

# **Automated Mobility in the region of Kufstein**



**FH Kufstein Tirol  
University of Applied Sciences**

# Automated Mobility Region Kufstein involved Master-Study programs

- Data Science & Intelligent Analytics (Master-PT)
- Smart Products & Solutions (Master-PT)
  - Focus on Sensor, Digitalisation of Products, etc.
- Web Engineering & IT Solutions (Master-PT)
- Drone Engineering & AI-based Innovation(Bachelor)



# Automated Mobility Region Kufstein

## Strategic Partnership with DLR GfR/DiMOS

Since 2008 operator of the european **satellite navigation system Galileo**

Since 2013 certified air traffic control organization with **Safety Management System** according to EU regulation 1034/2011 and 1035/2011

Since 2016 **multiventor capability** adviser of critical infrastructure for drone applications

Since 2017 strategic partner of the University of Applied Sciences Kufstein for applications in the area of automated mobility



# Automated Mobility Region Kufstein

## History (blue) and currently running projects (green)



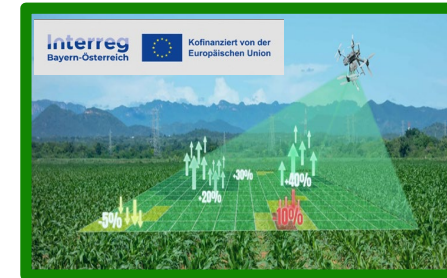
Setup Validation Infrastructure



Dangerous Good Detection for Fire Department



HyDroneRec: Hydrogen in Fixed Wing



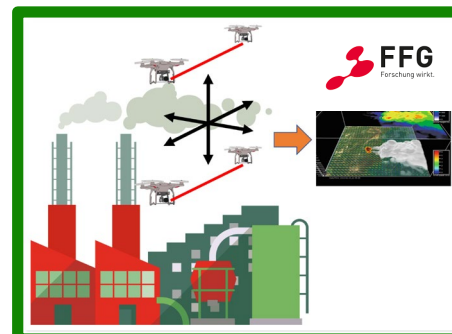
AI4GREEN: Drones in Agriculture



Research on Hydrogen Drone



Drones4VET



SpecDrone: Drones for Methan Detection



Start2: Drones for Mountain Rescue

- Set up of a mobile infrastructure for safe&secure drone applications
  - Infrastructure is partly acquired by our university and partly integrated by the DLR GfR
  - Application: Traffic monitoring by drones
- Research project of the country of Tyrol with the following partner organisation
  - FH Kufstein Tirol
  - Swarco AG
  - DLR GfR
  - TU Graz
- Budget: 340.000 Euro



©TU Graz

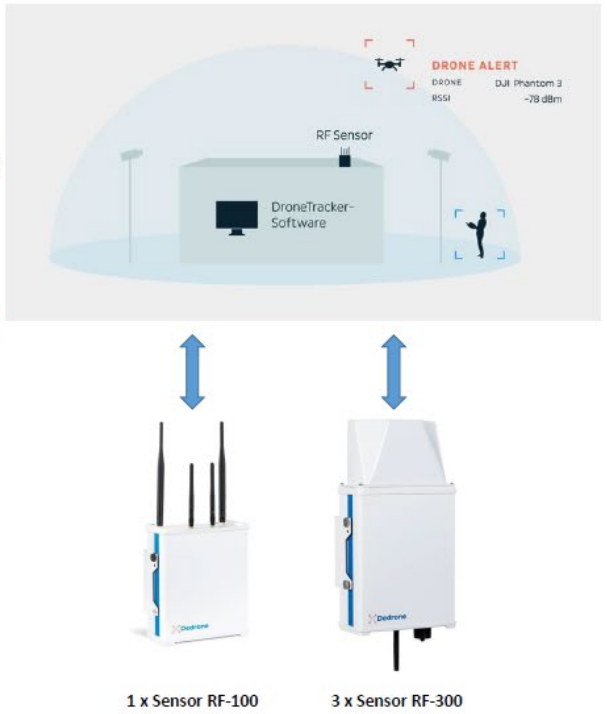
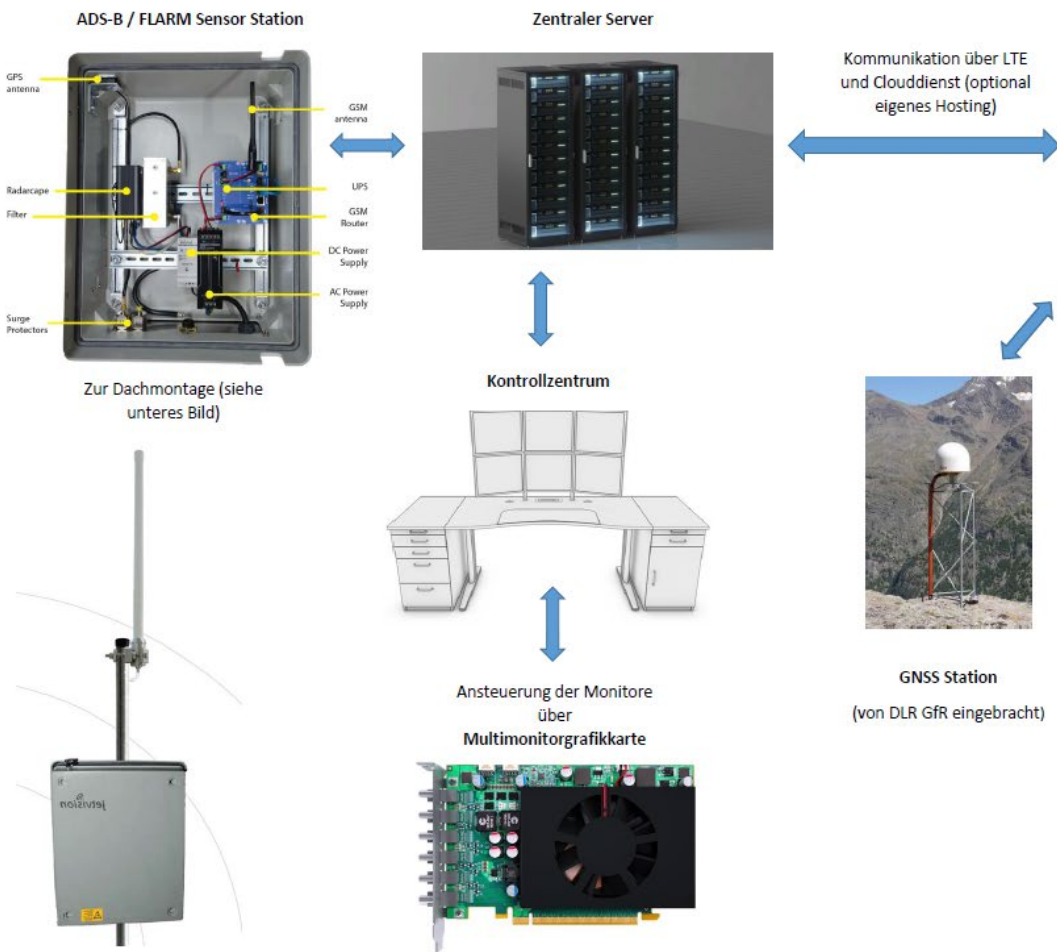


# Automated Mobility Region Kufstein

## Validation area: mobile Infrastructure

**Zentrale Infrastruktur (Zentraler Knoten)**  
 Server, Kontrollzentrum, Sensorik auf dem Dach

**Mobile Infrastruktur (Lokaler Knoten)**  
 Drohnen Detektionssystem



# Automated Mobility Region Kufstein

## Validation area: mobile Infrastructure

- Excerpt of our air traffic monitoring system

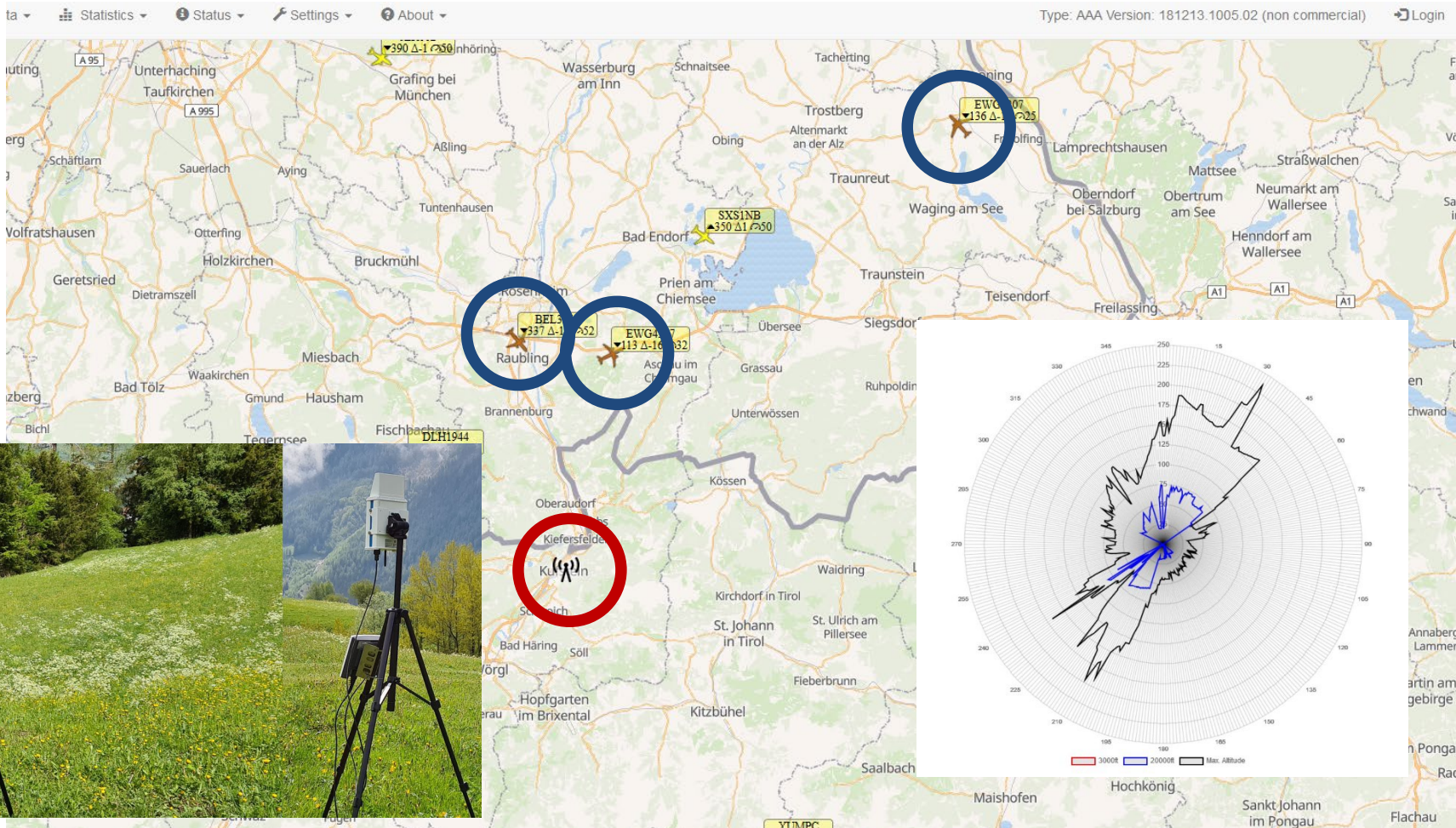


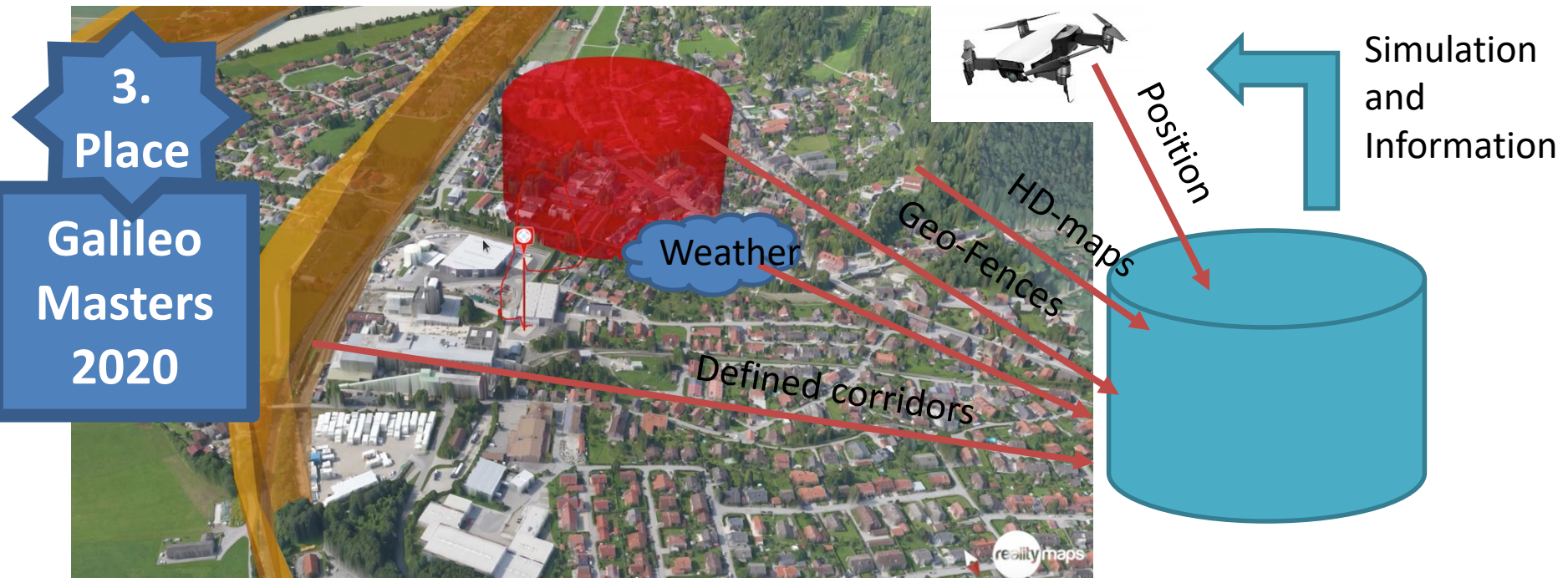
Abbildung 1: Dredrone drone detection system

Abbildung 2: ADS-B of our university

# Automated Mobility Region Kufstein

## Validation area: mobile Infrastructure (ALMODA)

- Set up of a Mobility Data Space for drone applications
- <https://bmdv.bund.de/SharedDocs/DE/Artikel/DG/KI-Projekte/almoda.html>



Video: [https://www.linkedin.com/posts/mariodoeller\\_drones-swarco-landtirol-activity-6877279341416476672-kQOh?utm\\_source=share&utm\\_medium=member\\_desktop](https://www.linkedin.com/posts/mariodoeller_drones-swarco-landtirol-activity-6877279341416476672-kQOh?utm_source=share&utm_medium=member_desktop)



- Research on drone based detection of dangerous goods in cooperation with the fire department of district Kufstein.
- Aim:
  - Increasing the reaction time of the fire department
  - Creation of an early-warning system

Video:

[https://www.linkedin.com/posts/mariadoeller\\_bezirksfeuerwehrverbandabrufkufstein-research-activity-7042529091454967808-b6l3?utm\\_source=share&utm\\_medium=member\\_desktop](https://www.linkedin.com/posts/mariadoeller_bezirksfeuerwehrverbandabrufkufstein-research-activity-7042529091454967808-b6l3?utm_source=share&utm_medium=member_desktop)



@Feuerwehr Sandoz Kundl



Mit Unterstützung von Bund, Land und Europäischer Union

Bundesministerium  
Nachhaltigkeit und  
Tourismus

LE 14-20



KUUSK



Europäische  
Kooperationsstelle für  
die Entwicklung des  
Südlichen Raumes  
Mit Österreich & Spanien in  
der Alpen- & Adria-Region



EFRE

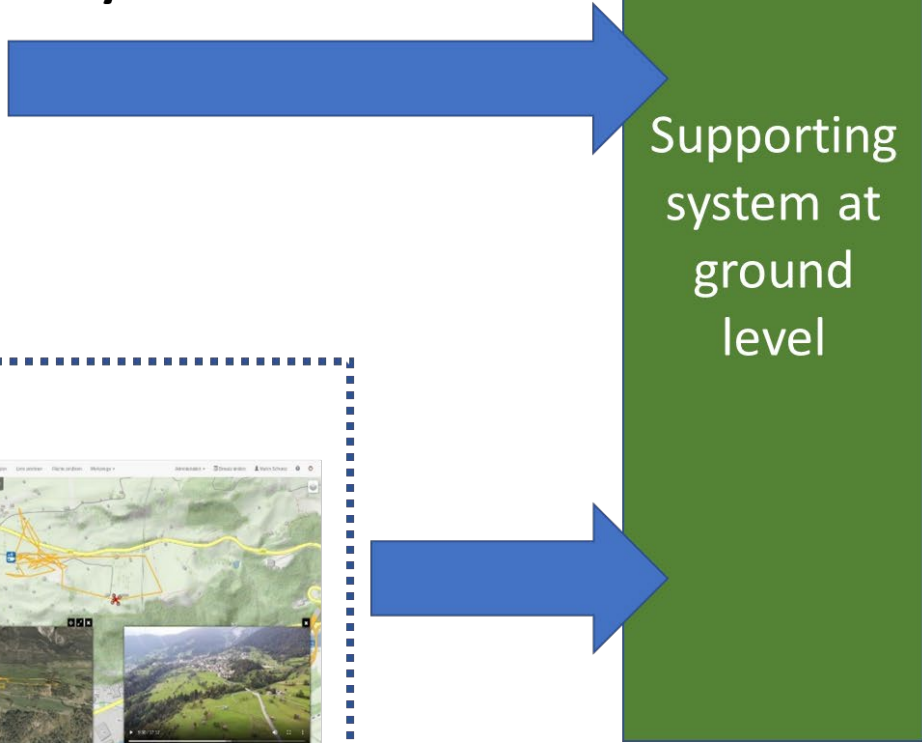
Europäische Union

# Automated Mobility Region Kufstein

## Application: drone based detection of dangerous goods

### 1+2: sensory platform and navigation

### 4: Communication to pilot / automated system



### 3: 3D visualization of area

# Automated Mobility Region Kufstein

## Application: Hydrogen Drone

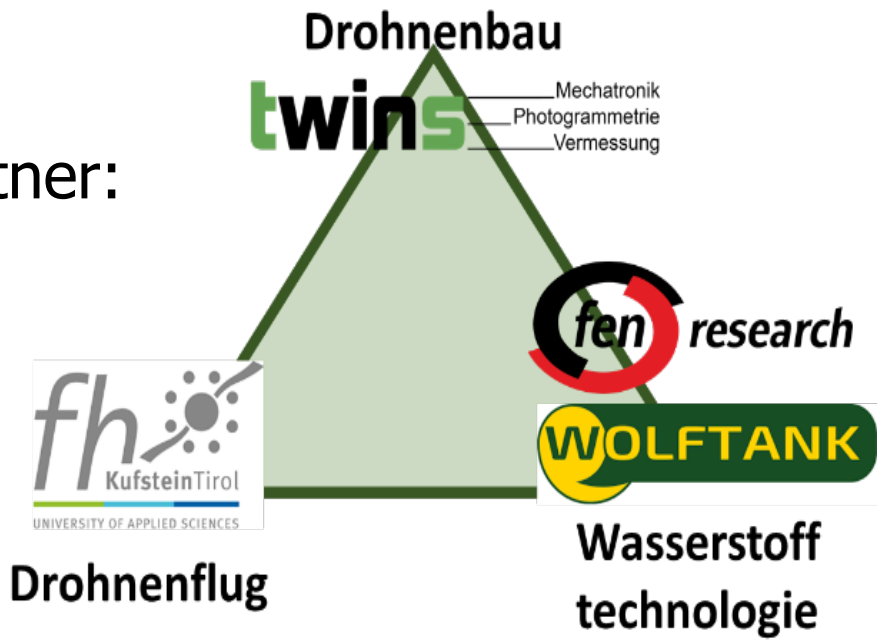
K-Regio  
Förderung



Aim:

1. Conception and setup of an innovative construction of an hydrogen drone (tank design)
2. Research on swarm based models for drone use cases.

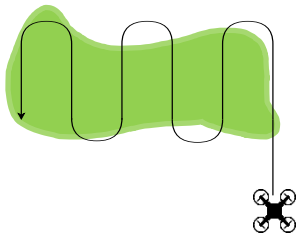
Partner:



# Automated Mobility Region Kufstein

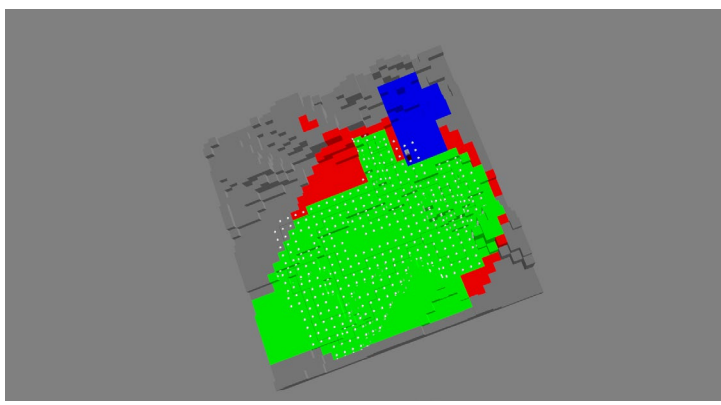
## Application: Drone swarm

### Traditional Approach



The target area is mapped with a predefined trajectory, which is operated by the drone.

### Our Approach



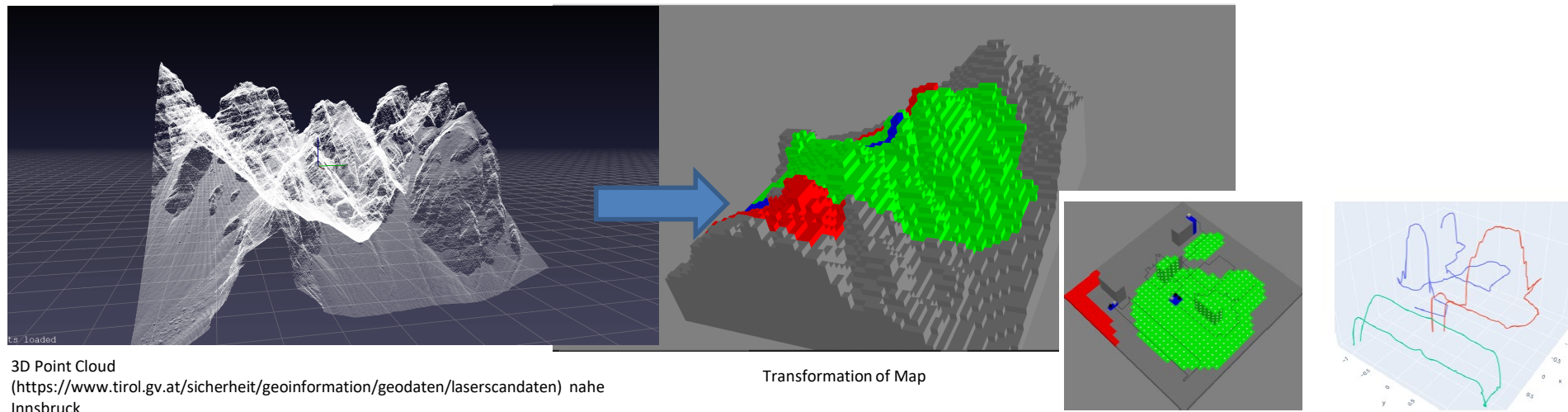
-  = Target area
-  = Start/land area
-  = no-fly zone
-  = neutral
-  = covered area
-  = trajectory

- Trajectory is calculated dynamically step by step based on a reinforcement learning approach. Approach has been enhanced based on the framework of Theile et al. [1]
- Considering battery, no-fly zones, etc. (see figure), ...
- Advantage: Without recalculation drone can react on any change:
  - Decreasing battery level
  - Change in target area
  - Drone of a swarm crashes
  - ...

# Automated Mobility Region Kufstein

## Application: Drone swarm

- AI based Reinforcement model is trained on real data and can be applied on it
- Swarm approach provides automated Coverage Path Planning for 3D space coverage
- Can be used for SAR missions (search and rescue), monitoring, inspection, etc.



Julian Bialas, Mario Döllner, Robert Kathrein, **Robust Multi-Agent Coverage Path Planning for Unmanned Aerial Vehicles (UAVs) in Complex 3D Environments with Deep Reinforcement Learning**, In Proceedings of the IEEE International Conference on Robotics and Biomimetics (IEEE ROBOT), Samui, Thailand, 2023.

**Drones4VET:** Erasmus+-Project for the setup of trainings for the use of drones in order to monitor construction sites.



Period: 2022 - End  
2024

6 Partner from France,  
Germany, Spain, Ireland  
and Austria



<https://www.commercialuavnews.com/construction/establishing-a-drone-business-with-part-107-in-construction>

# Automated Mobility Region Kufstein

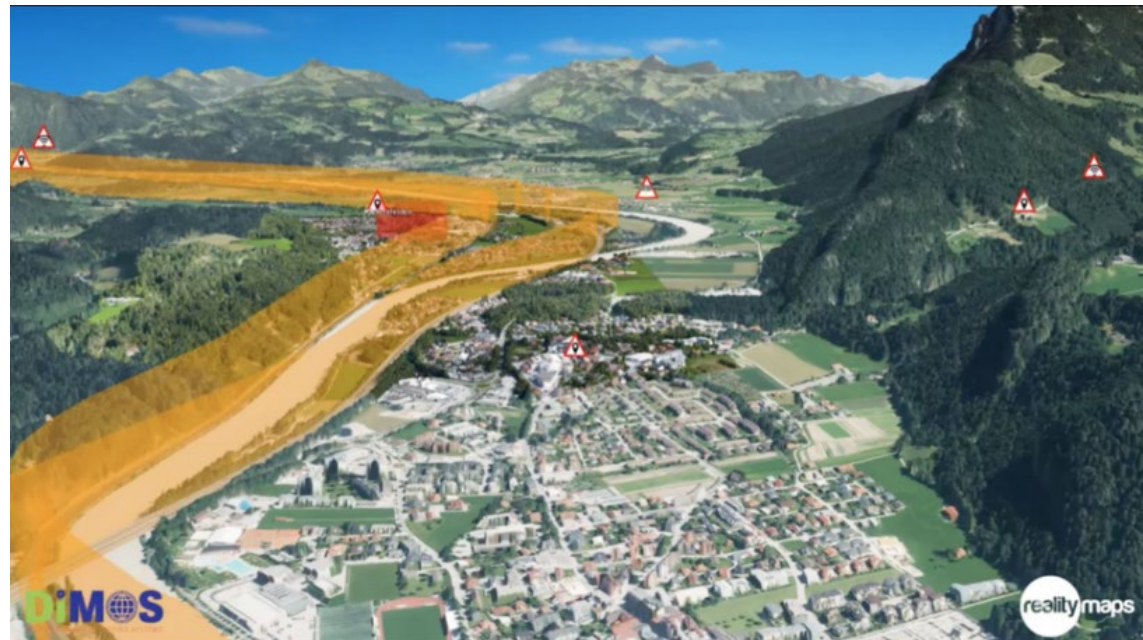
## Alpine Data Space for Mobility Inn region: ALMODA

**ALMODA:** Implements CNS (communication, navigation, surveillance) monitoring infrastructure to enable automated multimodal mobility (Train, Street, Air)



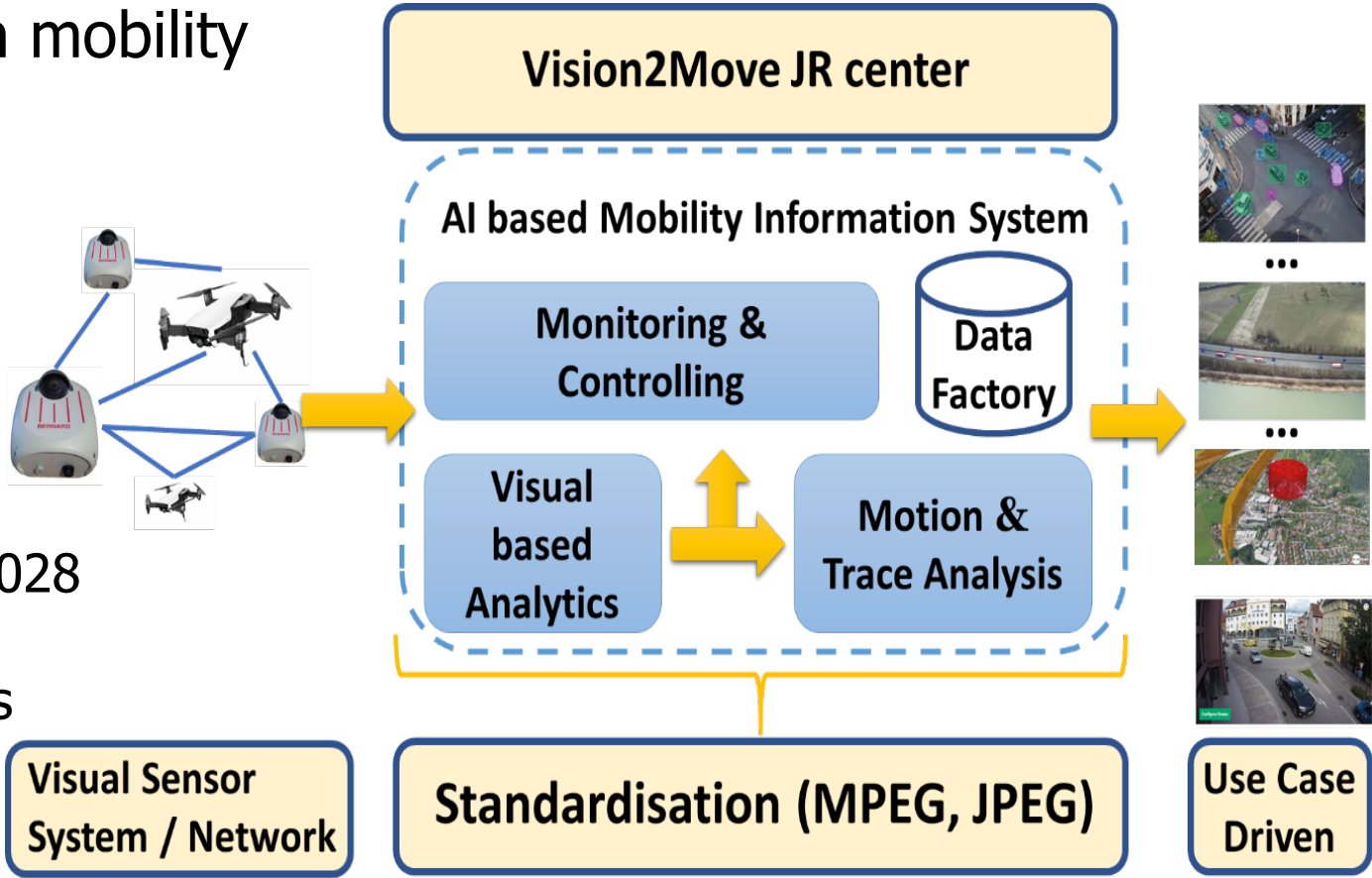
Period: 2021 - End  
2024

9 Partner from  
Germany and we as  
subcontractor



More information at: <https://bmdv.bund.de/SharedDocs/DE/Artikel/DG/KI-Projekte/almoda.html>

**Vision2Move:** JR Center for AI methods in mobility use cases.



Period: 2023 - End 2028  
 In Cooperation with:  
 Bernard Technologies  
 Inno Cube





# Automated Mobility Region Kufstein

## Josef Ressel Center for Multimedia Analysis in mobility

Year 2



MOMS



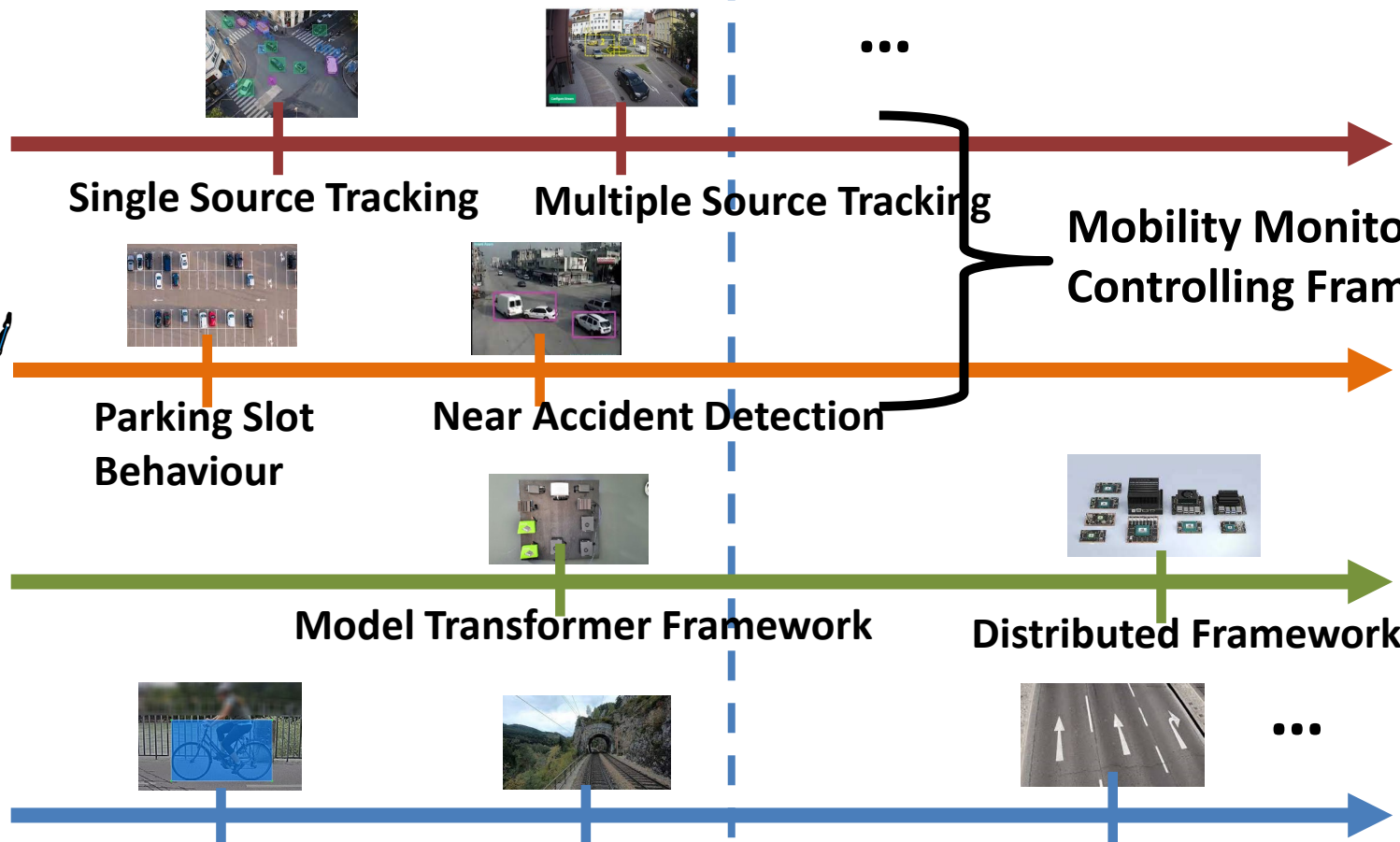
Behaviour



Embedded



Data Factory



Single Source Tracking

Multiple Source Tracking

Mobility Monitoring & Controlling Framework

Parking Slot Behaviour

Near Accident Detection

Model Transformer Framework

Distributed Framework

Bike/ebike & other DS

WGAN for synthetic data

Pavement Analysis

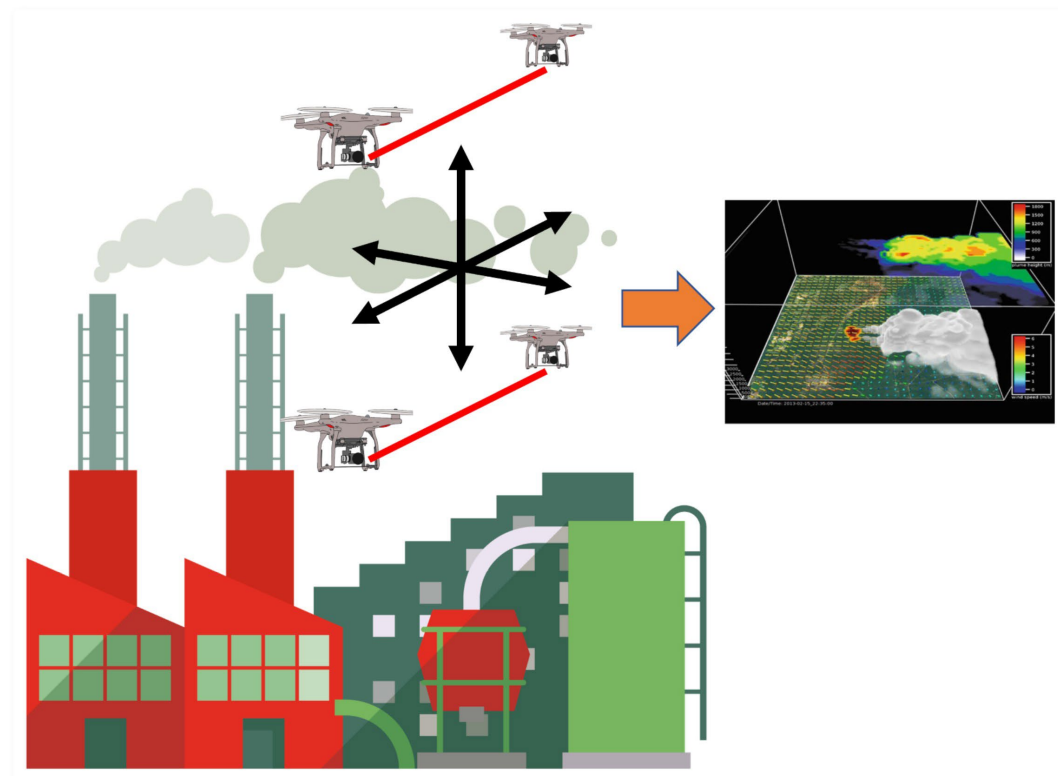
Ongoing Research Activities through Scientific Community

**SpecDrone:** FFG-Take-Off project for research on novel sensor system and drone coordination flight for the Detection of methane gas in dumps and other sites.



Period: 2023 - End  
2025

4 Partner from Austria



# Automated Mobility Region Kufstein

## Application: Hydrogen based drone platform

**HyDroneREC:** FFG-FORTE project for research on novel sensor systems for surveillance tasks and additive manufacturing concepts for the development of hydrogen based drone platforms.



Period: 2024 - End  
2026

4 Partner from Austria



# Automated Mobility Region Kufstein

## Application: SAR for Cross-Border Mountain Rescue

**Start 2:** Interreg IT-AUT project for research on swarm based drone platforms in order to support Mountain rescue services in SAR (search and rescue) missions.

**Interreg**  
Italia - Österreich  Co-funded by  
the European Union

Period: 2024 - End  
2027

6 Partner from Austria,  
Italy and Germany



**AI4GREEN:** Interreg BAY-AUT project for research on swarm based UAS platforms for supporting agriculture use cases for reducing resources like fuel, fertilizer, etc..

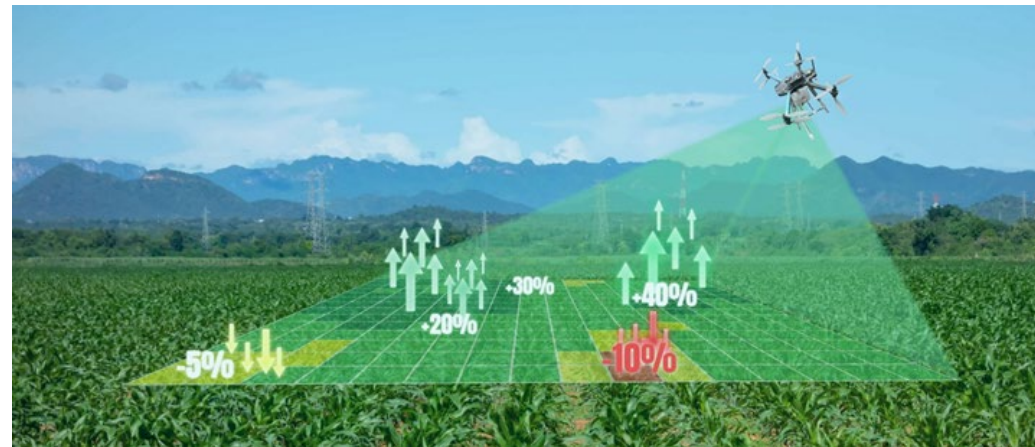
**Interreg**  
Bayern-Österreich



Kofinanziert von der  
Europäischen Union

Period: 2024 - End  
2027

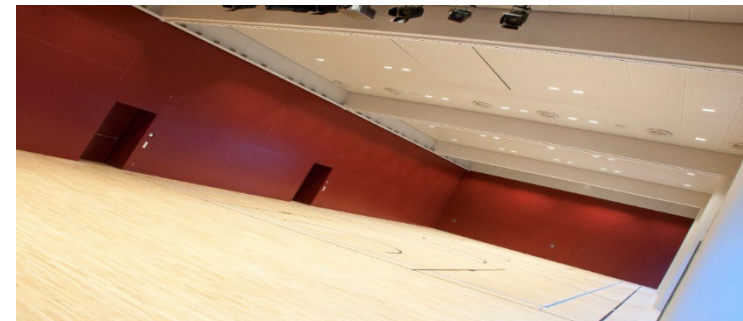
8 Partner from Austria,  
and Germany



- Drone Lab @ FH Kufstein Tirol (indoor & outdoor lab)
  - Research on automated drone applications.
  - Support of teaching in the respective study programs (Smart Products & Solutions and Data Science) and support of business partner.
  - Motion Capturing System (company Vicon <https://www.vicon.com/hardware/>)
  - 10 Crazyflies company Bitcraze and other construction kits.

### Video:

[https://www.linkedin.com/posts/mariodoeller\\_dronelab-activity-6891368957824368640-IUo0?utm\\_source=share&utm\\_medium=member\\_desktop](https://www.linkedin.com/posts/mariodoeller_dronelab-activity-6891368957824368640-IUo0?utm_source=share&utm_medium=member_desktop)

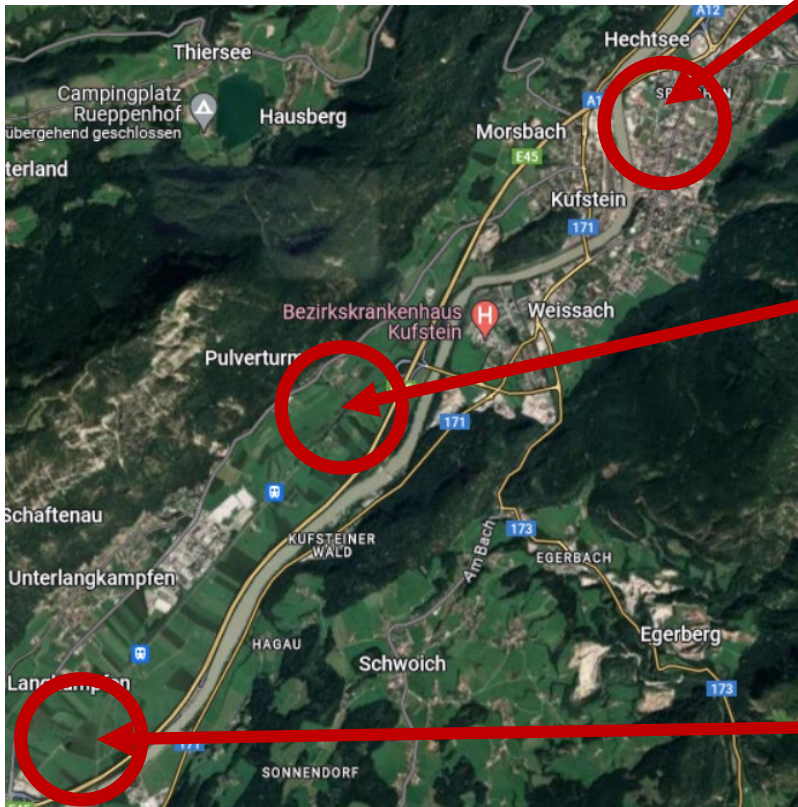


# Automated Mobility Region Kufstein

## Drone Lab – Outdoor Field

- Two Outdoor Fields => Airfield of regional airport and flying field of an union for model airplanes

University of Applied Sciences Kufstein Tirol



Airfield of regional model airplane club

Thank you for listening!



# Automated Mobility @ Region Kufstein

## Excerpt of Publications

Christian Schmid, Mario Döllner, **Additive Manufacturing in general and for the UAV Market in special**; In: NEW DEAL Research Agenda, ÖWGP (Österreichische Wissenschaftliche Gesellschaft für Produktionstechnik), pp. 8-13, Editor: Alois Ferscha; 2023

Nick Kachelriess, Kieran Quaine, Julian Bialas, Christian Schmid, Niusha Shakibi Nia, Eva Wernig, Christian Neuner, Gernot Mariacher, Mario Döllner, and Nikolaus Fleischhacker; **Efficient and Innovative Hydrogen Tank Design for a Lightweight Hydrogen-Powered Drone**; In Proceedings of the European Hydrogen Energy Conference, Poster Session, Bilbao, Spain, 2024.

Julian Bialas, Mario Döllner, Robert Kathrein, **Robust Multi-Agent Coverage Path Planning for Unmanned Aerial Vehicles (UAVs) in Complex 3D Environments with Deep Reinforcement Learning**, In Proceedings of the IEEE International Conference on Robotics and Biomimetics (IEEE ROBIO), Samui, Thailand, 2023.

Robert Kathrein, Oliver Zeilerbauer, Johannes Georg Larcher, Mario Döllner, **Concept for anonymous Re-Identification**, In Proceedings of the 34th FRUCT conference, IEEE Explore, Riga, Latvia, 2023.

Mirjam Klammsteiner, Mario Döllner, Patrik Golec, Michael Kohlegger, Ehtsham Rashid, Stefan Mayr, **Vision based stationary railway track monitoring system**, In Proceedings of the 33th FRUCT conference, IEEE Explore, Zilina, Slovakia, 2023.

Krispin Raich, Robert Kathrein, Mario Döllner, **Evidence Based Trust Scoring for Multimodal VANET Applications**, In Proceedings of the IEEE Intelligent Vehicles Symposium (IV), Anchorage, Alaska, USA, DOI: 10.1109/IV55152.2023.10186815, IEEE, 2023.

Julian Bialas, Mario Döllner, **Coverage Path Planning for Unmanned Aerial Vehicles in Complex 3D Environments with Deep Reinforcement Learning**, In Proceedings of the IEEE International Conference on Robotics and Biomimetics (IEEE ROBIO), Xishuangbanna, China, DOI: 10.1109/ROBIO55434.2022.10011936, 2022.

Krispin Raich, Robert Kathrein, Mario Döllner, **Large scale multimodal data processing middleware for ITS applications**, In Proceedings of the 30th IEEE International Conference FRUCT, Oulu, Finland, IEEE, DOI: 10.23919/FRUCT53335.2021.9599964, 2021.

# Automated Mobility @ Region Kufstein

## Excerpt of Publications

Robert Kathrein, Krispin Raich, Mario Döllner, **Detection of Dangerous Goods with cellular sensor network and drone based deployment system**, In Proceedings of the 30th IEEE International Conference FRUCT, Oulu, Finland, 2021.

Mario Döllner, Krispin Raich, Robert Kathrein, **Data processing pipeline for automated multimodal mobility**, In Proceedings of the Sixteenth International Conference on Autonomic and Autonomous Systems (ICAS), 2020, Lisbon, Portugal, Invited Panel contribution

Krispin Raich, Robert Kathrein, Michael Erharter, Mario Döllner, **Spatial Extension model for multimodal traffic management**, In Proceedings of the International Conference on Intelligent Vehicles (ICoIV 2020), Berlin, Germany, 2020.