



Der Roboter bringt viel, aber nicht alles

Prof. Dr. Roland Siegwart

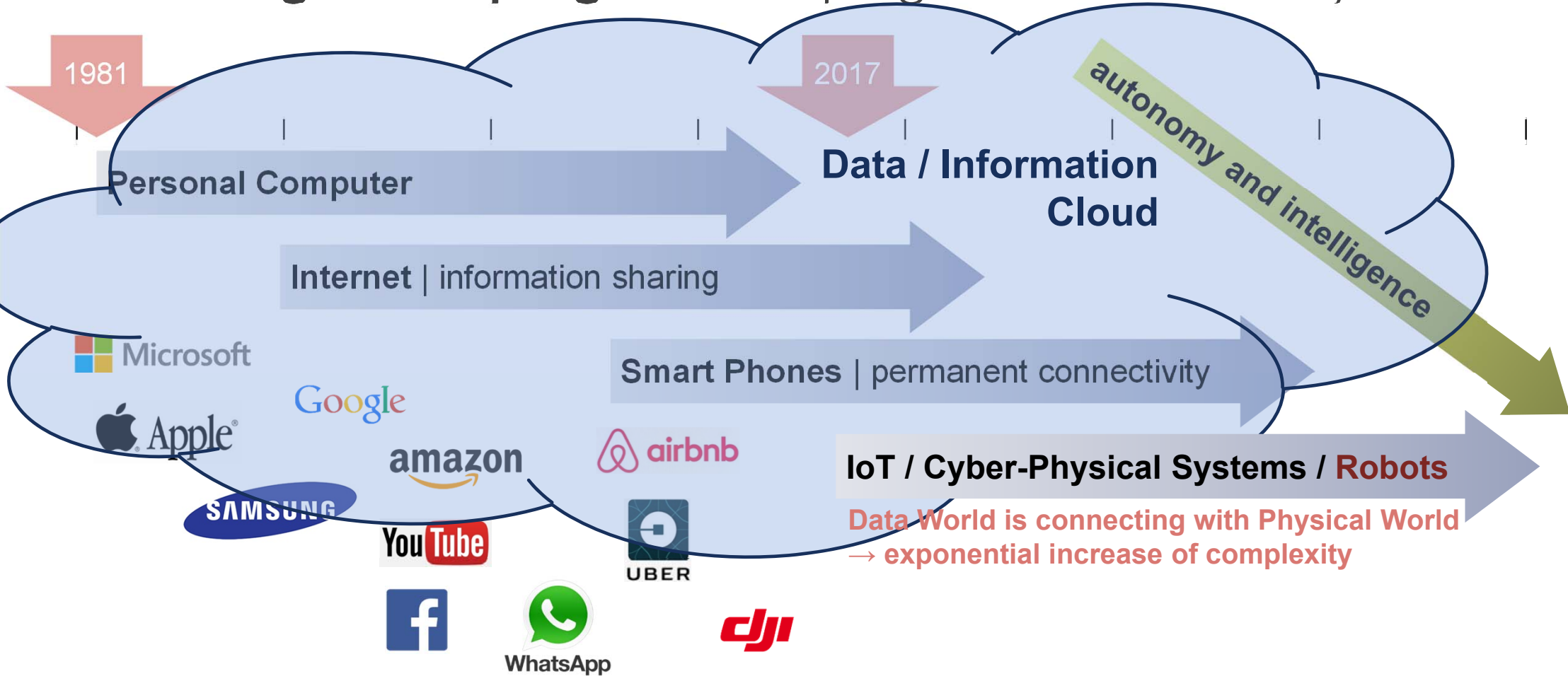
www.asl.ethz.ch

www.wysszurich.ch

swiss
BoardForum | event
sharing experience

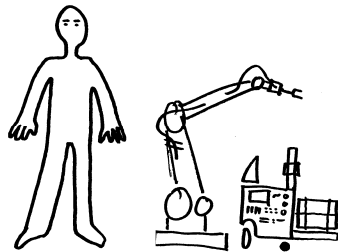
Kursaal Bern, 20. Juni, 2018

Technologies disrupting services | digitalization / industry 4.0

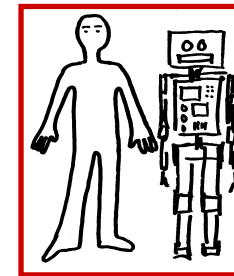


Nächste Generation von Robotern

| mobil, verbunden, intelligent, adaptiv und unter uns



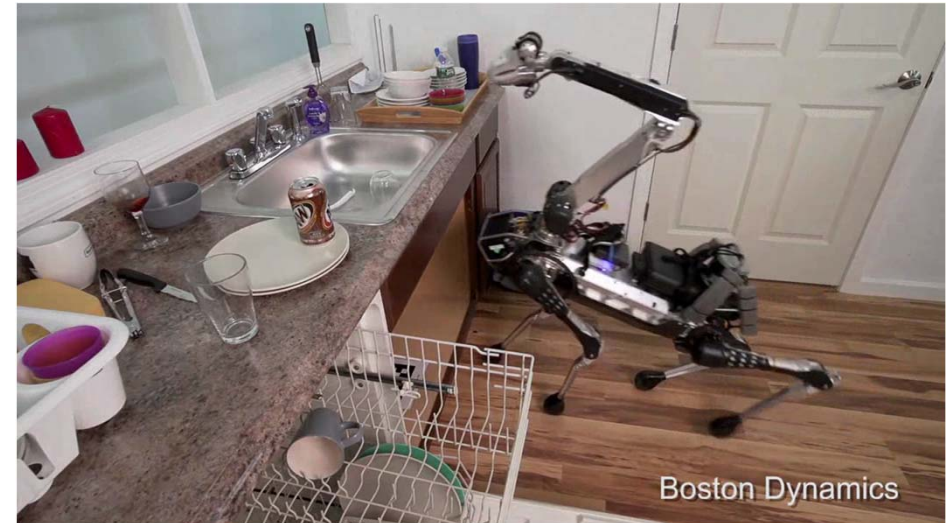
Industrial Robots



Service Robots



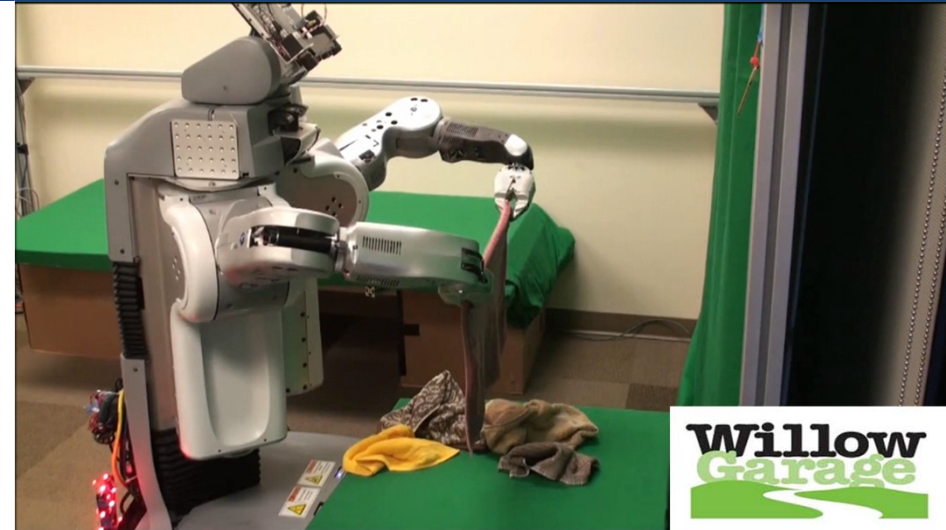
<https://www.youtube.com/watch?v=SeloQy0oXjl>



<https://www.youtube.com/watch?v=tf7IEVTDjng>

Serviceroboter | die Herausforderungen

- Roboter müssen mit **unsicherer** und nur **teilweise verfügbarer multimodaler Information** umgehen können.
 - Roboter müssen **sehen, spüren** und **verstehen** können.
 - Roboter müssen **taktil** mit der Umgebung interagieren können
→ («soft robots» mit Kraftreglung)
 - Roboter müssen **intuitiv programmierbar** sein
 - Roboter müssen **lern-** und **anpassungsfähig** sein
- **Um das zu erfüllen, braucht es Künstliche Intelligenz, aber auch neue Sensoren, Aktoren und Roboterkonzepte**



50x speed

<https://www.youtube.com/watch?v=gy5g33S0Gzo>

Service Robots

– wheeled and walking robots for challenging tasks

BeachBot (with Disney) – developed by students
| the beach artist

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



Vertigo – developed by students
| the ultimate wall climber

<https://www.youtube.com/watch?v=KRYT2kYbgo4>

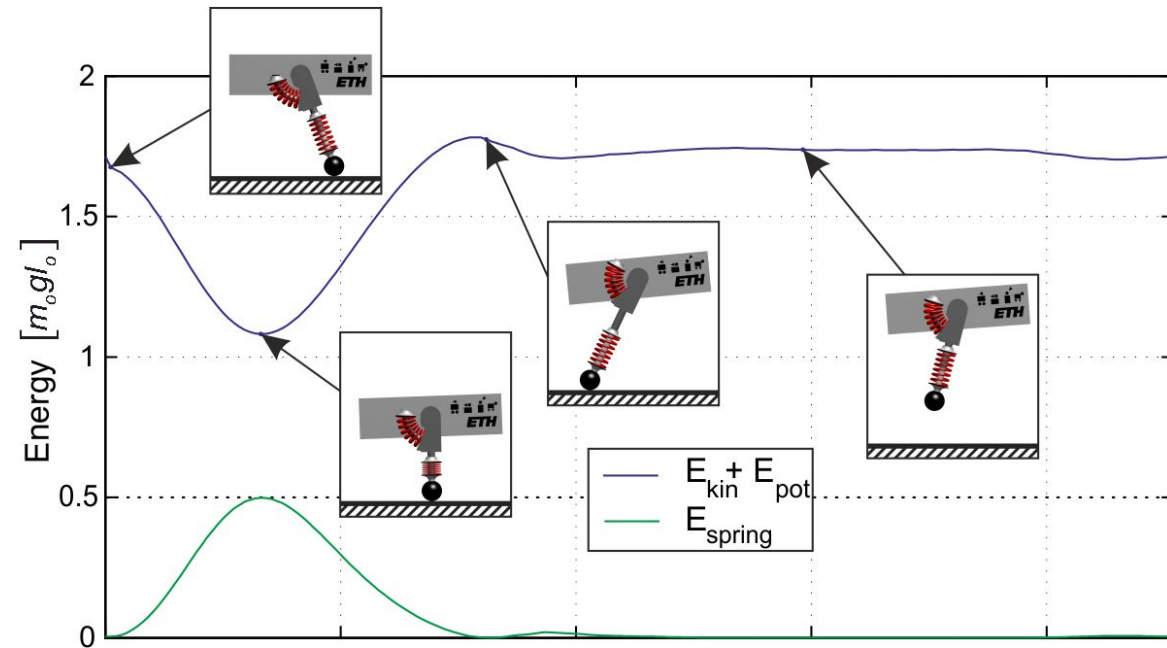
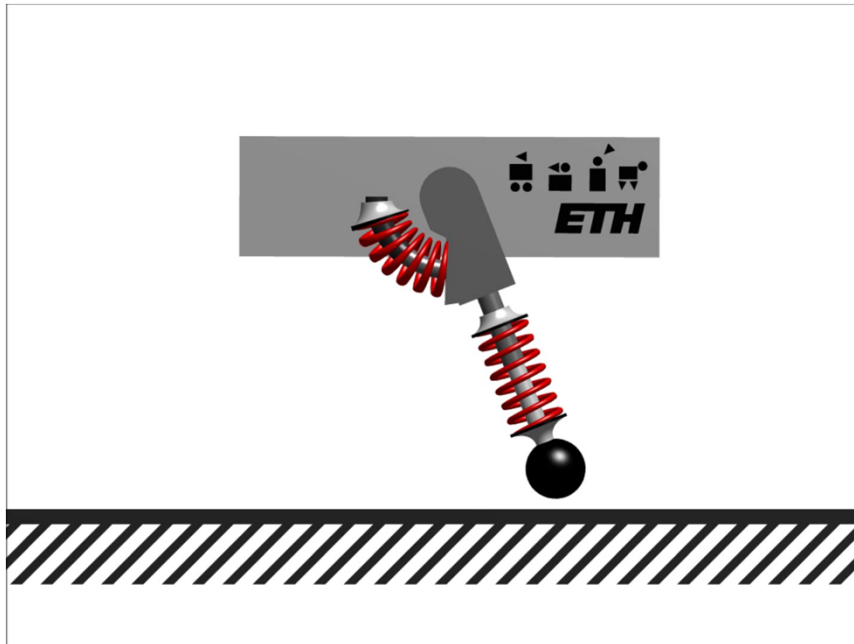
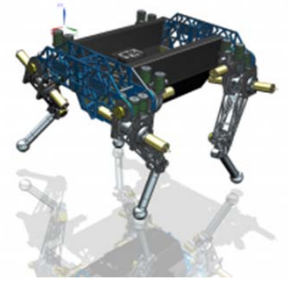


Efficient Walking and Running | what nature evolved (Extreme Jumpy Dog)



- <http://www.youtube.com/watch?v=Jql6TSyudFE>

Efficient Walking and Running | serial elastic actuation



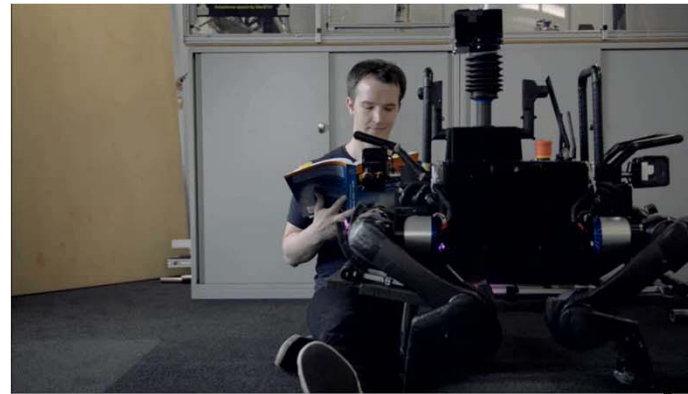
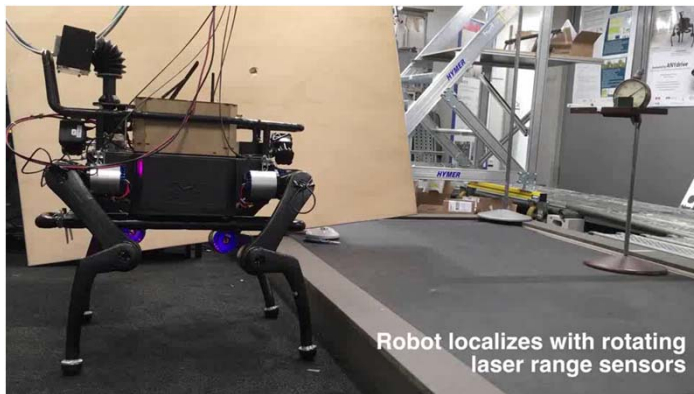
<https://www.youtube.com/watch?v=6igNZiVtbxU>

ANYmal

Combining dynamic motion skills with large mobility



Prof. Marco Hutter



Service Robots – flying robots for challenging tasks



wingtra – developed by students

| the VTOL UAV

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



| 81 hours non-stop in summer 2015

| 5.64 m, 6.2 kg

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

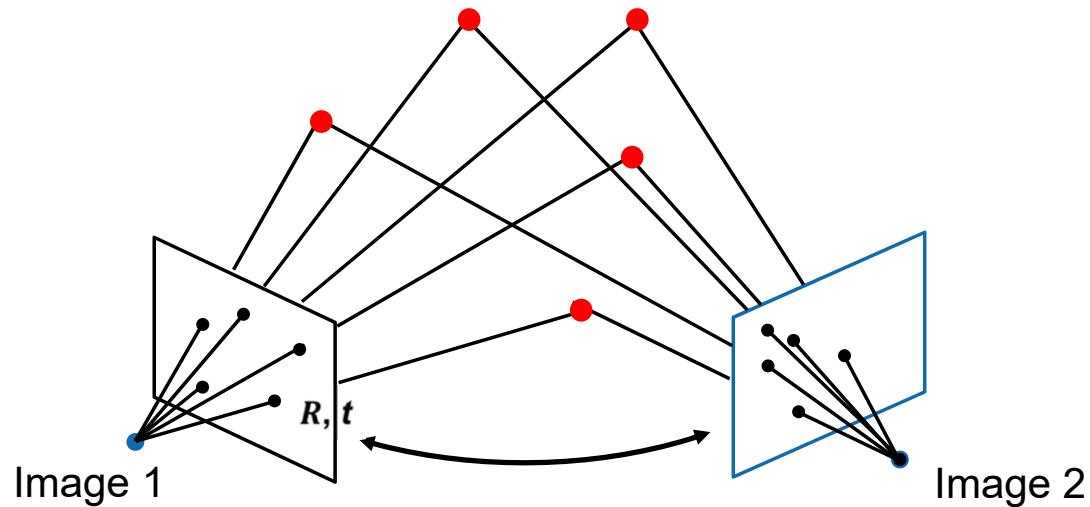
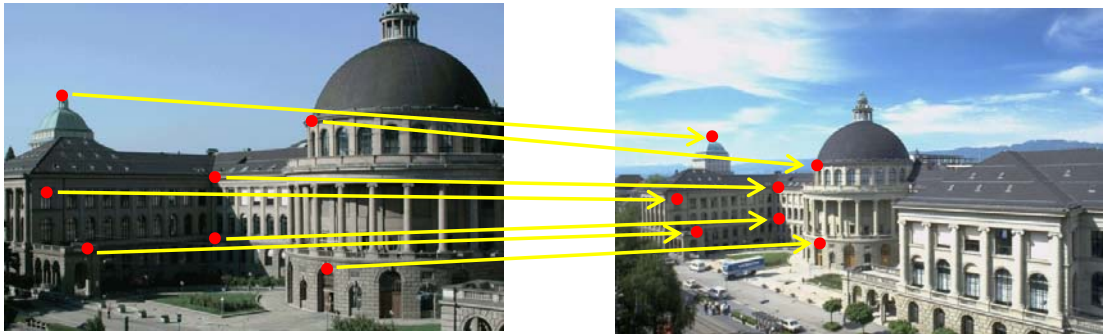
https://www.youtube.com/watch?v=wyS6W1t_ryQ



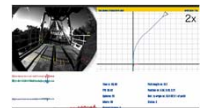
“Sehen” | Laser-basierte 3D Pläne



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



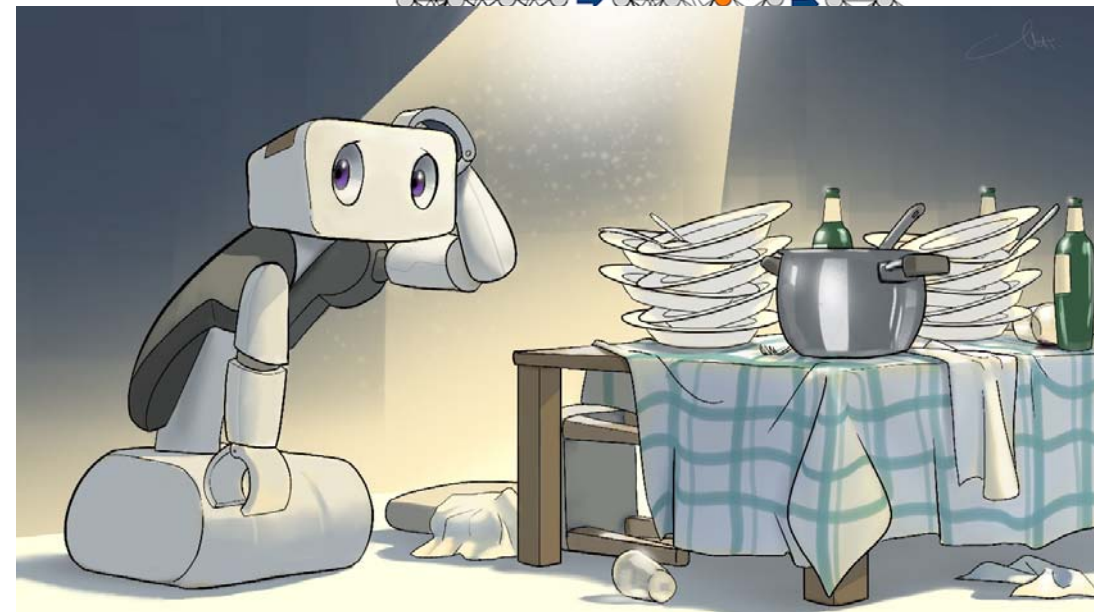
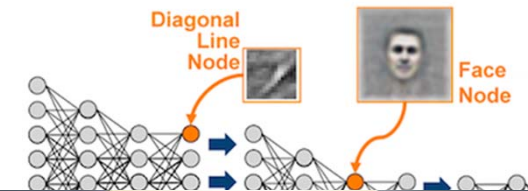
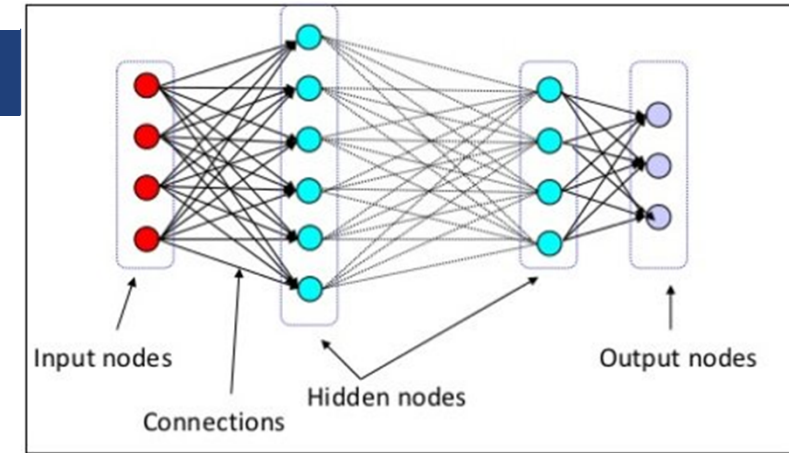
Google
Project Tango



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

AI-Example: Deep Learning for Robotics

- Key Idea: mimic behavior of neurons in a human brain in a very simplified way.
- Deep learning methods learn an unknown function from observing numerous exemplary input/output pairs.
- Examples
 - Recognizing object types in images.
 - Recognizing words in a voice recording.
 - Recommending products based on past purchases.
- Challenges involve the generation of a big amount of training data and tackling high computational burden.
 - how to generalize from low amount of data ?
 - how to learn from real world interactions?
 - how to learn from multimodal data?
 - how to learn semantics and to understand?
- **Narrow AI** ↔ **General AI**



Collaborative Visual-Inertial Navigation | teach and repeat



<https://www.youtube.com/watch?v=pDIQXsOrgI4>

Autonomous Cars Today | cameras (lane tracking, ...) → no map



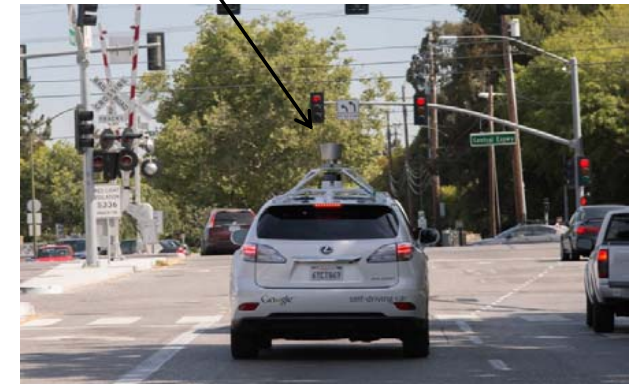
- Detection and tracking of ...
 - Lanes,
 - street signs,
 - other cars,
 - ...

<https://www.youtube.com/watch?v=aGW4nRzx8lw>

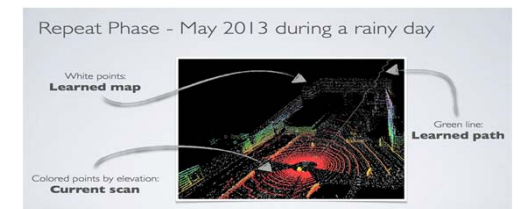


Today | 3D laser sensors → map based

Expensive, complex and cumbersome

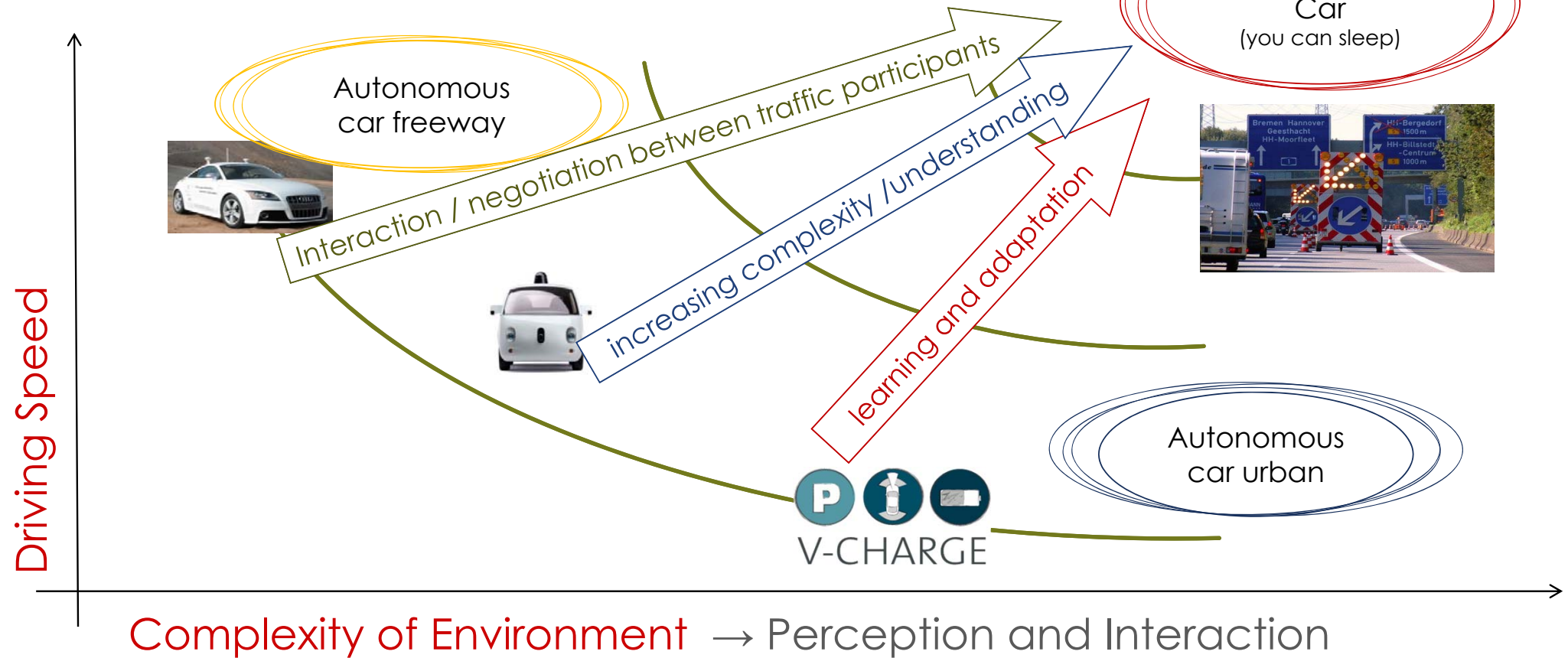


- Google Self-Driving Car Project (status summer 2015)
 - > 20 vehicles in use
 - > 2,7 mio km, 1.5 mio km in autonomous mode
 - > 11 accidents
 - No people insured
 - Non of them caused by car control algorithm



<https://www.youtube.com/watch?v=eJCR2TaeSFc>

Autonomous Cars | roadmap

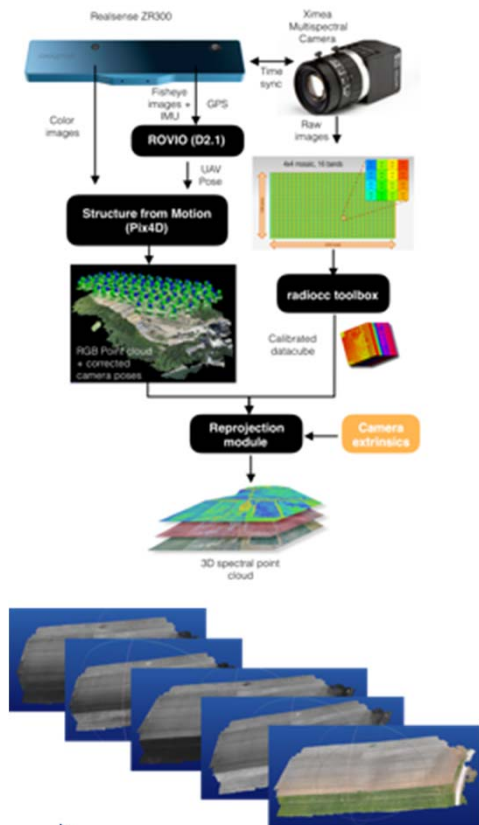


Autonomous Cars | a bright future without traffic jams



Flourish – Aerial Data Collection and Analysis, and Automated Ground Intervention for Precision Farming

Spatio-Temporal Spectral Environment Modeling

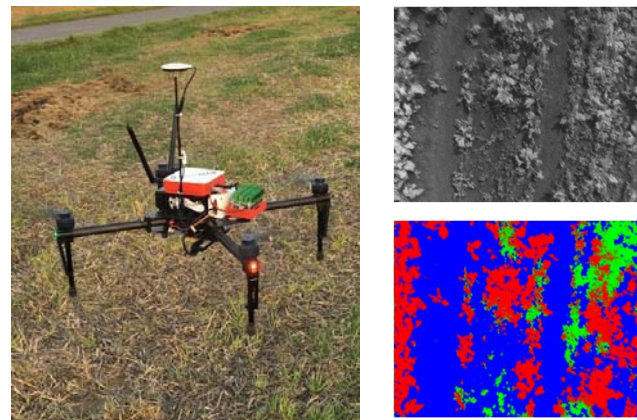


<https://youtu.be/5f1ErfW76Qc>

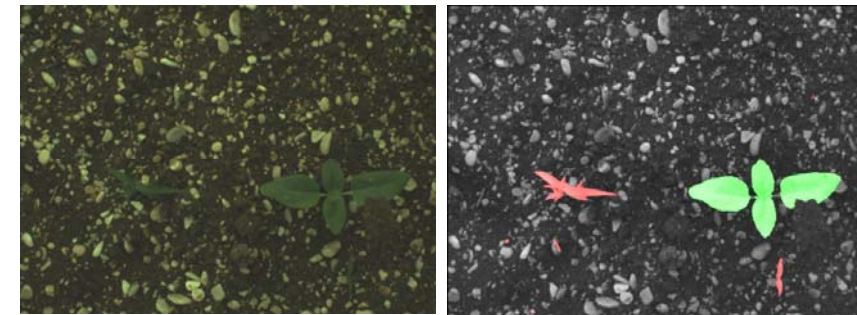
Autonomous UAV landing



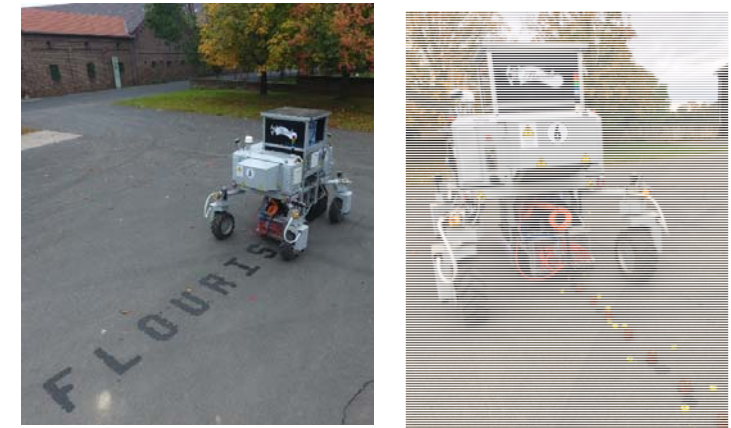
UAV onboard weed detection



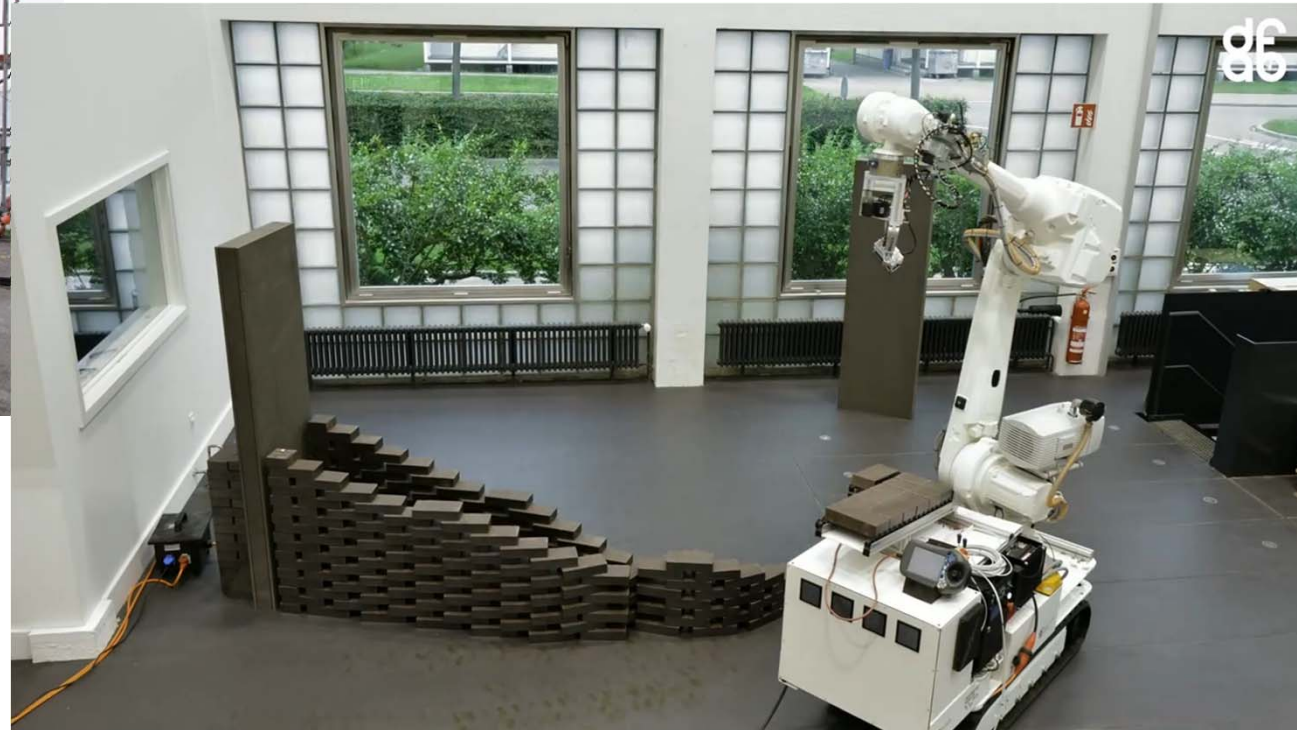
Weed classification on UGV (Sunflower ~95% acc.)



Automated spraying and stamping



Roboter auf der Baustelle – NCCR Digital Fabrication



Robotics Roadmap

Complexity of Services

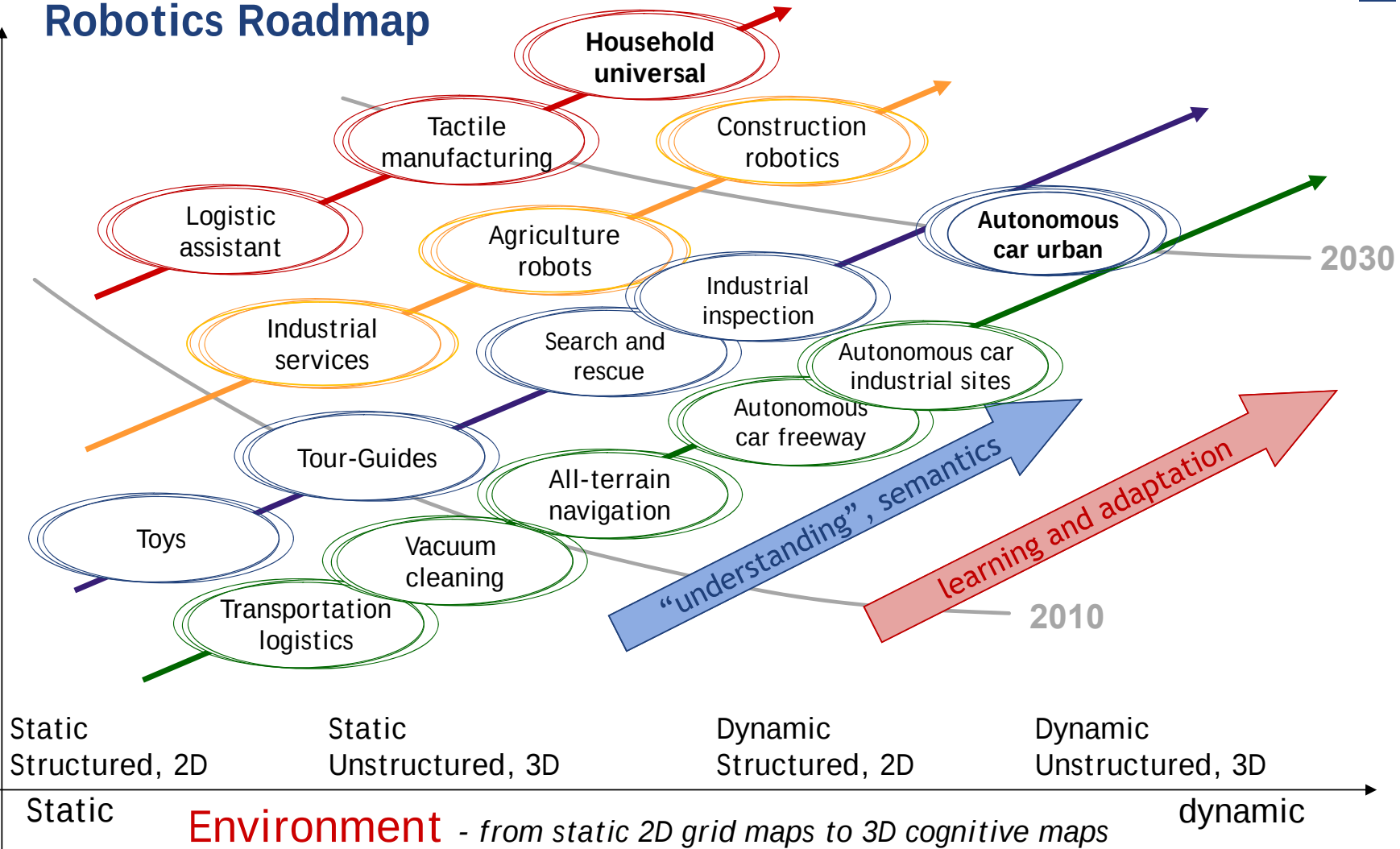
Tactile Manipulation

Mobile Manipulation

Advanced Interaction

Autonomous Navigation

Actions - from simple motion to complex interaction



Switzerland | a melting pot for robotics technology

Initiatives

robotics+ Swiss National Centre of Competence in Research

86 National Centre of Competence in Research Digital Fabrication

ETH zürich
Center for Learning Systems

Wyss Zurich
TRANSLATIONAL CENTER

ieLab

Autonomous Systems Lab

Wyss Zurich

Spin-offs (*ASL)



Industrial Collaborations (ASL)



Take Home Message

- Ja, Robotik boomte
 - ... es braucht aber noch viel F&E um diese komplexen Systeme auf den Markt zu bringen.
- Ja, Europa und speziell die Schweiz hat das Potential diesen wichtigen Markt zu erobern und somit nachhaltig Arbeitsplätze zu schaffen. Es geht um:
 - Hervorragende Forschung und grossartige Talente
 - Präzisionsmechanik und Künstliche Intelligenz
 - Innovation und Unternehmertum
- Für die Skalierung von Robotik-Technologie und Startups brauchen wir Talente, **mehr Risikobereitschaft und langfristig ausgerichtetes Risikokapital (> 10 Jahre)**

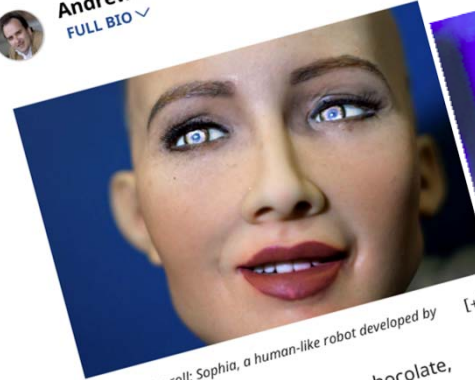


Forbes

Leadership / #CuttingEdge
SEP 26, 2017 @ 01:22 PM 16,626

How Switzerland Became The Silicon Valley Of Robotics

Andrew Cave, CONTRIBUTOR
FULL BIO



On a Swiss roll: Sophia, a human-like robot developed by Switzerland. Mountains, lakes, chocolate, fondue and banks? Right? Only partly. The Alpine nation is now "the Silicon Valley of robotics" according to Chris Anderson, chief

THE WORLD UNIVERSITY RANKINGS

RANKING

Rank Name

1

2

ETH Zurich - Swiss Federal Institute of Technology Zurich
Switzerland
Explore

California Institute of Technology
United States
Explore

«Die Schweiz ist das Silicon Valley der Robotik»

Von Alain Zuckerman. Aktualisiert am 04.04.2013
Internetguru Chris Anderson prophezeit eine neue industrielle Revolution. Diesmal will er als Unternehmer selbst dabei sein.



Top 10 countries for talent competitiveness

- 1 Switzerland
- 2 Singapore
- 3 USA
- 4 Norway
- 5 Sweden
- 6 Finland
- 7 Denmark
- 8 UK
- 9 Netherlands
- 10 Luxembourg

Top 10 cities

- 1 Zurich
- 2 Stockholm
- 3 Oslo
- 4 Copenhagen
- 5 Helsinki
- 6 Washington
- 7 Doha
- 8 San Francisco
- 9 Paris
- 10 Boston