ROCK STRENGTH (EIRS) (tick) | | | | | | sample number(s): | | | WEATHERING (EWE) | | | | |
| «125 MPs Crumbles in hand 125 - 5MPs Thin alable break entity in hand 5 - 125 MPs Thin alable break entity in hand 5 - 125 MPs Thin alable break entity in hand 125 - 50 MPs Limpt broken by light hammer blows 100 - 200 MPs Limpt broken by heavy hammer blows 100 - 200 MPs Rocks ring on hammer blows. Sparks fry | | | | | l ringing | | | | | (tick) unweath slightly modera highly comple | tely | 1.00 0.95 0.90 0.62 0.35 | |
| DISCONTINUITY SE | | | | | C1(*2) | J2 | J3 | J4 | J5 | EXIST | NG SLOPE/V | ALL? | |
| Dip direction (DDD) (| deg): | | | | 342 | 054 | 260 | 073 | 5 144 | Slo | Slope/wall dip-direction/ | | |
| Dip (DD) (deg): | | | | | 36 | 60 | 52 | 77 | 56 | - | Slope/wall d | ip | |
| Spacing (EDS) (m): | | | | | 0.25 | 0.50 | 0.25 | 0.1. | 5 0.30 | | (SDD/SD) (deg) 026/60 | | |
| along stnke (m): | | | | | >1 | >1 | >1 | >1 | >1 | Slope/v | Slope/wall height: 5 m Stability of existing slope/wall (tick): | | |
| Persistence along dip (m): | | | | >6 | >5 | >2 | >5 | >2 | | | | | |
| CONDITION OF DIS | CONTINUIT | TES | | | | | | | | | all (tick): | | |
| Roughness large-scale (RI) (on an area between 0.2 x 0.2 and 1 x 1 m²) (see reverse side page) | wavy: 1.00 slightly wavy: 0.95 curved: 0.85 slightly curved 0.80 straight 0.75 | | | | 0.75 | 0.80 | 0.85 | 0.75 0.80 | | stable small pr large pr | stable 1 small problems 2 large problems 3 | | |
| Roughness small-scale (Rs) (on an zero of 0.2 x 0.2 m²) (see reverse side page) | rough stepp smooth step polished ste rough undu smooth und polished un rough plana smooth plan polished pla | ped pped lating ulating dulating r sar | | 0.95 0.90 0.85 0.80 0.75 0.70 0.65 0.60 0.55 | 0.60/0.75 (*3) | 0.75 | 0.90 | 0.7. | 5 0.75 | sets; use form. 2) If inf | If more than 5 discontinuity sets; use rear of page or second form. If infill material equals | | |
| Infill material (Im) | sheared material, e.g. m free of clay, talc, etc. fi | | | 1.07 1.00 0.95 0.90 0.85 | 0.55 | 1.00 (*5) | 1.00 (*5) | 1.00 (*5) | 0 1.00 | 0.55. 3) If ros | 3) If roughness is anisotropic (e.g. ripple marks, striation, etc.); roughness should be assessed perpendicular and parallel to the roughness and directions noted on this form 4) Non-fitting of discontinuities should be marked in roughness | | |
| | | | coarse medium fine | 0.75 0.65 0.55 0.42 0.17 | (*4&*5) | | | | | parallel directio 4) Non- should | | | |
| | flowing ma | eguiarities terial | | 0.05 | İ | | | Ĺ | | column | s. | | |
| Carst (Ka) none karst | | | 1.00 0.92 | 1.00 | 1.00 | 1.00 | 1.0 | 0 1.00 | 1 | | | | |
| SUSCEPTIBILITY TO | WEATHER | ING (SW) | | | | • | _ | remark | s: All compas | s readings : | in 360 deg froi | n North | |
| degree of weathering: date excavation: | | | | remarks: | | | (000) over East (090); magnetic declination correction set to 0 deg. | | | | | | |
| Weathering from slightly to 1995? moderately: Sand-altitions: > 50 year, Slate: 20?? year | | | | in slaty clears *5 Washed material m | vers consider avage discon down weath esent on all ty planes, bu | "I Exemuted by exervator/pneumatic hammer. Damaged rock already fallen off, hence, no damage at present. "2 Bedding/cleavege, "3 Smooth planar: too conservative; Smooth undulating: too optimistic: hence: average | | | | | | | |





Étudiants

Expert

Étudiants en VR

Expert sur site





Gestion des risques post-miniers

Inspection de mine en chambre et pilliers













5- Conclusions

V-Rock, outil didactique

- renforce la confiance des étudiants lorsqu'ils rencontrent des affleurements réels pour la première fois.
- accélère l'acquisition de compétences scientifiques plus approfondies lors des camps de terrain essentiels.

V-Rock, outil évolutif

- peut intégrer des dimensions sensorielles pour une immersion renforcée
- peut accélèrer à d'autres apprentissages





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