Faculties and Institutes of the ZHAW

School of Engineering

- Institute for Applied Information Technology (InIT)
- Institute of Applied Mathematics and Physics (IAMP)
- Institute for Data Analysis and Process Design (IDP)
- Institute for Energy Systems and Fluid Engineering (IEFE)
- Institute for Mechatronic Systems (IMS)
- Institute for Mechanical Systems (IMES)
- Institute for Sustainable Development (INE)
- Institute of Computational Physics (ICP)
- Institute of Embedded Systems (InES)
- Institute of Materials and Process Engineering (IMPE)
- Centre for Aviation (ZAV)
- Centre for Product and Process Development (ZPP)
- Centre for Signal Processing and Telecommunications (ZSN)
Studying Aviation at the ZHAW

Methods and Concepts
- Safety and Security
- Economics
- Sustainability
- Humans - Technology - Environment
- Communication

Dealing with Current Challenges and Anticipating the Future

A Broad Range of Topics

The Fascination of Technology and Flight
Our Aviation Partners

- Eurocontrol - Air Navigation Service Provider
- SWISS – Swiss International Air Lines
- Pilatus AG – Flugzeugwerke Stans
- Edelweiss Air
- Aero Club Schweiz
- BAZL – Bundesamt für Zivilluftfahrt

- SR Technics
- SAT – Swiss Aviation Training
- Flughafen Zürich AG
- Schweizer Luftwaffe
- Skyguide - Zivile und militärische Flugsicherung

- Center for Aviation Competence Universität St. Gallen (HSG)
- RUAG Schweiz AG
- Kuerzi Avionics AG
- ICAO – International Civil Aviation Organisation
Our Vision

A Swiss University – an International Outlook

Die Mobilität der Zukunft gestalten.

Die ZHAW School of Engineering setzt auf zukunftsrelevante Themen in Ausbildung, Forschung und Entwicklung. Wir verbinden Technologien, Methoden und Fachgebiete mit dem Ziel, die globale Mobilität der Zukunft effizienter und sicherer zu gestalten. Im Studiengang Aviatik bilden wir seit 10 Jahren Luftfahrt-Experten aus, die sich diesen Herausforderungen stellen. Das erfordert umfangreiche Fachkenntnisse, eine vernetzte Denkweise, Team- und Kommunikationsfähigkeit sowie Selbstständigkeit bei der Arbeit im Spannungsfeld von Mensch, Technik und Umwelt.

www.zhaw.ch/engineering/av
Swiss Drone Activities

• ADS95 Drone Operation by Swiss Air Force

• Drone Projects at ZHAW
  - Development of UMARS
  - Project DIWA
  - Remote Pilote Station

• Start Up’s from Swiss Universitites

• Drone Industry in Switzerland

• Drone Regulation & Growing Sector
ADS95 Drone Operation in Switzerland

Swiss Air Force Operation for Reconnaissance & Surveillance

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<td>Power</td>
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<tr>
<td>Speed</td>
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<td>Endurance</td>
<td>4 h</td>
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RAPS: Ranger autoland position sensor; Ground Control Station in Container

Will be replaced by Hermes 900 called ADS15.
• ADS95 Drone Operation by Swiss Air Force

• **Drone Projects at ZHAW**
  - Development of UMARS
  - Project DIWA
  - Remote Pilote Station

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• **Drone Industry in Switzerland**

• **Drone Regulation & Growing Sector**
Development of UMARS at ZHAW

UMARS
Unmanned Modular Airborne Research System

Unmanned Aerial Systems in Atmospheric Research

Zürcher Fachhochschule
From clean Sheet to a flying System

UMARS 1
First Campaign in 2011
Measurement of Methane, CO₂
Further Development

UMARS 2
UMARS 2

Spacecraft Dimensions:
- Length: 350 mm
- Width: 200 mm
- Height: 200 mm

Payload:
- Maximum: 10.0 kg

Max Takeoff Weight:
- 30.0 kg

Min Speed:
- 15.6 m/s

Power:
- 4.5 kW

Endurance:
- Up to 4 h

Max. Altitude:
- Up to 5000 m
UMARS 2 / Avionics

- Basic:
  - 2x ARDUPILOT MEGA 2.0
- Open source Hard and Software, was modified und extented
- Watchdog:
  - Autopilot Status
  - Flight Parameters
  - Manuel Mode
- Rescue System (Parachute)
- IMU instead of IR sensors
- Payload:
  - 5 hole probe (GPS, 3D Wind)
Objective: design, realize and test an in house developed Flight Control Unit (FCU) running on a specific HW which must:
- interface with a range of hardware devices
- able to run complex algorithms

Motivations:
- Current available HW and SW is not easily modifiable
- Ownership of design provides the maximum flexibility
- Further developments in terms of redundancy and dissimilarity
Wingcopter – vertical take off

<table>
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<td>Max Speed</td>
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DIWA – Drone Interaction With Animals

A drone system that supports wildlife biologists in:
- Getting DNA-samples
- Surveying
- Immobilization

Developments at ZHAW in:
- Drone
- Dart mechanism
- Gimbal system
- Permits and safe operation

Challenges:
- Robust and safe system
- Usually flight at night (IR camera system)
- Aiming and hitting target
- Repulsion at lightweight drone

diwa is a drone system for day and night observation, immobilization (RDDS) and DNA-sampling for wild animals in remote places.
Remote Pilot Station (RPS)

**Goal:**
- Enhanced situation awareness

Currently Operation of 3 Multicoptors 250 mm till 700mm, Autoquad m4 V2
Human Centred Design of Cockpits and Remote Pilot Stations: Commonalities

- Operation in the same airspace system
- Operation under the same Air Traffic Control
- Situation Awareness
- Challenges of Automation
- Enabling technologies:
  - Synthetic Vision
  - Enhanced Vision
  - Voice Control
  - et cetera
Different Screen Layouts, …

SMI Eye Tracking Glasses
• ADS95 Drone Operation by Swiss Air Force

• Drone Projects at ZHAW
  - Development of UMARS
  - Project DIWA
  - Remote Pilote Station

• Start Up‘s from Swiss Universities

• Drone Industry in Switzerland

• Drone Regulation & Growing Sector
Aeroscout GmbH is located in Lucerne, Switzerland.

The company was founded in 2005 and is a spin-off company of the Swiss Federal Institute of Technology (ETH) Zurich and was spin off from the Institute of Dynamic Systems and Control.

The company is headed by Dr. Christoph Eck (CEO), a former doctoral and post-doctoral student of ETH Zurich and a former managing partner at weControl AG.

The Aeroscout team has been working on UAVs since 1995.

Aeroscout works closely together with RIEGL laser scanning products.
• *Wingtra* is a fast-growing spin-off from the Autonomous Systems Lab at ETH Zurich.

• They are developing and marketing hybrid flying robots for civil applications.

• It has a team of 2 talented young engineers, designers, and business developers.

• The company was founded in April 2016.

• Wingtra flying robots take-off and land like a helicopter but fly like planes.
• They started Skye as a research project back in 2011 as a collaboration between Disney Research Zurich and the Autonomous Systems Lab at ETH Zurich.

• It is an airship drone for advertising and events.

• FOCA approval for indoor operation over crowded people.
Flyability SA is a Swiss company founded in 2014 located in Laussane, Switzerland.

Dr. Adrien Briod (CTO) and Patrick Thévoz (CEO) Lausanne (EPFL) are the founders of the company.

The company builds safe drones for operating indoors, in complex and confined spaces, and in contact with people.

It currently employs more than 20 full time employees.
The Fotokite is a tethered flying camera. No piloting skills are required. It is safe to use near people and infrastructures.

Fotokite is located in Zurich.

It was founded in 2013.

The company has a team of enthusiastic roboticists and engineers and currently employs 1-10 employees.

They build a socially responsible way to capture aerial perspectives.

Source: www.digitaltrends.com
• ADS95 Drone Operation by Swiss Air Force

• Drone Projects at ZHAW
  - Development of UMARS
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  - Remote Pilote Station

• Start Up‘s from Swiss Universities

• Drone Industry in Switzerland

• Drone Regulation & Growing Sector
• It produces drones for commercial use that can accurately map geographic locations.

• senseFly was founded in 2009 by a team of robotics researchers and quickly became the industry leader in mapping drones.

• senseFly is located in Cheseaux-Lausanne, Switzerland

• senseFly is the commercial drone subsidiary of Parrot Group, the world leader in consumer drones.

• It currently employs more than 100 employees.
• Young high-tech UAS engineering company.
• 3 years research and development on the Swissdrones Dragon UAV.
• HQ located in Sevelen Zwitserland.
• High payload (Geo Info LIDAR, spraying fertilizer), low cost solution.
• Intermeshing rotor system
• SwissDrones Dragon 50:
  - Long range data link
  - Fully autonmous auto lift up
  - auto landing, way point missions
  - Integrated heading function
Meteodrones to Master the Weather.

Dr. Martin Fengler, CEO
mfengler@meteomatics.com
Meteodrones to Master the Weather.

Improving PBL Data Situation
Radar

Air/ Craft
Balloons
Satellite

PBL up to 1.5 km

Low stratus

Only little data: Improve that with Meteodrones!

Weather station
Laser Sound/Microwave

Red/green navigation lights
White strobe (visibility >3 km)
Red/green navigation lights
Component to stay in reserved airspace

Measuring Principle
Wind measurement using aircraft pitch & roll.

Flight Track in Google Earth
No More Runways - Ever

Today: Mostly Rotary or Fixed Wing UAVs
Swiss Aerobotics' Hummel = Smart Combination of Both
• ADS95 Drone Operation by Swiss Air Force

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Regulations: Swiss GALLO Approach

**Guidance for an Authorisation for Low Level Operation of RPAS**

Without permission possible

- Remote controlled multicopter under 30 kilogram total weight with direct eye contact of the pilot.
- Multicopter at model airfield and as official participants in flight events.
- Multicopter in the free nature and residential areas without human gatherings (over a thousand people in a small area). Be aware of the private sphere.

With permission possible

- Multicopter with a video goggle and without a second pilot with eye contact.
- Multicopter over 30 kg total weight.
- Multicopter in the area of less than 100 meters from human gatherings, if it is necessary and public flight events or a model airfield are excluded.
- Multicopter within 5 kilometers of a civilian or military airfield. Permission is required from the airfield controller or the air traffic control.

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**Kontakt BAZL**

E-Mail Kontakadresse: rpas@bazl.admin.ch
www.bazl.admin.ch/rpas
### Rules and Regulation

- FAA: Small UAS rule (part 107) released in June 2016
- EASA: "Prototype" Commission Regulation on Unmanned Aircraft Operations released in August 2016 (Focus on *open* and *specific* categories)

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<td>2017/Q4</td>
<td>2018/Q3</td>
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A Growing Sector (France Activities)

The Rise of the activity

- Registered Operators

- Advertising and Media
- Surveillance and security
- Structure and building monitoring
- Mines, quarries
- Agriculture
- Others

- 1387 Operators
- 2240 Light RPAS

- +72% Number of operators growth over the past 6 months

- 349 Distinct manufacturers, of which
- 25 supply 68% of the fleet

- < 4Kg
- 86% of the domestic RPAS fleet

- 1245 € HT
- Average daily rate for an aerial photo report

- More than 60 Training centers

dgac France ICAO RPAS Symposium March 2015
Gold Rush or Reality?

The Industries Where Drones Could Really Take off

Value of drone powered solutions to industries in 2015 (billion U.S. dollars)

- Infrastructure: 45.2
- Agriculture: 32.4
- Transport: 13.0
- Security: 10.5
- Media & Entertainment: 8.8
- Insurance: 6.8
- Telecommunication: 6.3
- Mining: 4.3

Total: $127.3 billion
Thank You

The Future of Drone Systems ?