
HE VD
IG

Utilisation de l’IA pour le relevé automatique des réseaux souterrains

Adrien Gressin

AI Days, 07.02.2024

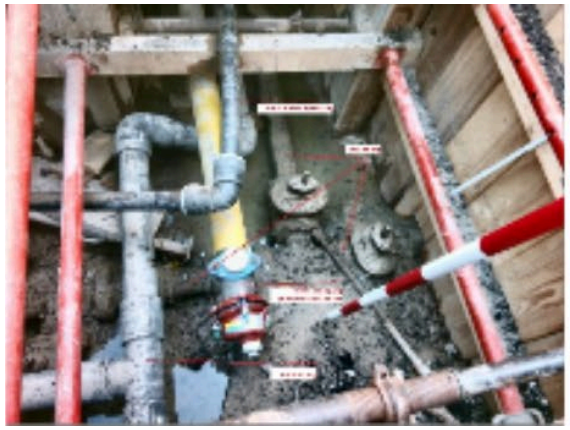
Updating the underground cadastre

- Complex task (2 surveyors)
- Field work (travel, hazards...)
- Coordination with construction teams

  → Slow, complex and costly !

Potential for simplification and automation?

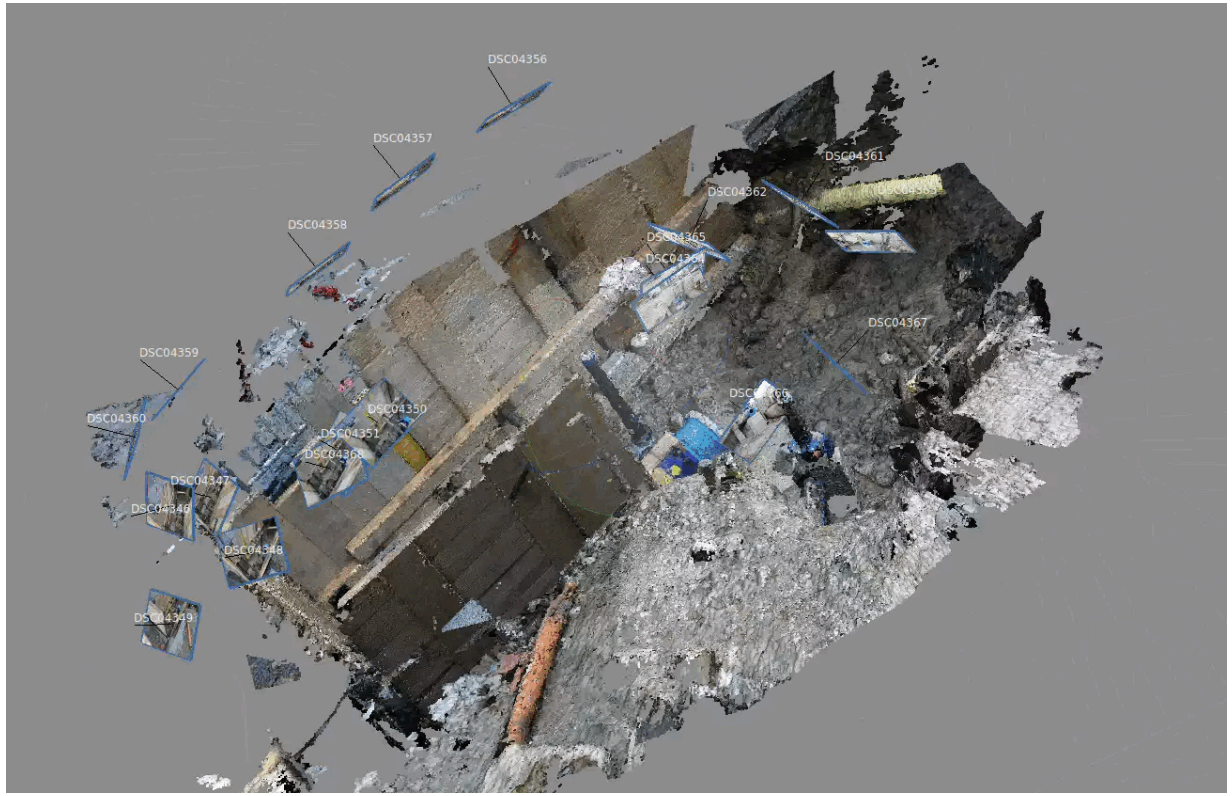
- INDG + Innosuisse project with Industrial Services of Geneva and Lausana



3D object extraction (multi-stereo)

Idea: Taking advantage of multi-stereo

- Images use
  → many existing algorithms
- Richer than ortho-image
  → fewer hidden objects, redundancies
- Easier than with a 3D point cloud



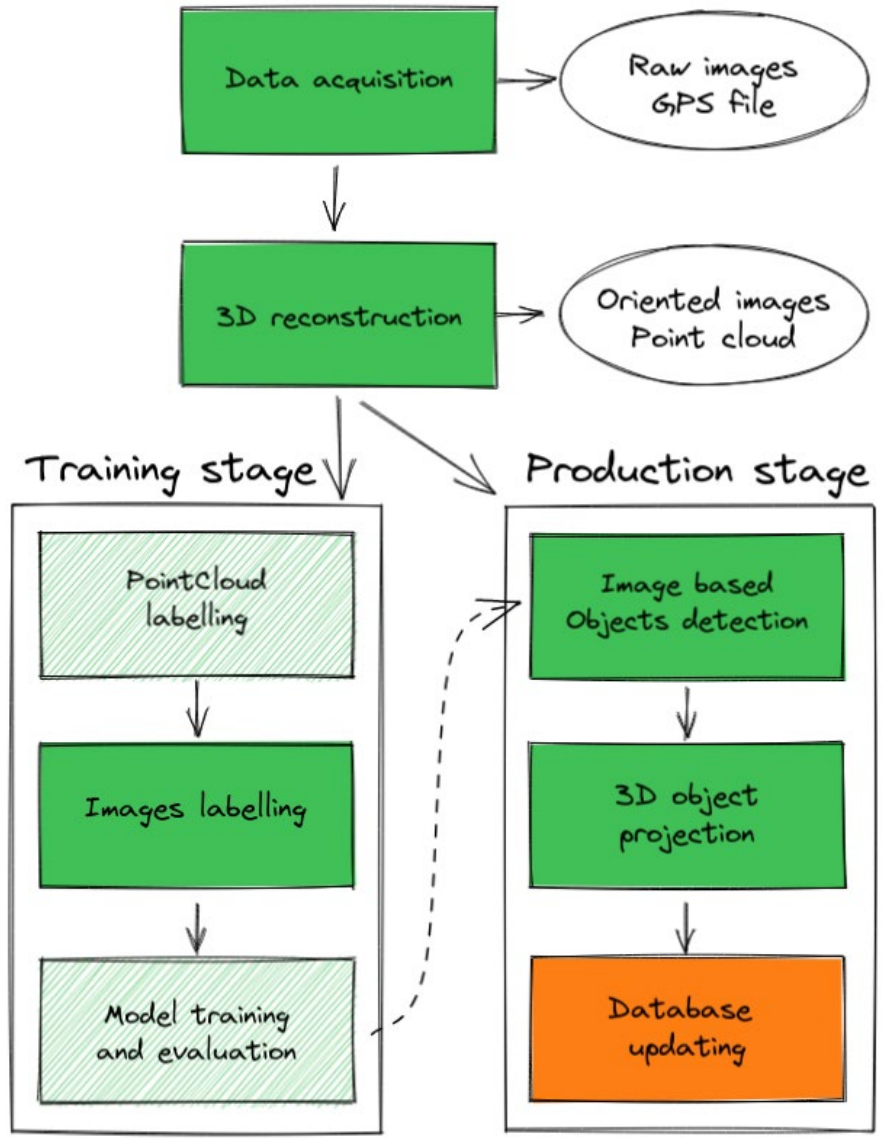
3D object extraction (multi-stereo)

Method

- Image based object detection
- 3D projection (photogrammetry)

Automation

- Collected data checking
- 3D reconstruction (photogrammetry)
- Image labelling
- 2D / 3D Detection
- Database updating



3D object extraction (multi-stereo)

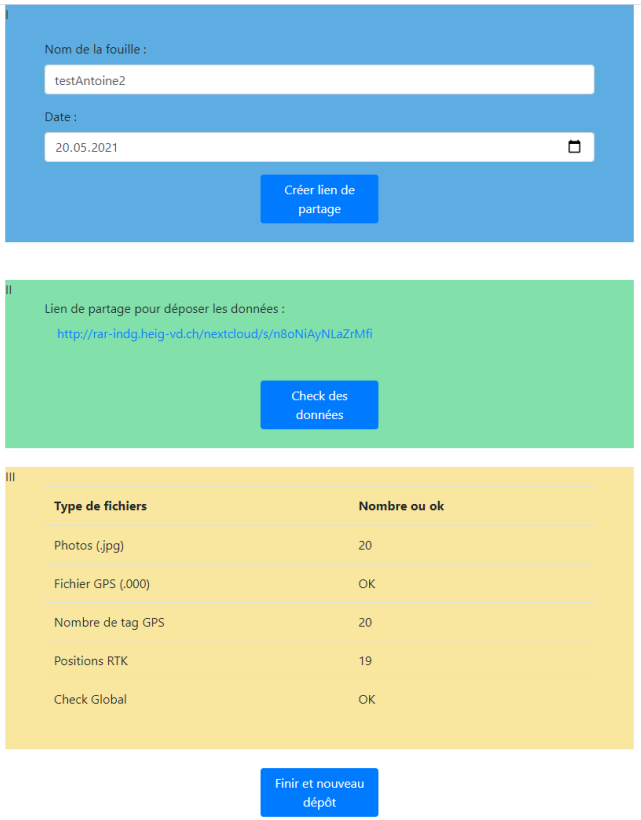
Data collection

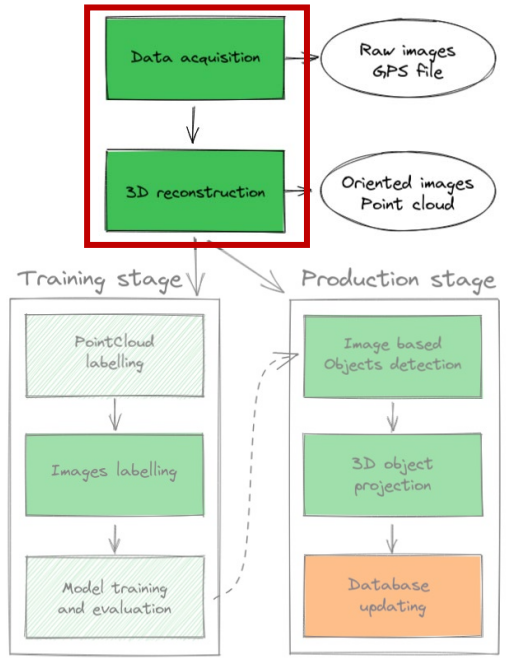
- Web interface for data repositories
- Private cloud repositories
- 1st data control (images / GNSS)
- Automatic 3D reconstruction

Nextcloud

python™

Metashape



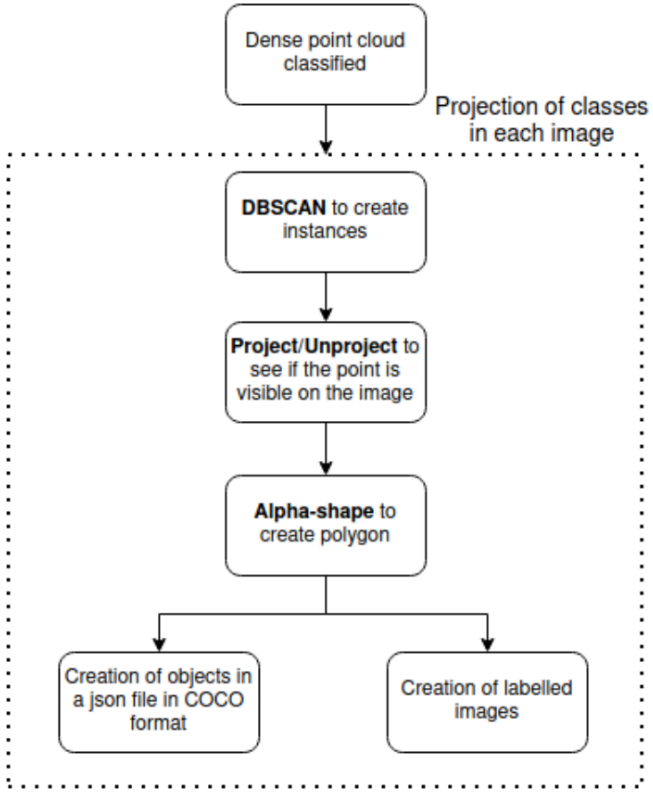


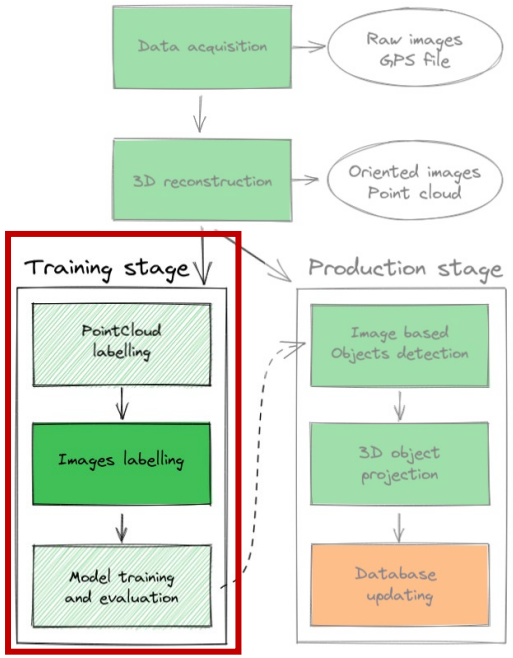
A. Carreaud, K. Lisb , A. Gressin, Fast Image Labelling using 3D reconstruction, Swiss Geoscience Meeting, 2021.

3D object extraction (multi-stereo)

Learning

- Manual labeling of the 3D point cloud
- Automatic projection into images





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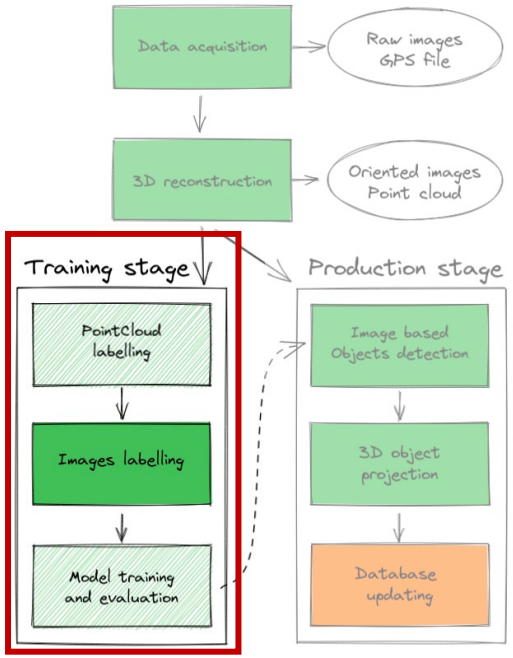
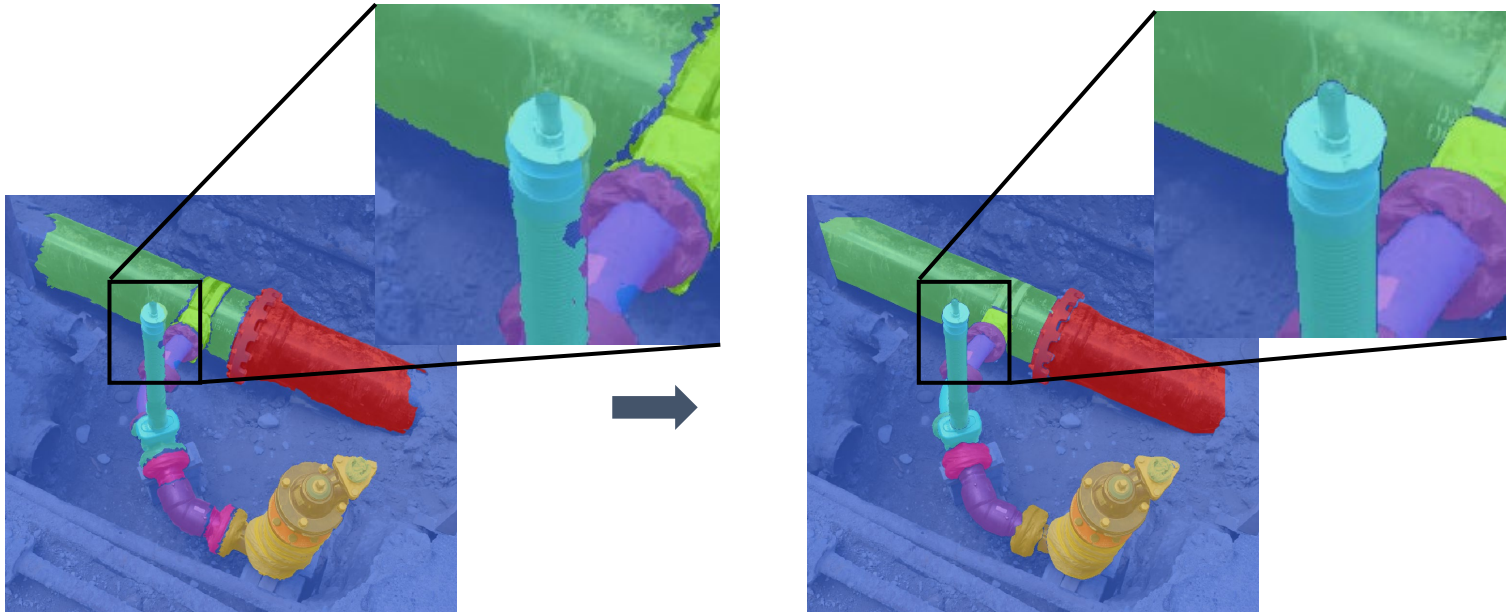
3D object extraction (multi-stereo)



Learning

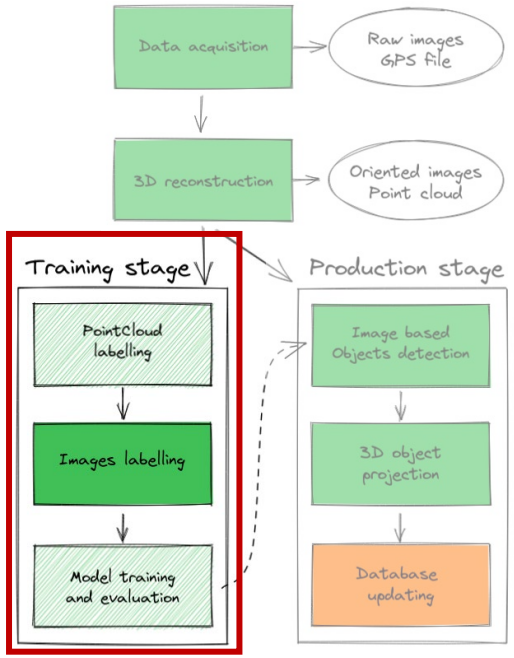
- Manual labeling of the 3D point cloud
- Automatic projection into images
- Using SAM to improve automatic masks



Mask automatic

Improved by using SAM

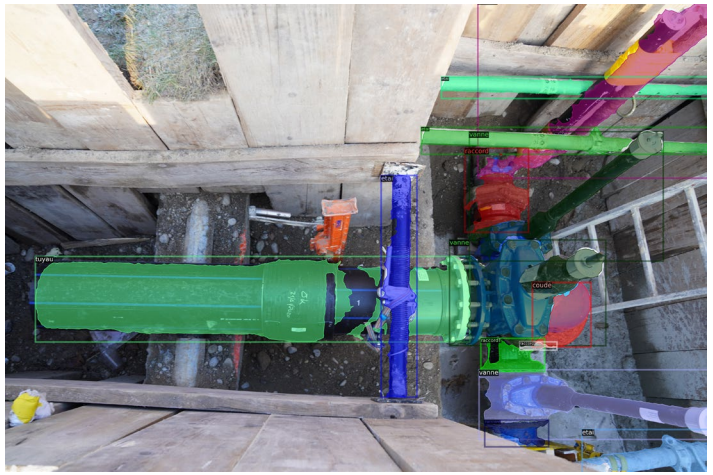
3D object extraction (multi-stereo)

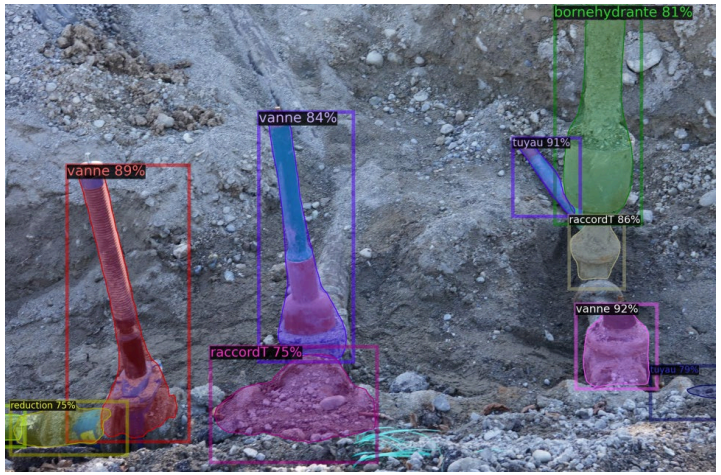


Learning

- Manual labeling of the 3D point cloud
- Automatic projection into images
- Using SAM to improve automatic masks
- **Training of the DL object detector (Mask-RCNN → ViT)**

Dataset			Total time labeling		Classification
Task	# images	# classes	Manual (estimated)	Semi-automated	mIoU
Object detection	1500	20	175 h.	5 h.	93.4 %

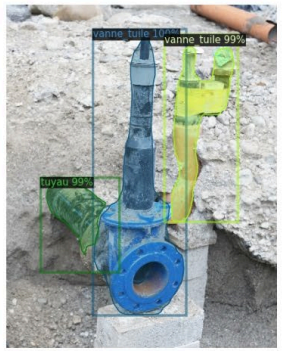


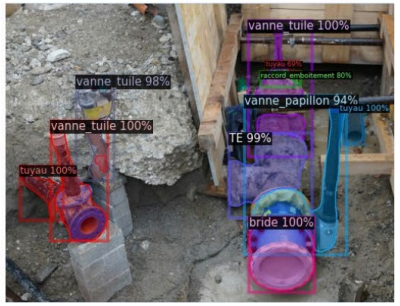


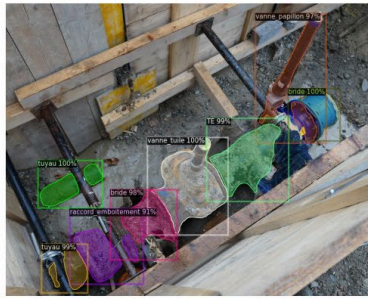
3D object extraction (multi-stereo)

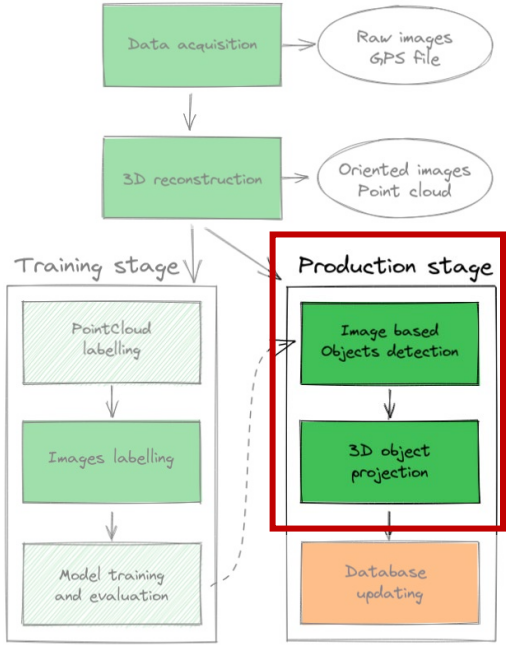
Production

- Image based object detection
- 3D reprojection
  - Depth maps masking
  - By class 3D reconstruction







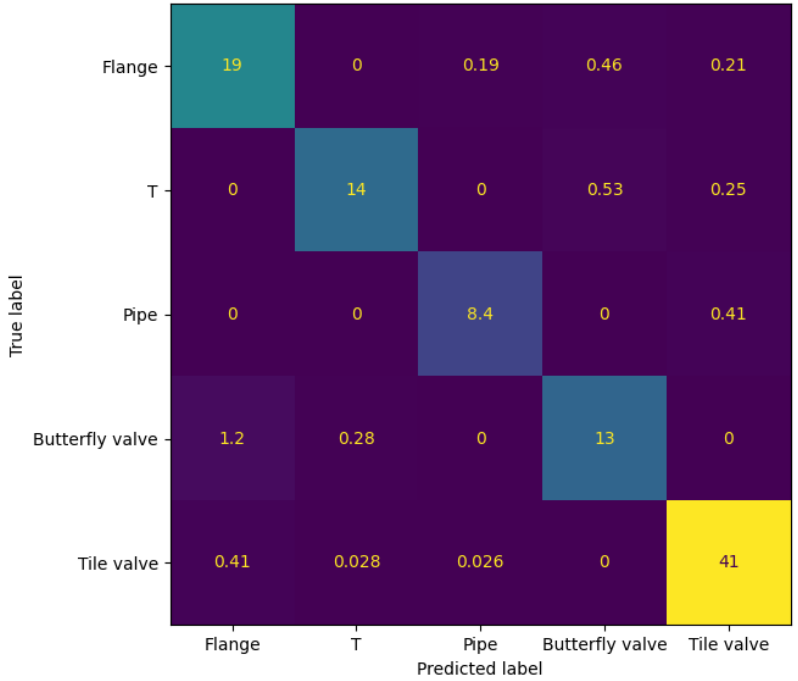


Updating the underground cadastre

Results

	User Acc. [%]	Producer Acc. [%]
Flange	92.1	95.7
T	97.9	97.9
Pipe	97.5	95.3
Butterfly valve	93.2	90.0
Tile valve	97.9	98.9
Overall Accuracy = 96.0 %		

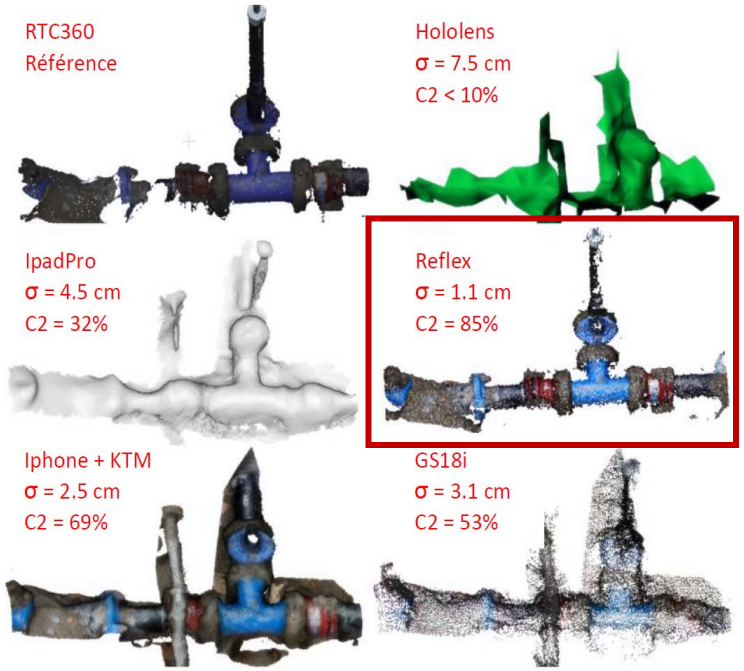
User Accuracy and Producer Accuracy obtained on each class and Overall accuracy on 3D point cloud.



Confusion matrix on 3D point cloud

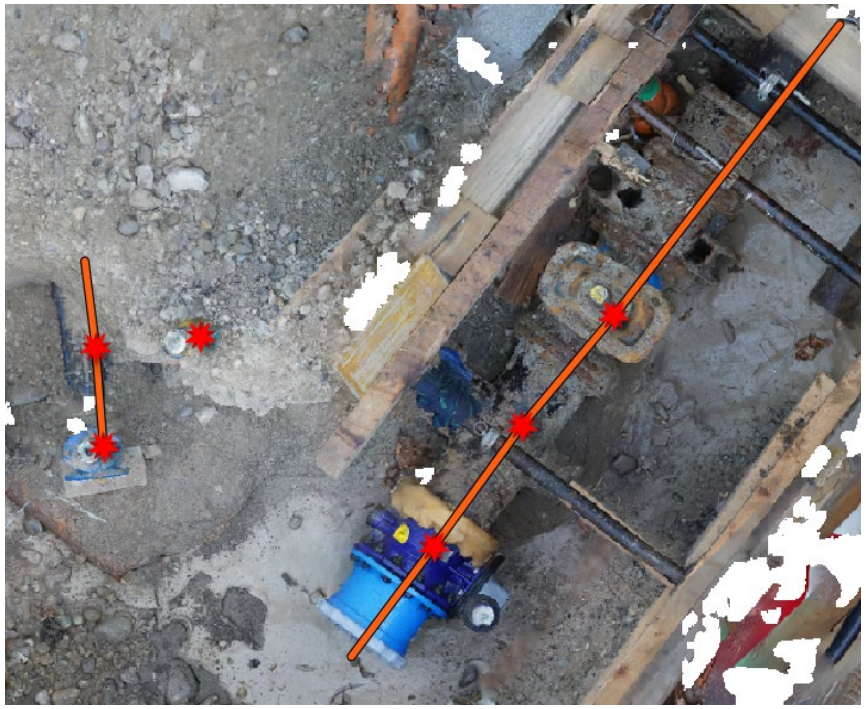
Updating the underground cadastre

Results



Updating the underground cadastre

Skeletonisation of 3D classified point cloud

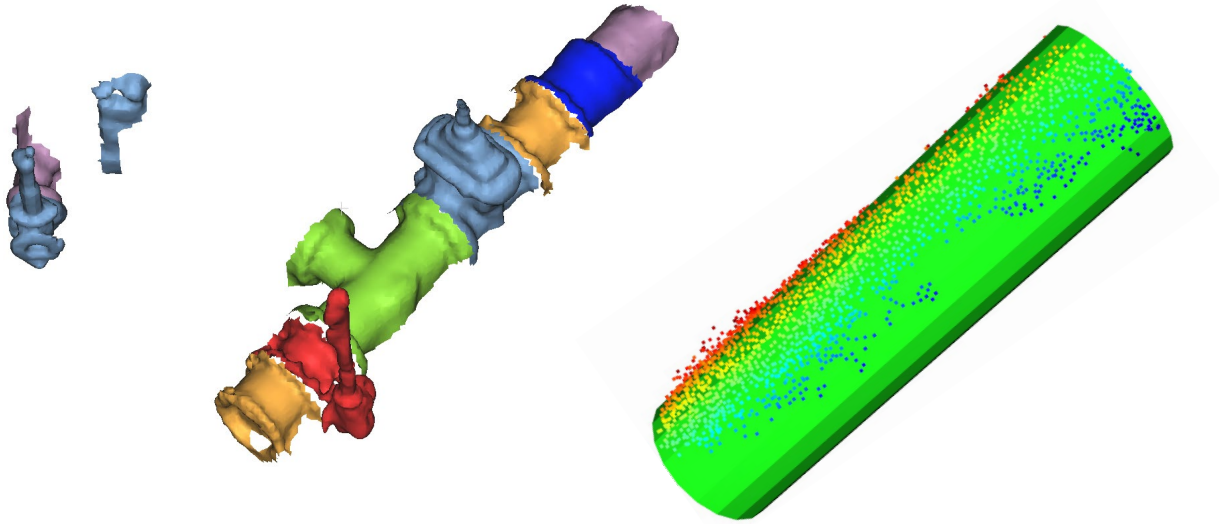


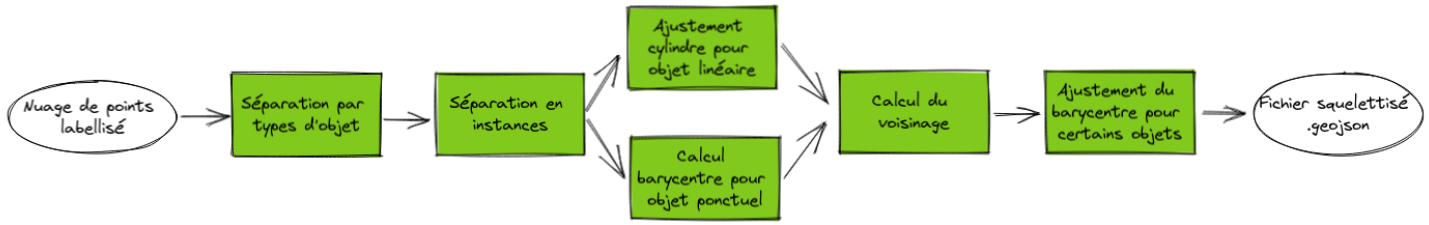
Updating the underground cadastre

Skeletonisation of 3D classified point cloud

Processing steps :

1. Instance split
2. Shape adjustment
   i. If point object → Barycentre
   ii. If linear object → Cylindre
3. Neighbouring objects research
4. Barycentres adjustment



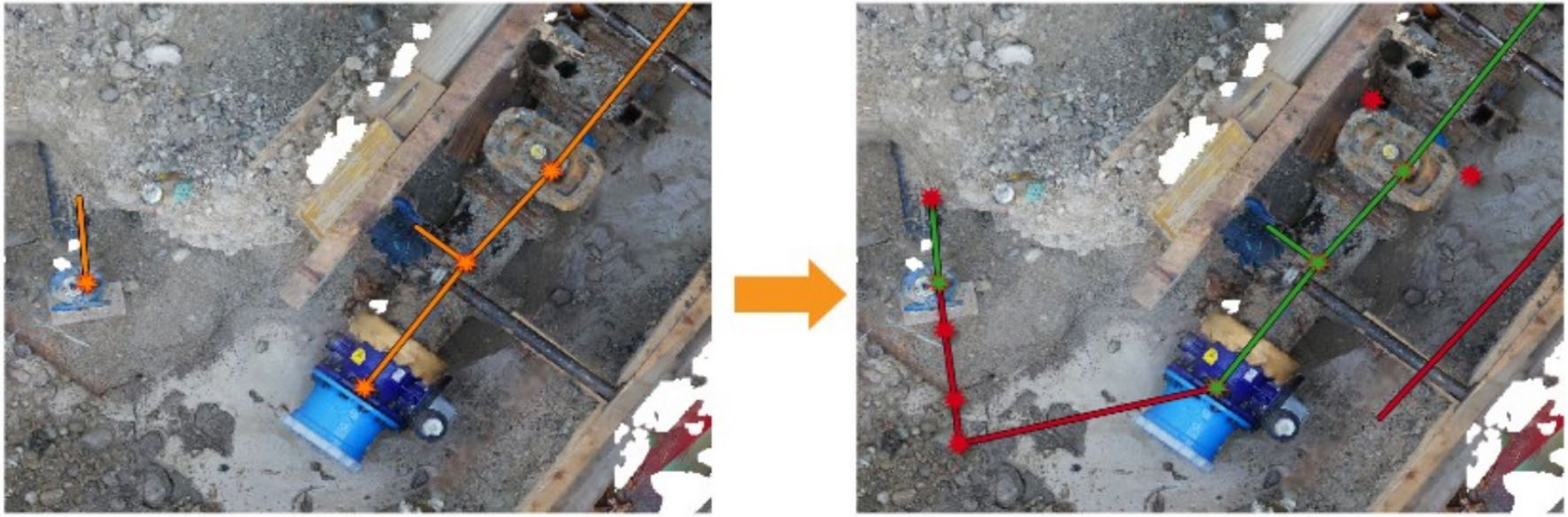


Before

After

Updating the underground cadastre

Topology verification (symbolic reasoning)



In collaboration with the University of Geneva

Conclusion

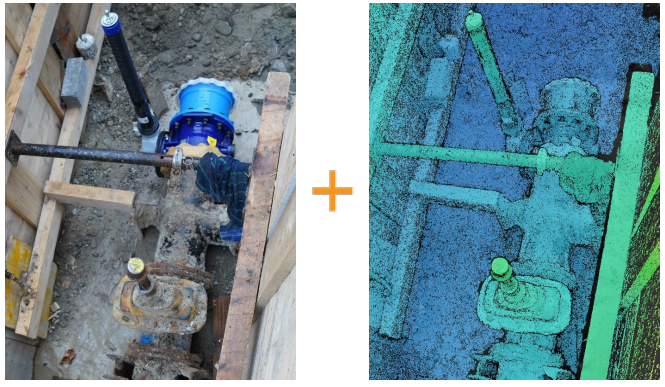
- Development of a generic method for 3D objects extraction
- Class-independent (custom learning)

  → Promising results on different applications

Outlook

Refinement the learning model

- DepthMap
  - → Master's thesis



Multi sensor fusion

- LiDAR + Image
  - → Doctoral thesis in progress

Towards real time?

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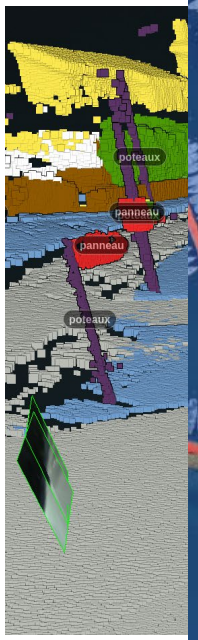
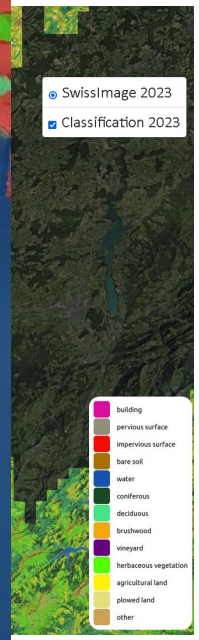
Hes·so
Haute Ecole Spécialisée
de Suisse occidentale





Projects and partners list

Magic3D : Modélisation 3D Avancée pour la Gestion des Infrastructures et des enjeux Climatiques
→ Project HES-SO avec ORBIS360 (Sion)

AutoInspect3D : Automatisation de l'inspection tridimensionnelle des réseaux de distributions d'électricité
→Project HES-SO, avec données SwissGrid, SITN, Vevey, Orbis360, Helimap System…

Creation of a RGB-IR-nDSM ViT based architecture with MAE
→ Project with Swiss Territorial Data Lab / Swisstopo

Completed projects

Obstacle detection for the safety of cycle races
→ With HES-SO Valais, Tokiwi and UCI

Updating the underground cadastre
→ INDG and Innosuisse project - with the Geneva IS, Lausanne IS, UNIGE and EPFL

Precision viticulture
→ Project «innovation cheque» with «IG Groupe», with Changins wine school

Updating Lausanne city cadastre
→ Mandat project, in collaboration with Lausanne city and Vaud canton

Solar potential of facades
→ Project FASOL/VALES funded by HES-SO et SIG, led by HEPIA

IN NUMBERS

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Projects

8

People from HEIG-VD involved