



Fliegende und laufende Roboter für Suche und Rettung

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www.asl.ethz.ch

**Campus – Fabrik – Kaserne:
Innovationen für die Sicherheit**

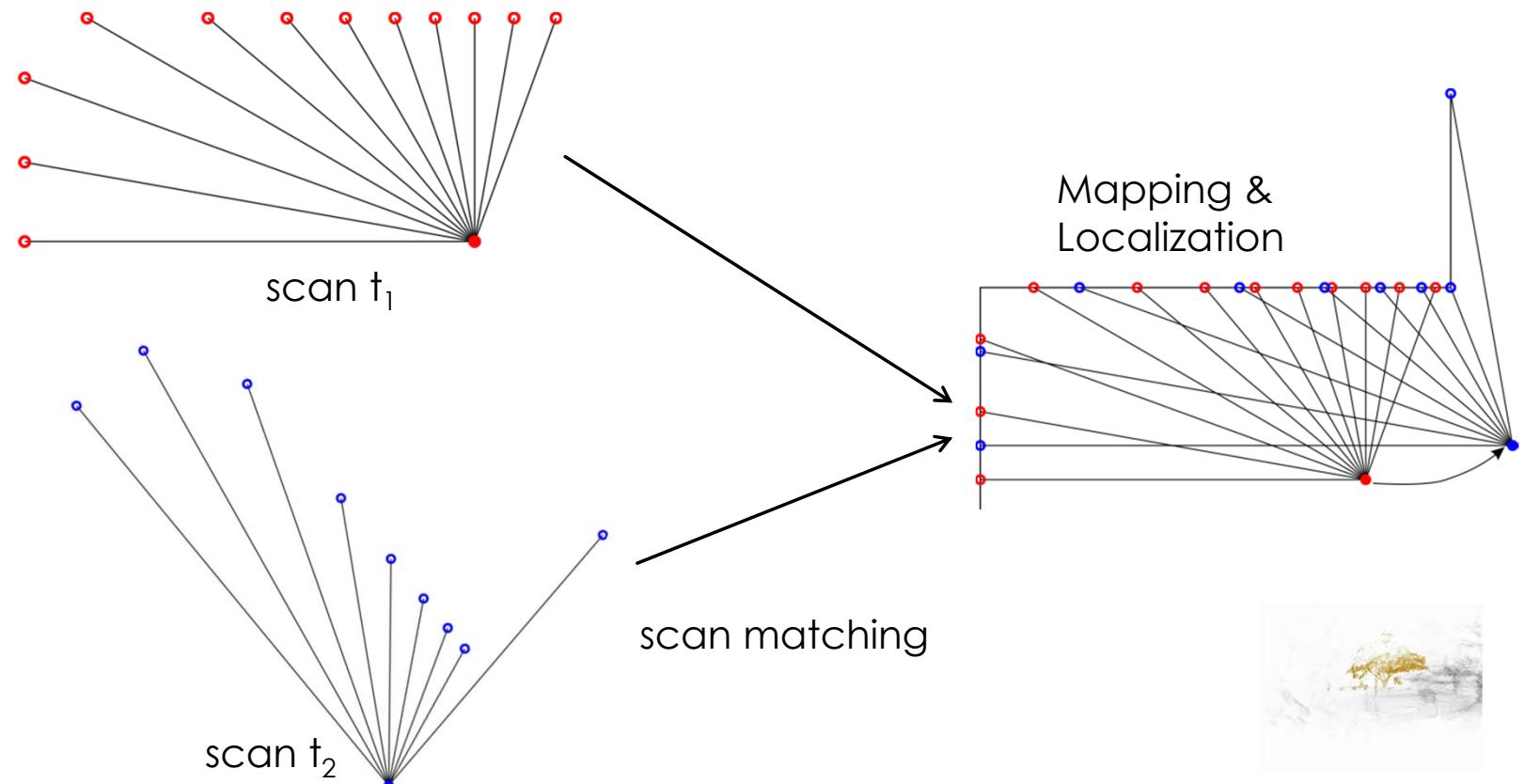
Industrieorientierung armasuisse | Herbstveranstaltung STA
Bern, 7.11.2019

Robots for Challenging Environments | Locomotion

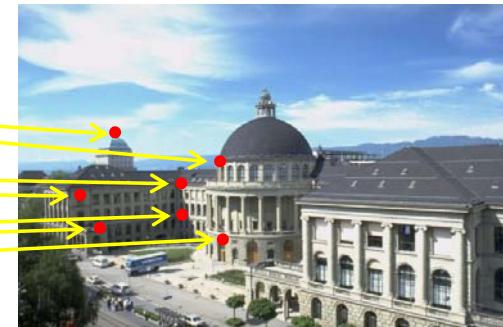
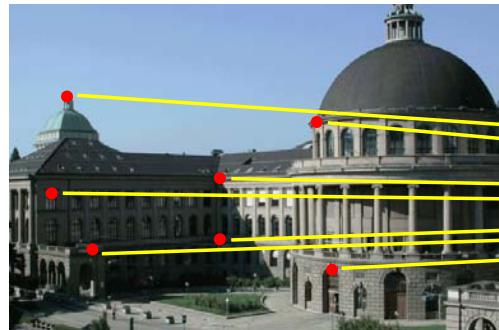
- Vertigo – developed by students
 - | the ultimate wall climber
<https://www.youtube.com/watch?v=KRYT2kYbgo4>
- ANYmal – “soft” interaction with the environment
 - | the ultimate quadruped
<https://www.youtube.com/watch?v=EI1zBTYpXW0>
- wingtra – developed by students
 - | the VTOL UAV
<https://www.youtube.com/watch?v=QADvPDWtgFU>



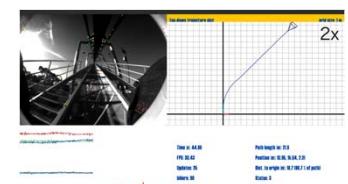
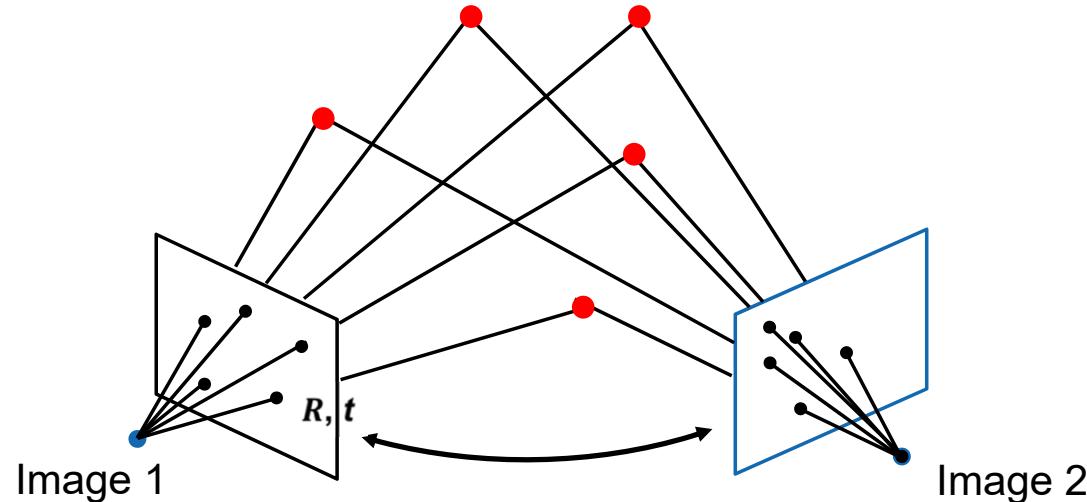
“Sehen” | Laser-basierte 3D Pläne



“Sehen” | Bewegungsschätzung mit Kamera und Inertialsensor (IMU)



Google
Project Tango



<https://www.youtube.com/watch?v=yvgPrZNp4So>

Collaborative Visual-Inertial Navigation | *teach and repeat*



A Google Tango tablet is used to teach the path of an inspection mission.



<https://www.youtube.com/watch?v=pDIQxsOrgI4>

Drones in Search and Rescue | collision avoidance and path planning

- real time 3D mapping (on-board)
- optimal path planning considering localization uncertainties



<https://www.youtube.com/watch?v=49WiPHkkhBw>

ANYmal | walking robots in the field

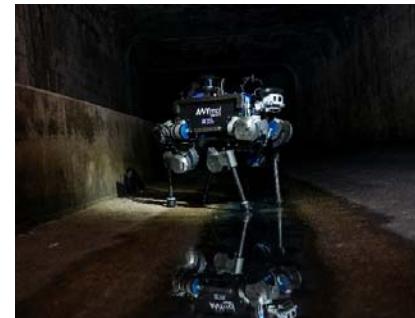


Prof. Marco Hutter



Search and rescue

ARCHE
ADVANCED ROBOTICS



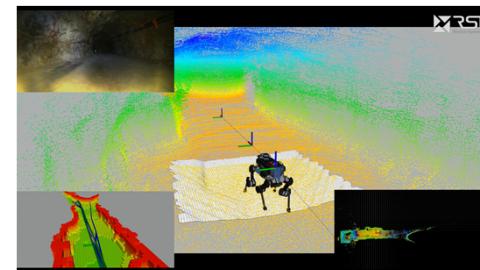
Sewer and mine
inspection



Underground
exploration



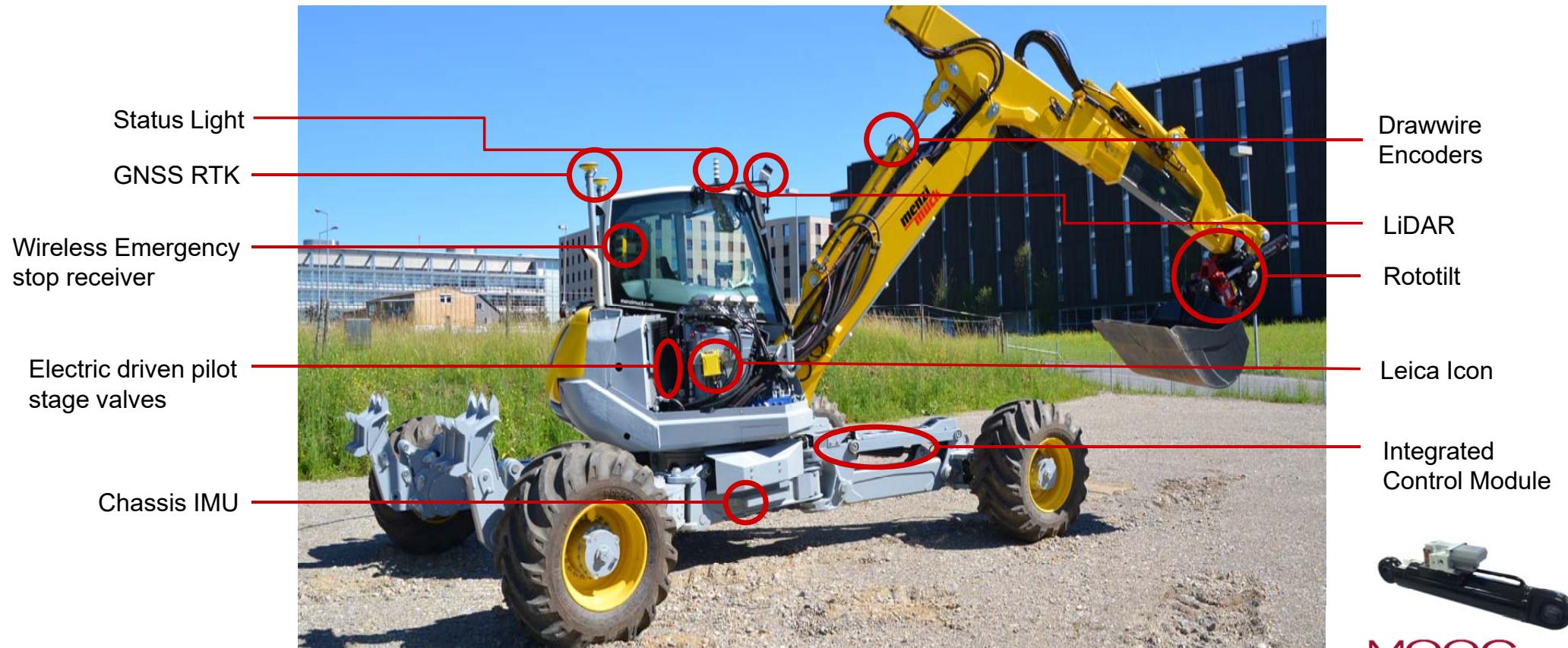
Industrial inspection



North Sea
September 2018

ANYbotics

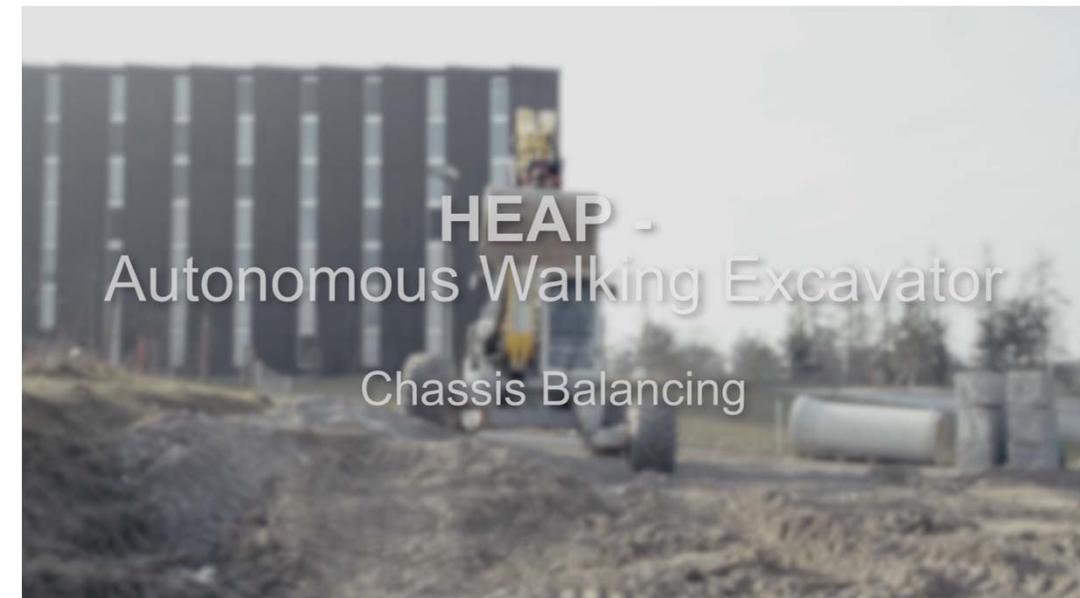
HEAP | walking excavator in the field (Customized Menzi Muck M545)



HEAP | automated walking excavator in the field



- Precise end-effector control using whole-body-dynamics
- Machine learning for high-precision control
- Automated terrain adaptation
- Safety guarantee, reduced machine load,
less terrain damage



Environmental Monitoring | measurement of glacial flow

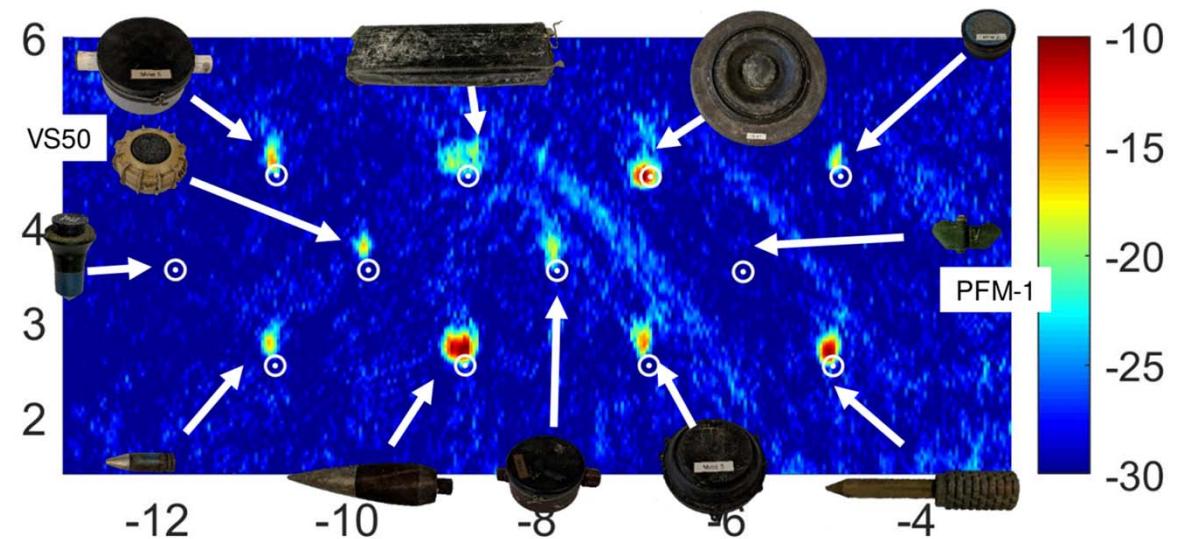


Glaciers are greatly affected by global warming

Project FindMine¹ | An airborne humanitarian demining system



- Ground penetrating radar
- Vision, Lidar, GPS
- Fast land release
- Light weight (<10 kg)
- Cheap (< 10000 USD)
- Traverse any terrain
- Repeatable and georeferenced mapping



¹ More info: <https://www.ue-stiftung.org/findmine>

AtlantikSolar | flying non-stop for days

Wingspan: 5.64 m
Weight: 6.2 kg



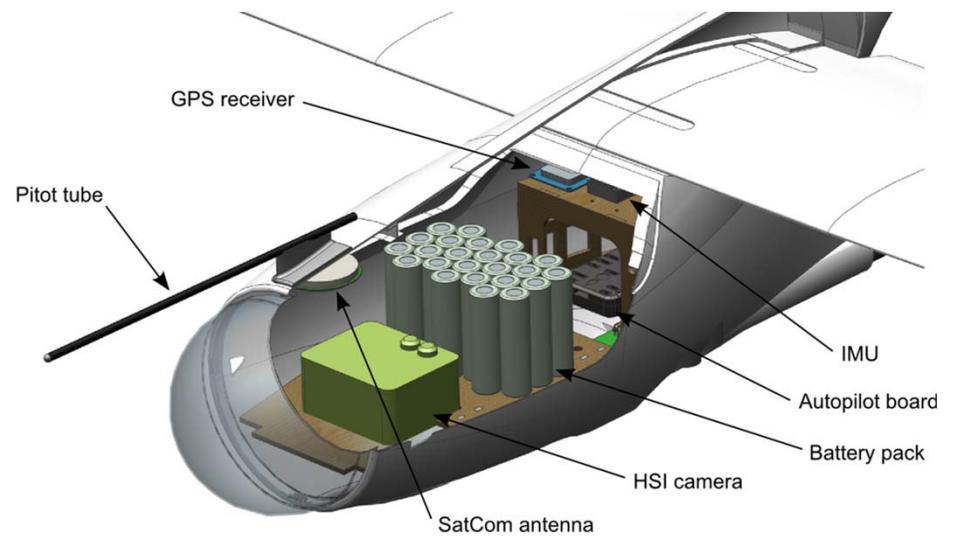
2008: first 27 h flight

2015: 81 h non-stop in summer

2018: Monitoring of glaciers in Greenland

https://www.youtube.com/watch?v=8m4_NpTQn0E
https://www.youtube.com/watch?v=wys6W1t_ryQ

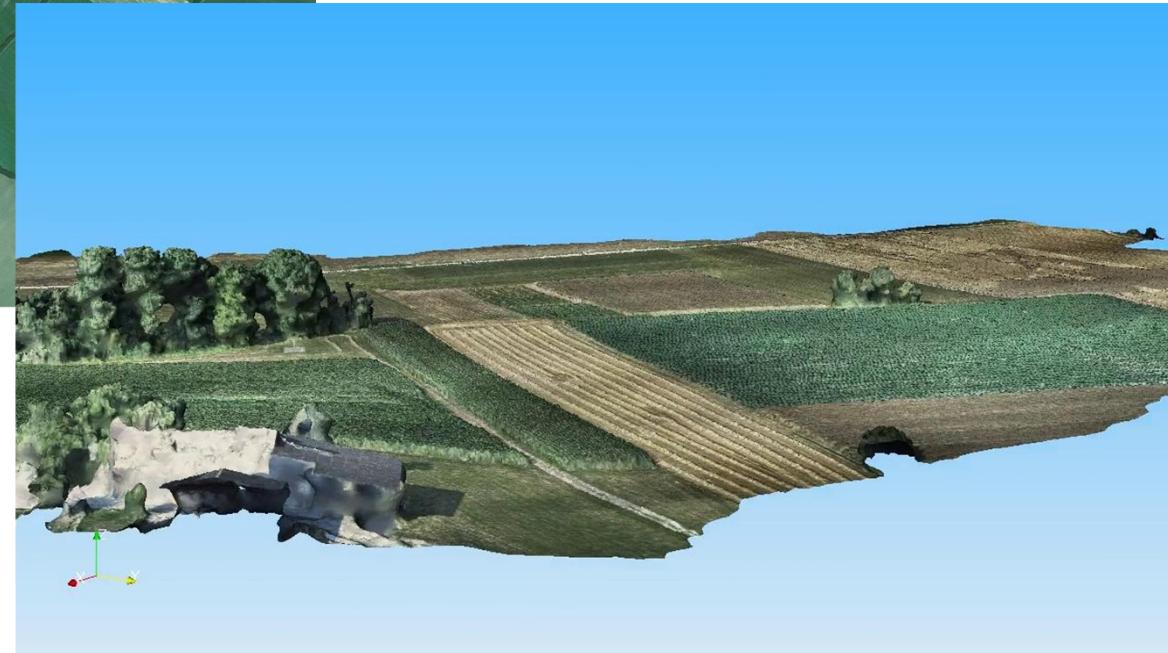
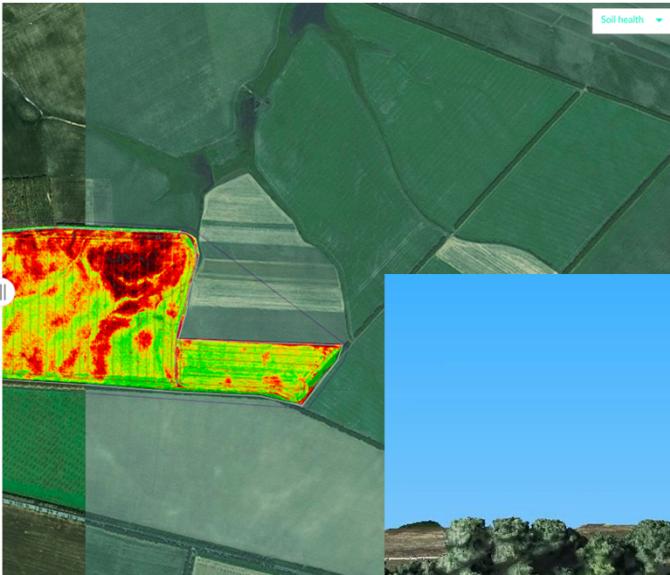
Solar³ | fixed-wing drone for ultra large coverage



Solar³ | fixed-wing drone for ultra large coverage



Solar3 | geo-referenced 2 and 3D sensor data



Drones accessing and interacting in challenging environments

Today



Future



Flying Robots for Inspections in Contact | VOLIRO V



- https://www.youtube.com/watch?time_continue=25&v=Qjka4bKqQXA
- <https://www.voliro.ch/>

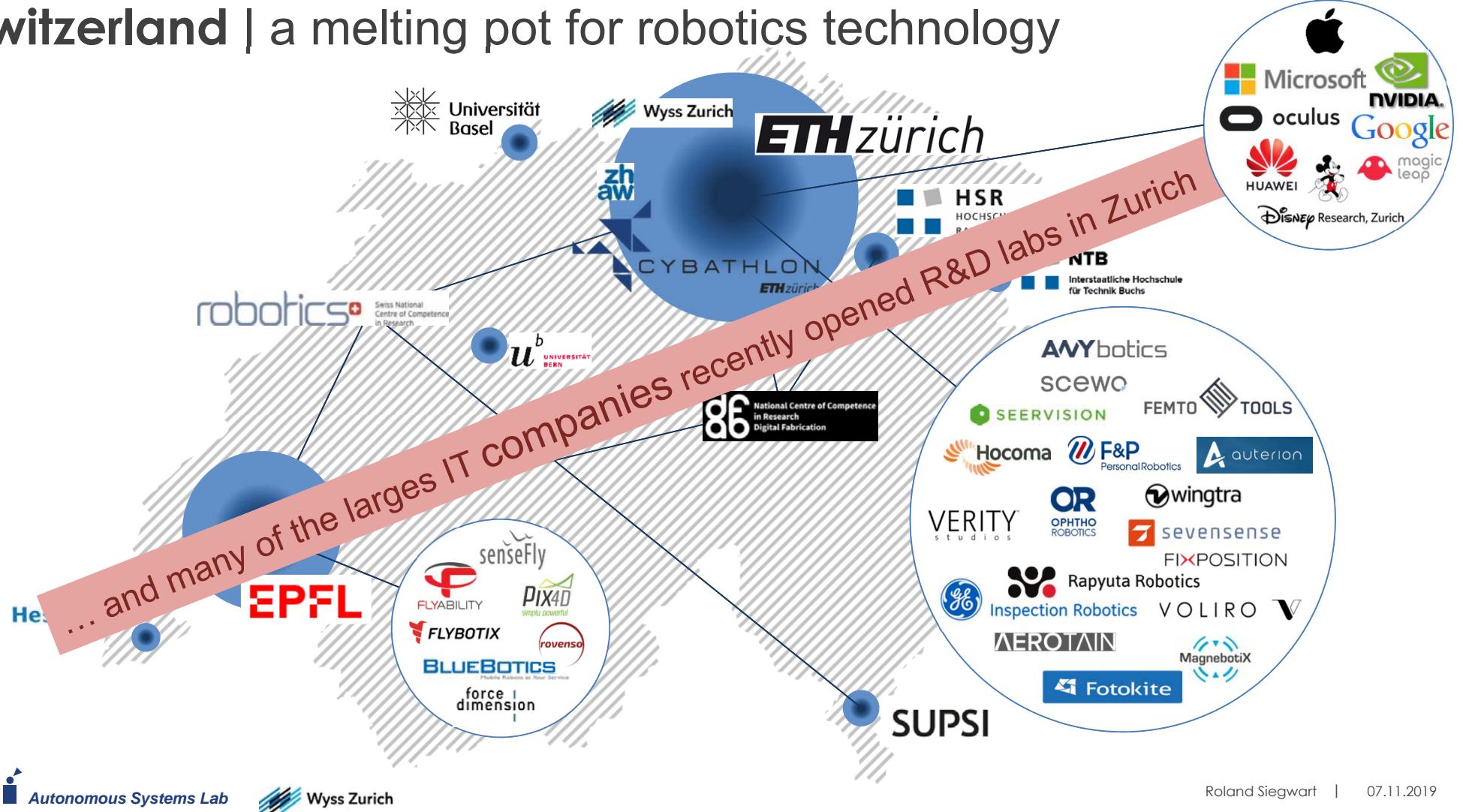
Fassaden reinigen und lackieren



in collaboration with:



Switzerland | a melting pot for robotics technology



Zusammenfassend | fliegende und laufende Roboter

- Fliegende und laufende Roboter können sehr komplexe und schwierige Umgebungen erreichen
- Navigationstechnologien (Lokalisierung, automatische Kartographierung, Wegplanung) sind bereit um für Such und Rettung eingesetzt zu werden
- Omni-direktionale Drohnen eröffnen ganz neue Anwendungsbereiche
- Die Zeit ist reif für den Einsatz von Robotern für mühsame und gefährliche Jobs

Thank you / Danke / Merci / Gracie

- To the ASL Team →
- Industrial partners



- Our Spin-offs



- Institutional partners

