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Comparing a TLS point cloud with UAV point clouds

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Agenda

- **Motivation**
- **Conclusion**
- **Field work**
- **Office work**
- **Final note**

Motivation

- **Lerch Weber Corporation**

- Swiss surveying company
- UAV since 2011, Gatewing X100
- 2017 senseFly eBee Plus

- **2017 Trimble SX10**

- Total station
- High accuracy laser scanner



- **TLS point cloud versus UAV point clouds**

- **Gravel pits with UAV technology without GCPs?**

Conclusion

- Gravel pits with UAVs and not using GCPs?
- Yes, but RTK on the UAV required!
- Mean difference between SX10 point cloud
 - UAV point cloud **with** GCPs = 6 cm
 - UAV point cloud **without** GCPs = 10 cm
- Accuracy sufficient for most gravel pits

Field work 1

- **Gravel pit in Switzerland**
 - 200 x 200 m
 - flat areas, steep faces
 - 40 m difference in height
- **9 ground control points**
 - yellow plastic plates
 - evenly distributed, horizontally + vertically
 - GNSS Trimble R10 / Swiss VRS network



Field work 2

- 4 SX10 stations
- As "free stations"
 - 3 known points measured
 - 2 people required
- Medium point density
- $\frac{3}{4}$ hours per station
- Accuracy 3.0 mm at 200 m
- Scans merged and georeferenced in SX10



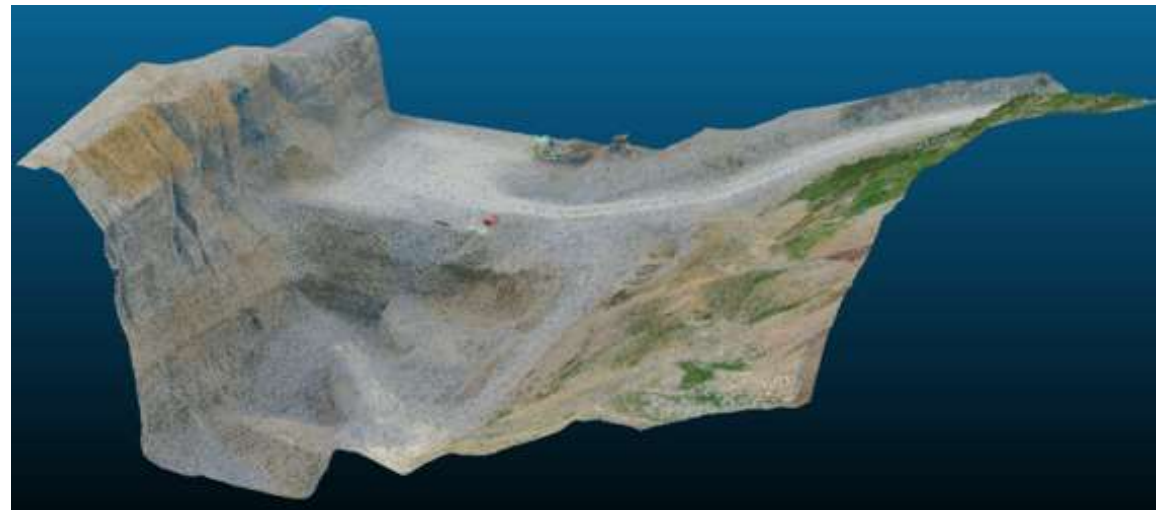
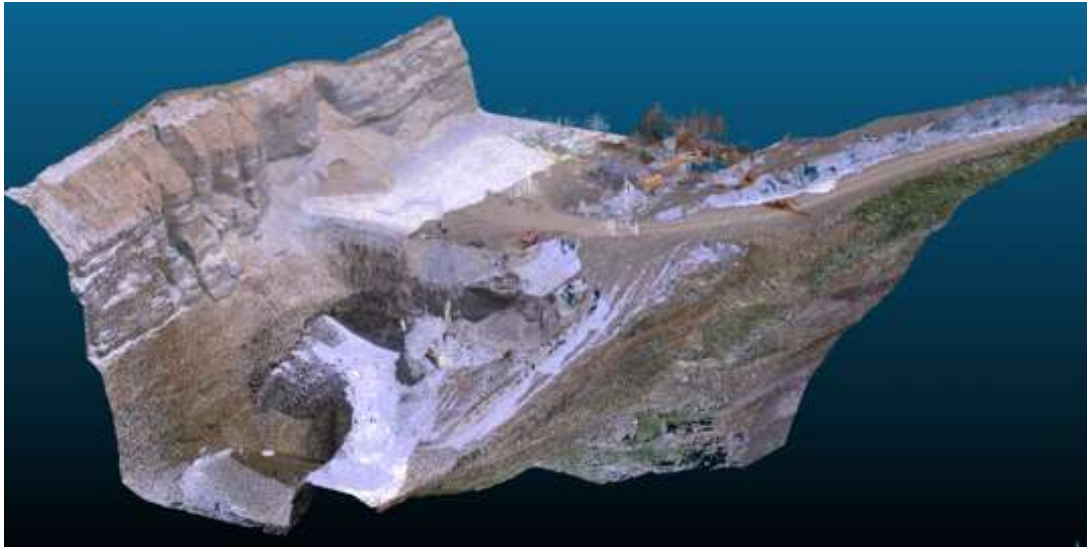
Field work 3



- **eBee Plus by senseFly**
 - 2 flights
 - 100 + 150 m above ground
- **RTK-feature turned on**
- **Planning with eMotion**
- **Swiss VRS network**
- **14 minutes / 180 pictures**



Visual results



Office work 1

- Point Cloud (UAV + RTK + no GCPs) =
Point Cloud (UAV + RTK + GCPs)
- 4 UAV point clouds
- 9 GCPs versus 0 GCPs



UAV Point cloud number	1	2	3	4
Flight number	1	2	1 & 2	1
Flight height	100 m	150 m	100 & 150 m	100 m
Ground sample distance [cm/pixel]	2.5	3.6	2.5 & 3.6	2.5
Number of GCPs used	9	9	0	0

Office work 2

- 4 UAV point clouds, accuracy a few centimetres
- SX10 point cloud, accuracy a few millimeters
- SX10 point cloud = Reference point cloud
- Comparison with CloudCompare

UAV Point cloud number	1	2	3	4
Number of GCPs used	9	9	0	0
Mean difference between SX10 point cloud and UAV point cloud [cm]	5.5	6.4	9.4	9.5
std.dev [cm]	5.2	5.9	5.9	5.8

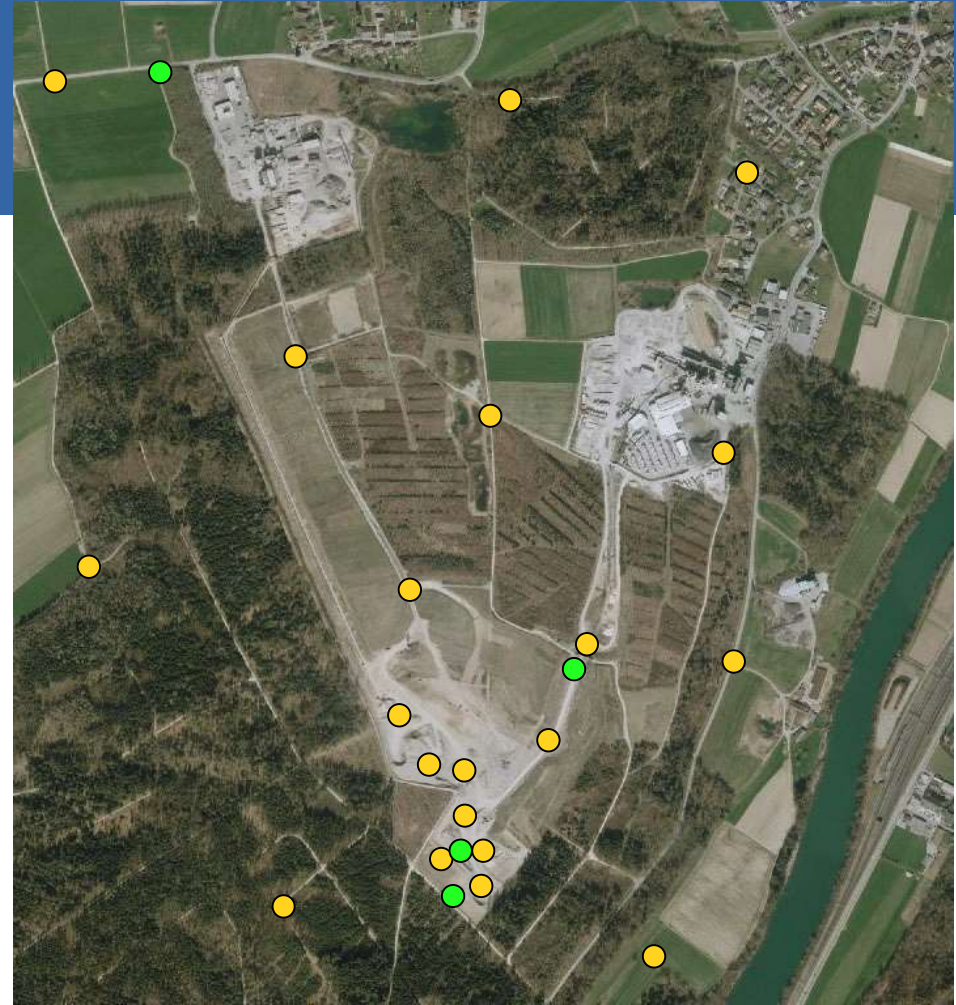
Final Note

- **Latest job**

- 2.5 km²

- **Without** RTK:
20 GCPs, 4 hours

- **With** RTK:
4 GCPs, < 1 hour



- **One measurement = No measurement**

- **RTK reduces need of GCPs enormously!**

Thank you for your attention!