aerodays2015
Aviation in Europe – Innovating for Growth
The 7th European Aeronautics Days

myCopter: Enabling Technologies for Personal Aerial Transportation Systems

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Max-Planck-Institut
für biologische Kybernetik

The dream of Personal Aerial Vehicles

Technology exists to build aircraft for individual transport

- many concepts have already been developed

Drawbacks of current designs

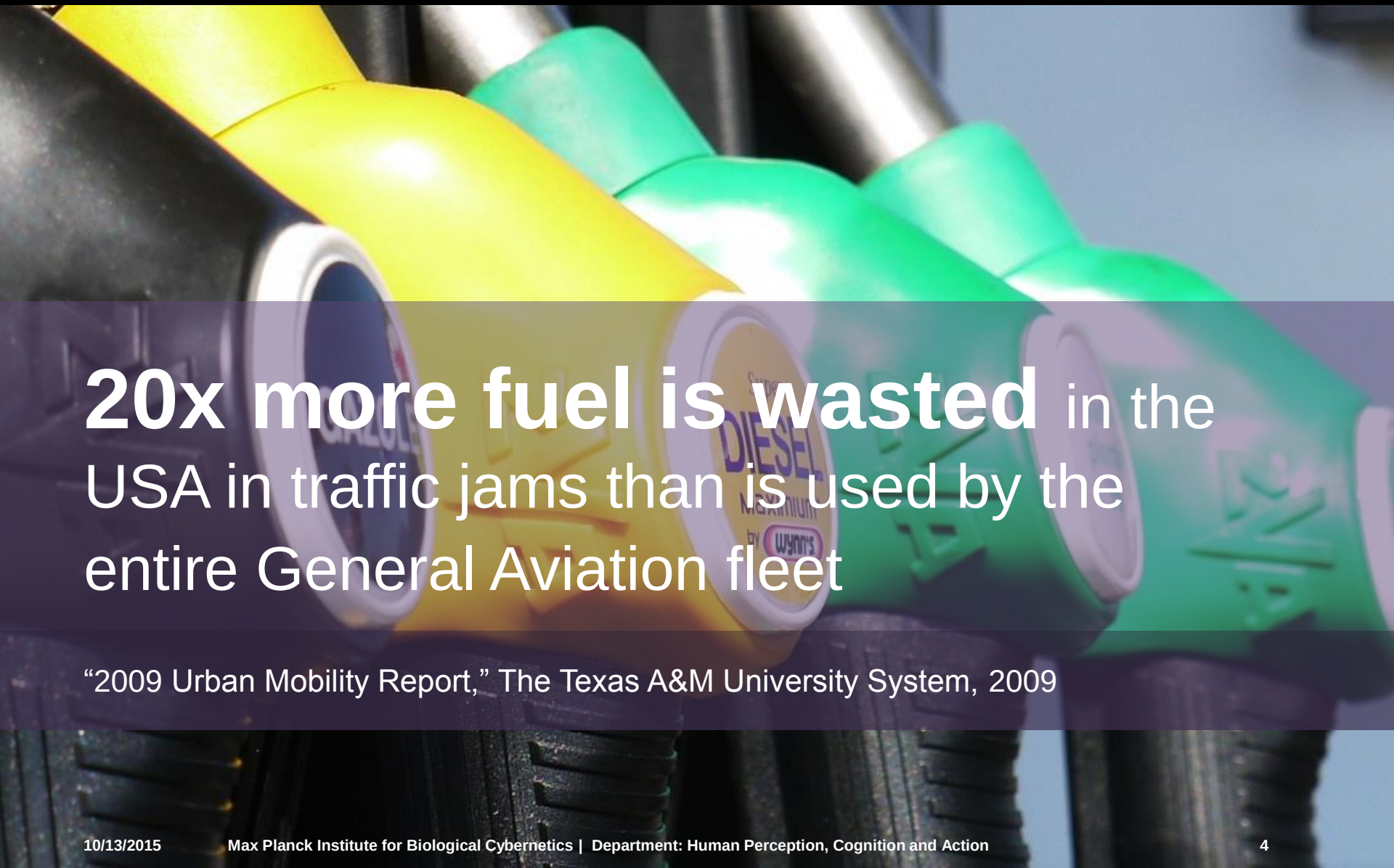
- Need for of a pilot license
- Need for infrastructure (e.g., landing strip)
- Focus on vehicle design instead of transport system

Motivation for Personal Aviation

100 Billion Euro is lost yearly in the EU due to congestion

"Green Paper – Towards a new culture of urban mobility," Sept. 2007, Commission of the European Countries, Brussels.

Motivation for Personal Aviation



20x more fuel is wasted in the USA in traffic jams than is used by the entire General Aviation fleet

"2009 Urban Mobility Report," The Texas A&M University System, 2009

Motivation for Personal Aviation

In large European cities, car drivers spend **more than 50 hours per year** in traffic jams

"Roadmap to a Single European Transport Area," 2011

Challenges for Personal Aviation

“Designing the air vehicle is only a relative small part of overcoming the challenges… The other challenges remain…” [EC, 2007]

- How many?
- Who can fly?
- What about safety, noise, … ?
- How are PAVs integrated into existing transport systems?

European Commission, Out of the box – Ideas about the future of air transport, 2007

EU-project: myCopter

- Duration: Jan 2011 – Dec 2014
- Project cost: €4,287,529
- Project funding: € 3,424,534

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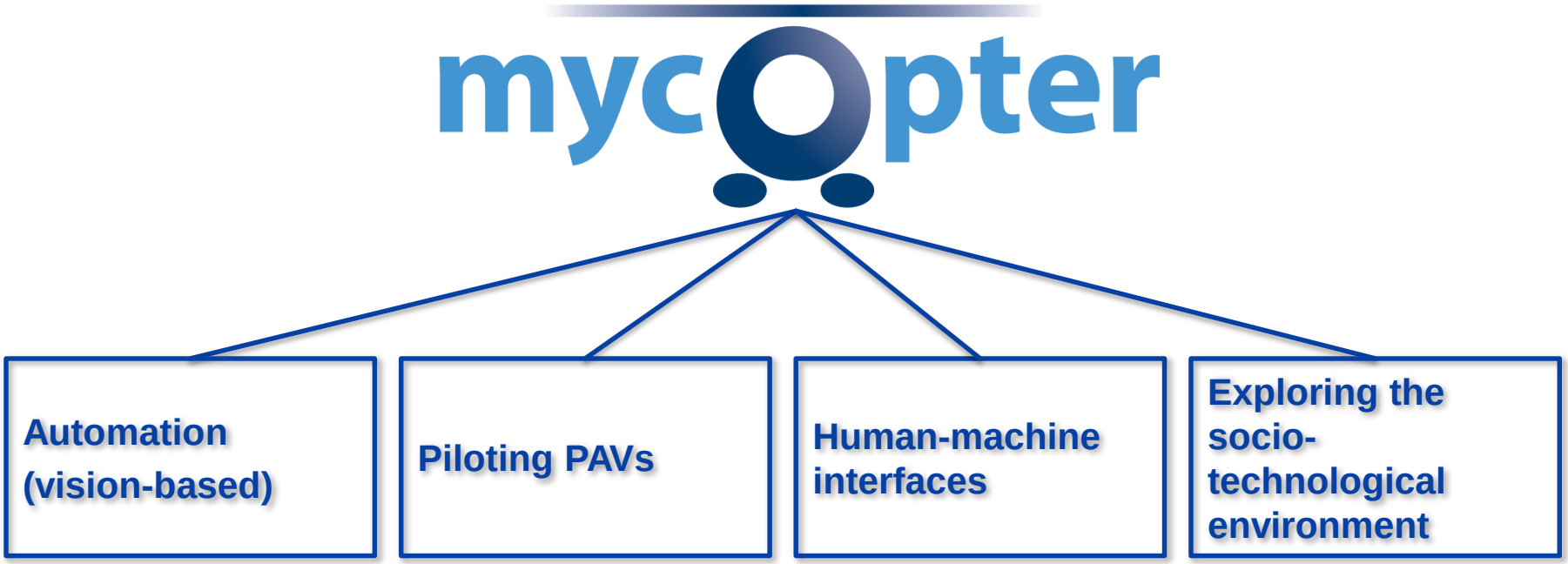
ETH Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

KIT Karlsruhe Institute of Technology

DLR

Enabling Technologies for Personal Aviation



- Navigation
- Landing place assessment
- Sensor-fusion for collision avoidance

- Shared control between human and automation
- Situational awareness

- Control interfaces and displays
- Multi-sensory feedback

- Acceptance: noise, safety, fuel, cars in the sky
- Integration into current transport systems

Novel Approaches to Automation

Goal: Develop robust novel algorithms for vision-based control and navigation

Challenges

- Emulate VFR pilots
  - Recognize obstacles and other traffic
  - Recognize landing areas
  - In all season and in adverse weather conditions

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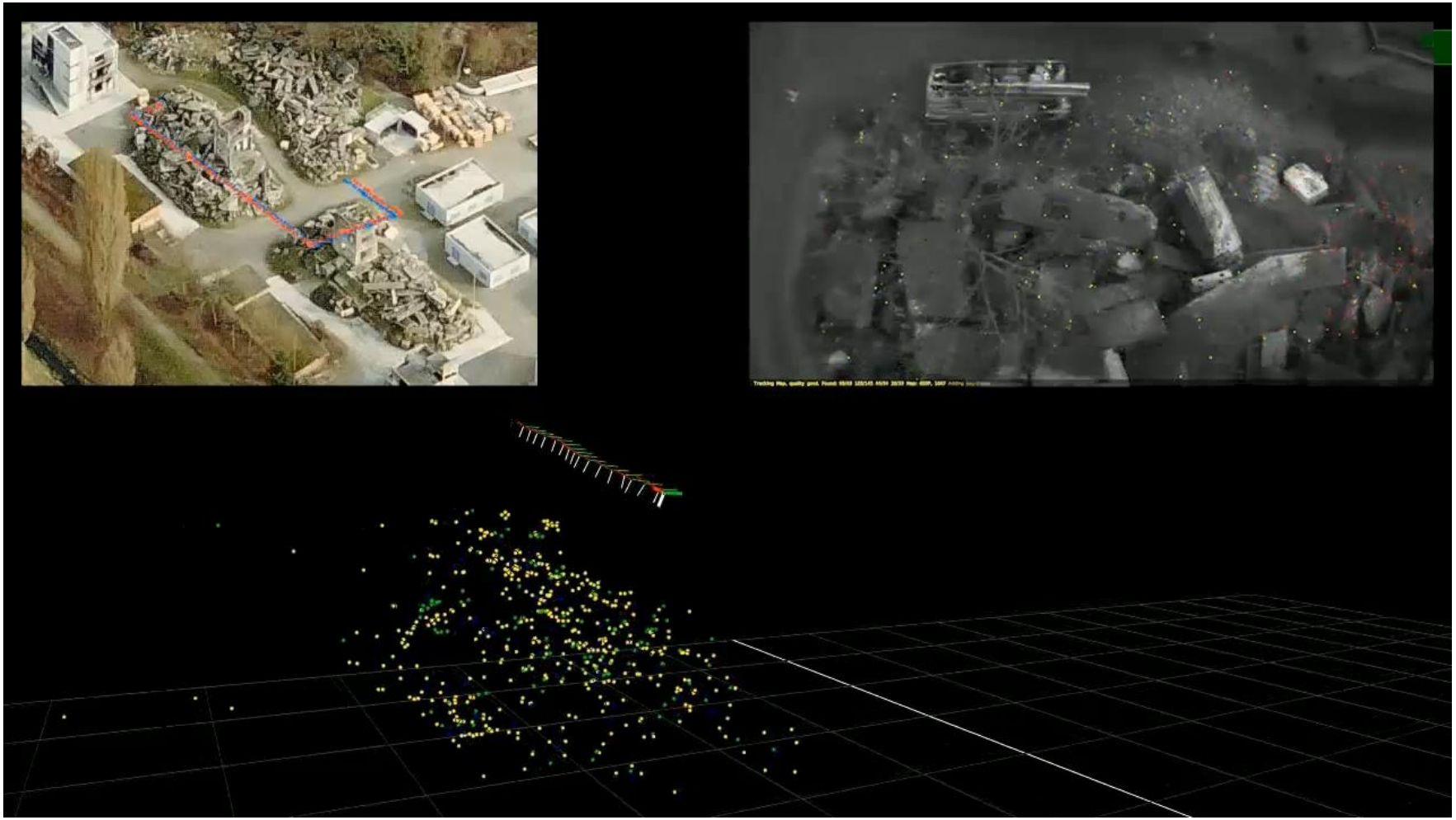
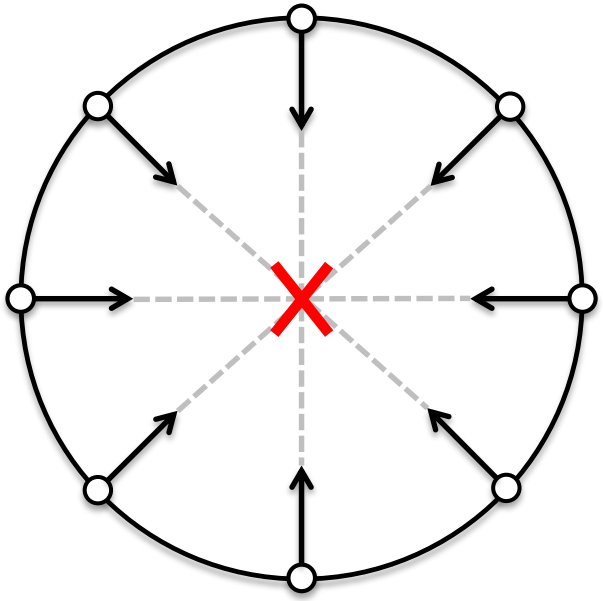
Framework for Vision-Based Navigation



Collision Avoidance Strategies

50 vehicles at the same altitude fly from a point on a circle to a point on the opposite side



Demonstration of Swarm Technology

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Piloting PAVs

Goal: Develop augmentation for PAVs

Challenges

- Flying a helicopter is difficult and requires lots of training
- It is not clear which skills prospective pilots should have

Augmented PAV Dynamics

Develop and assess new response types for VTOL vehicles

Basic helicopter rate control with cyclic

⋮

Attitude control (pitch and roll)

⋮

Translation control (forward/lateral velocity)
Turn coordination, heave augmentation

⋮

Car-like steering

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Human-Machine Interfaces

Goal: Develop human-machine interfaces that make flying as easy as driving a car

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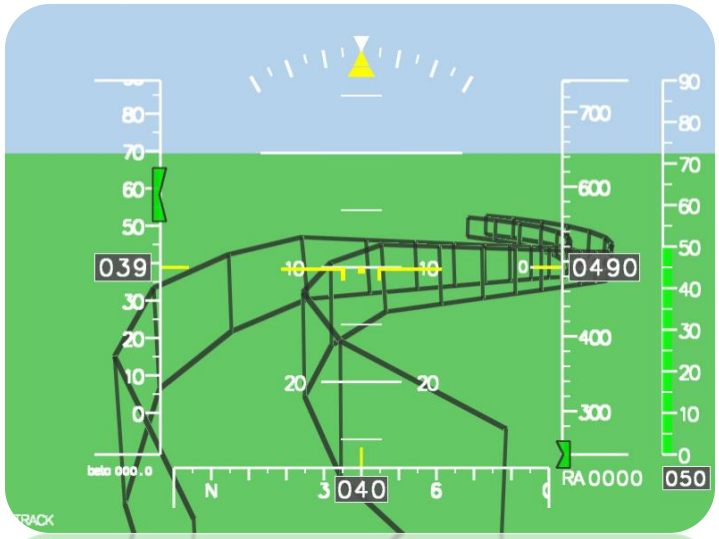
Challenges

- Current flight controls and displays are not intuitive
- Multisensory perception is not taken into account
- No reliable objective measurements of pilot workload

Intuitive Displays and Controls

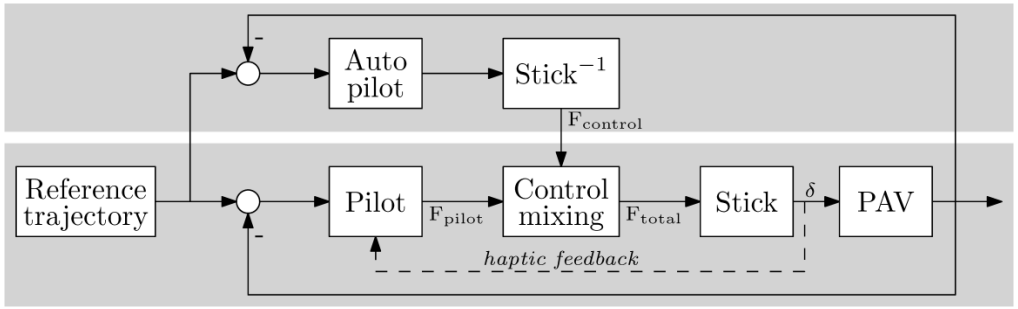
- Highway-in-the-Sky display
- Active sidestick to feel the highway (spring-like guidance forces)



Multi-sensory Human-Machine Interfaces

Novel HMI: haptic shared control

- Combining the advantages of manual and automatic control
- The pilot remains in control and can overrule the automatic control system



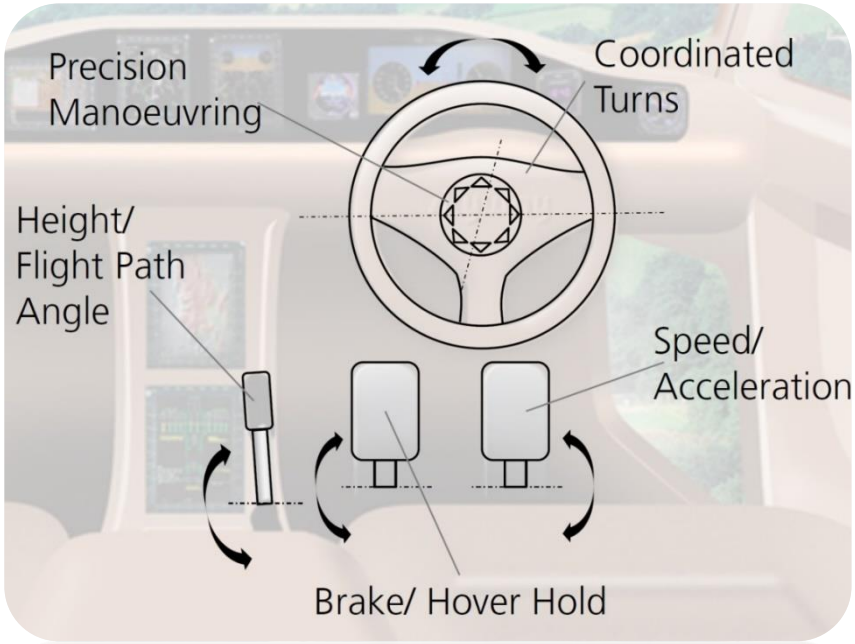
Objective Measures for Workload using EEG

Novel mental workload measures

- Traditionally with questionnaires, such as NASA-TLX
- Alternative: psychophysiological measures, EEG, heart-rate variability, skin conductance

Human-Machine Interfaces

Exchange helicopter flight controls with a steering wheel and pedals



HMI Demonstration in DLR Simulator

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The Socio-Technological Environment

Goal: Generate knowledge on the demands and preferences of society towards PAVs

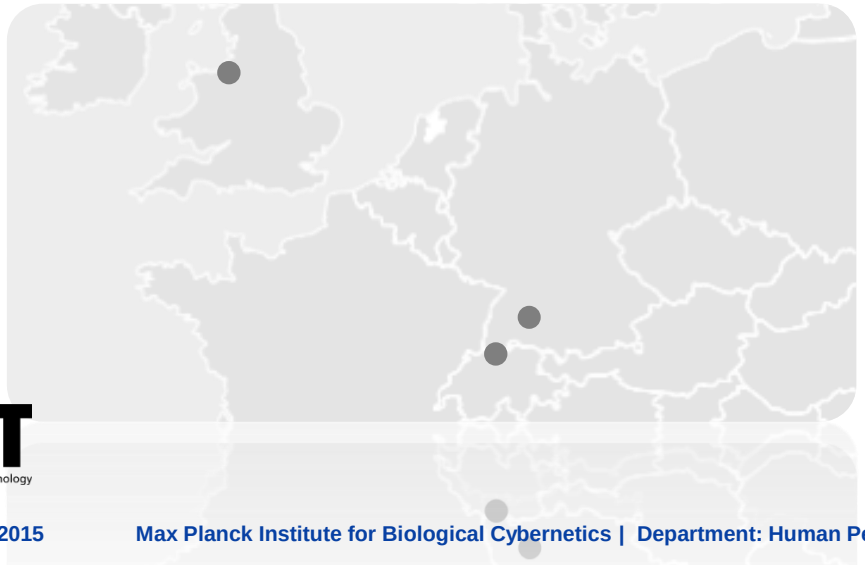
Challenges

- Identifying hurdles for introducing PAVs
- User expectations and objections
- Investigating where PAVs could have an impact

How do people see Personal Air Transport?

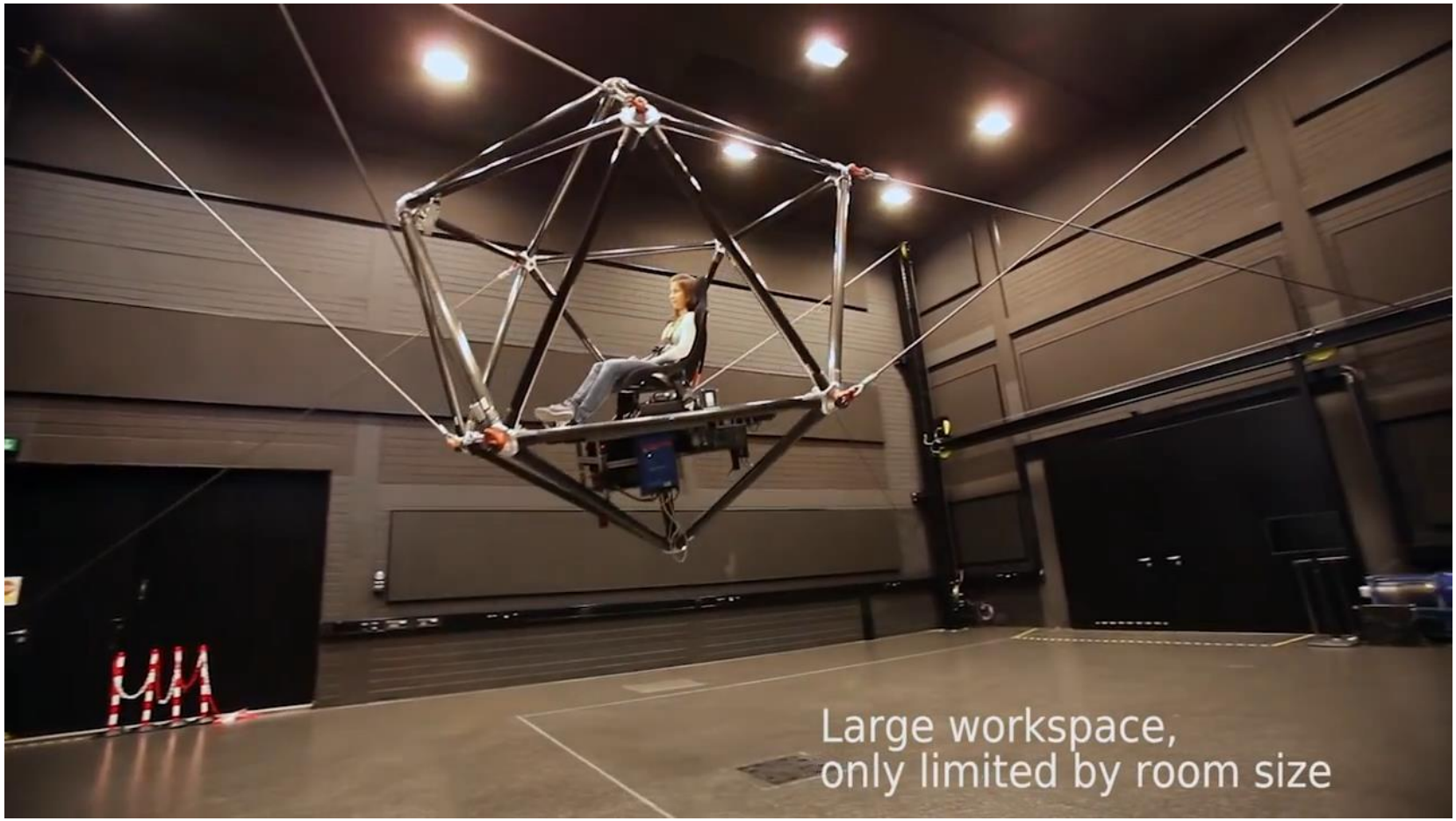
Focus group interviews in 3 European countries to determine user perceptions and expectations

1. Discussion on mobility patterns and behaviour as well as perceived promises and actual expectations on PAV / PATS
2. Demonstration of a PAV ride in a simulator
3. Discussion on PAV-specific aspects such as design, operational environment, autonomy, usability, etc.



Where do we go from here?

Developing PAV handling with MPI's high fidelity motion simulator



CableRobot Simulator: https://youtu.be/cJCsomGwdk0

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