myCopter:
Enabling Technologies for Personal Aerial Transportation Systems

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Max-Planck-Institut für biologische Kybernetik

The dream of Personal Aviation

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 often on vehicle design instead of transport system

Challenges for Personal Aviation

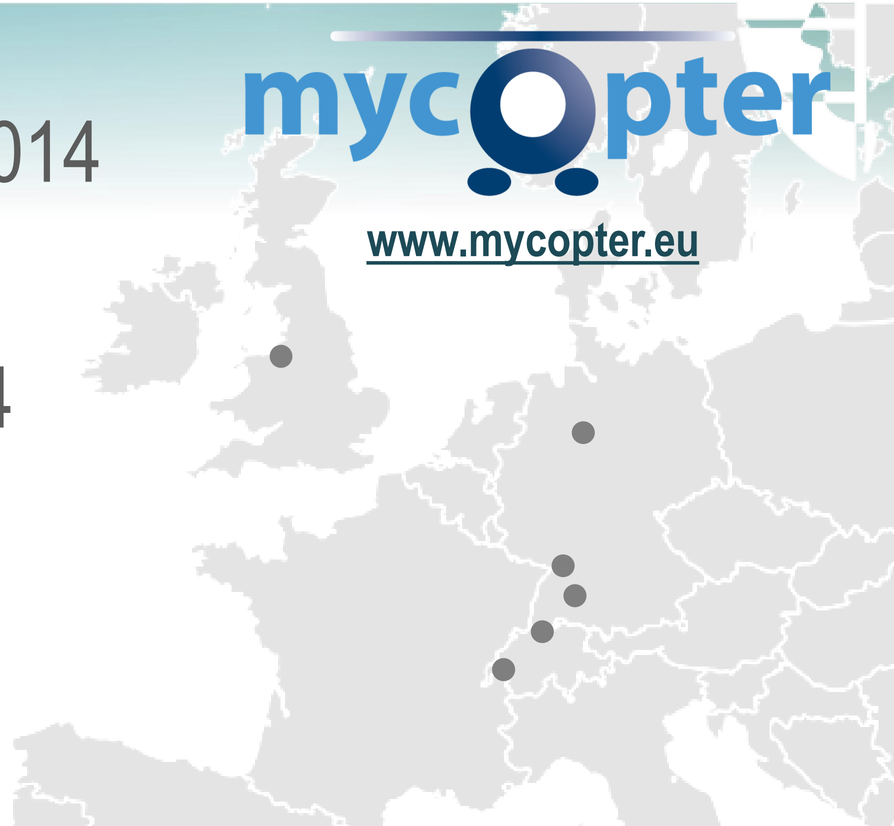
"Designing the air vehicle is only a relative small part of overcoming the challenges… The other challenges remain…" [EC, 2007]

- Accessibility to large audience?
- Vehicle dynamics? Training?
- Automation? Human interaction?
- Safety, noise, … ?
- Integration?

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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DLR

Enabling Technologies for Personal Aviation

mycopter

Automation and autonomy

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

Human-machine interfaces and training

- Control interfaces and displays
- Shared control
- Multi-sensory feedback

Socio-technological environment

- 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

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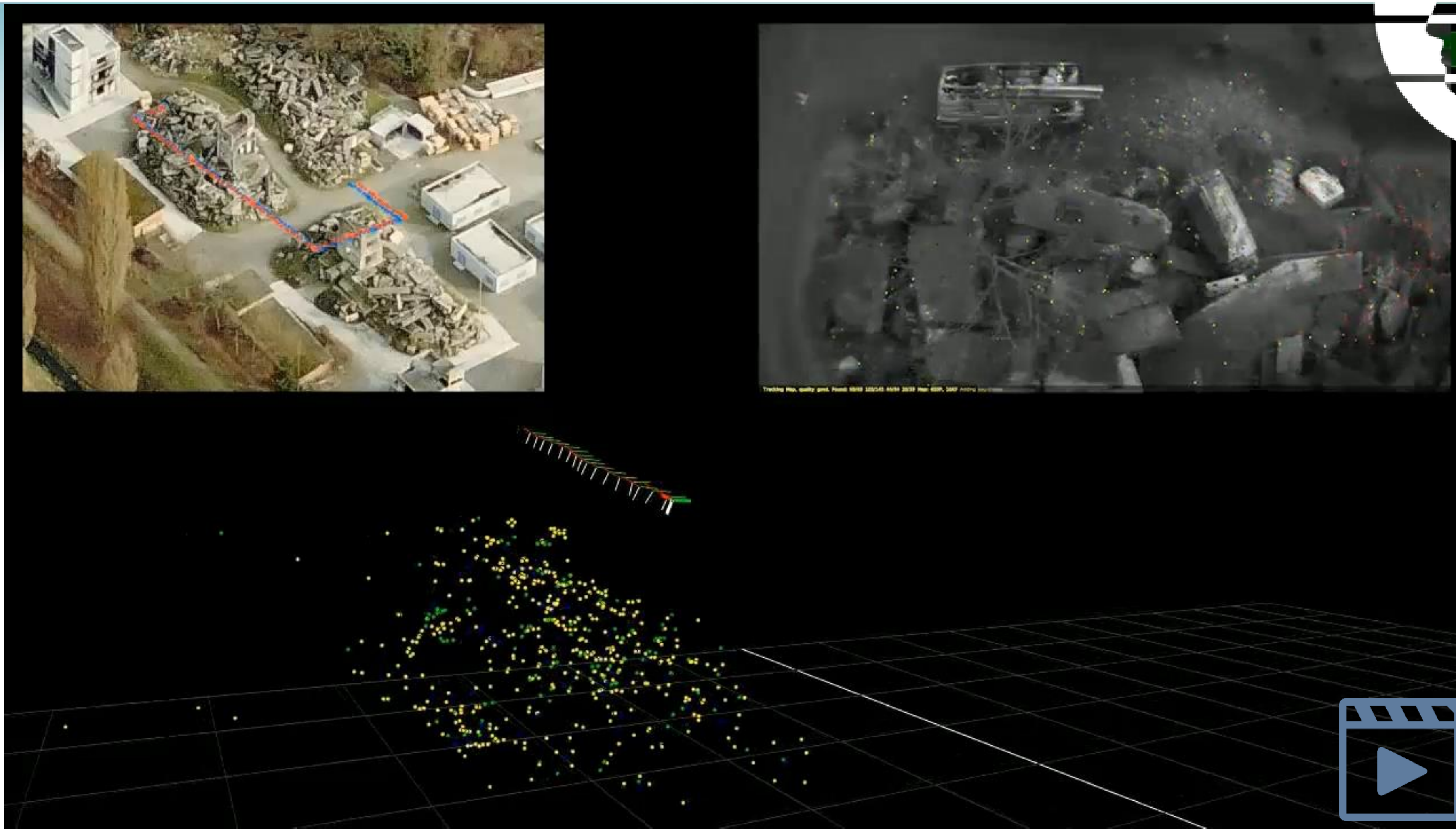
Challenges

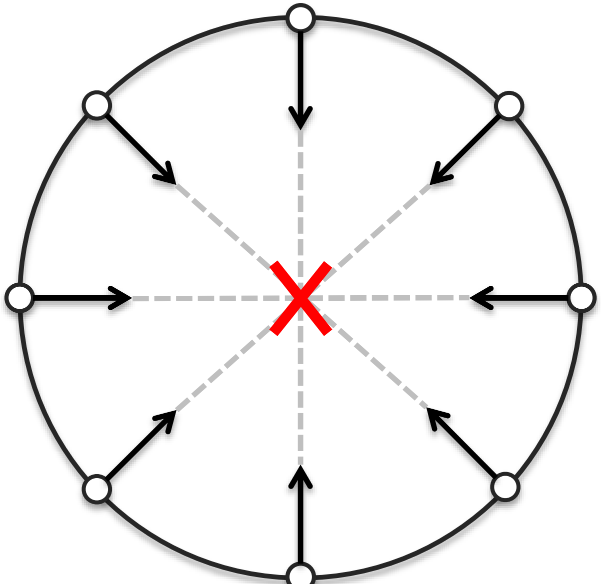
- Recognize obstacles and other traffic
- Recognize landing areas
- In all season and in adverse weather conditions

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



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Demonstration of Swarm Technology

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Piloting Personal Aerial Vehicles

Goal: Develop response requirements for PAVs

Challenges

- Flying a helicopter is difficult; requires lots of training
- Determine response type that is flyable by novice "flight-naïve" pilots
- Determine the training requirements for PAV pilots

PAV response types

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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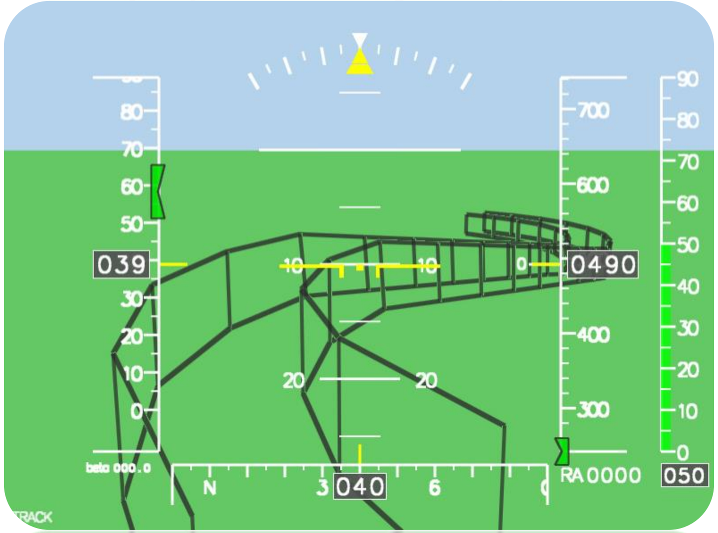
Challenges

- 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
- Haptic aid: active sidestick to “feel” the highway



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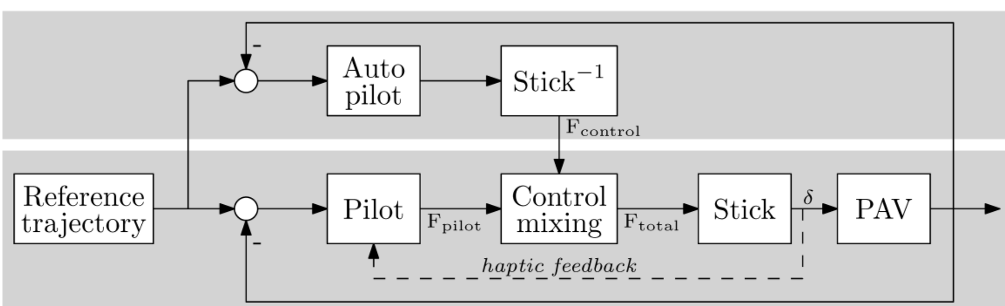
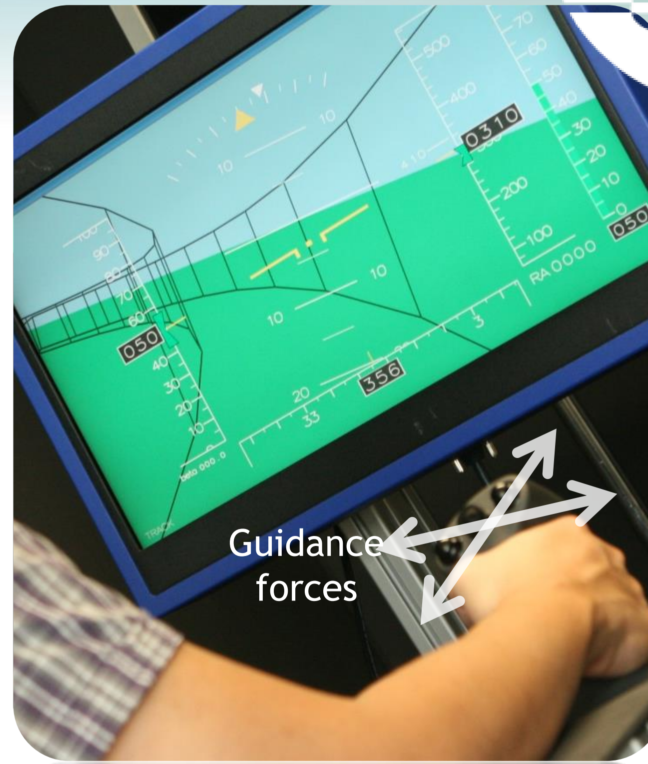
Multi-sensory Human-Machine Interfaces

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





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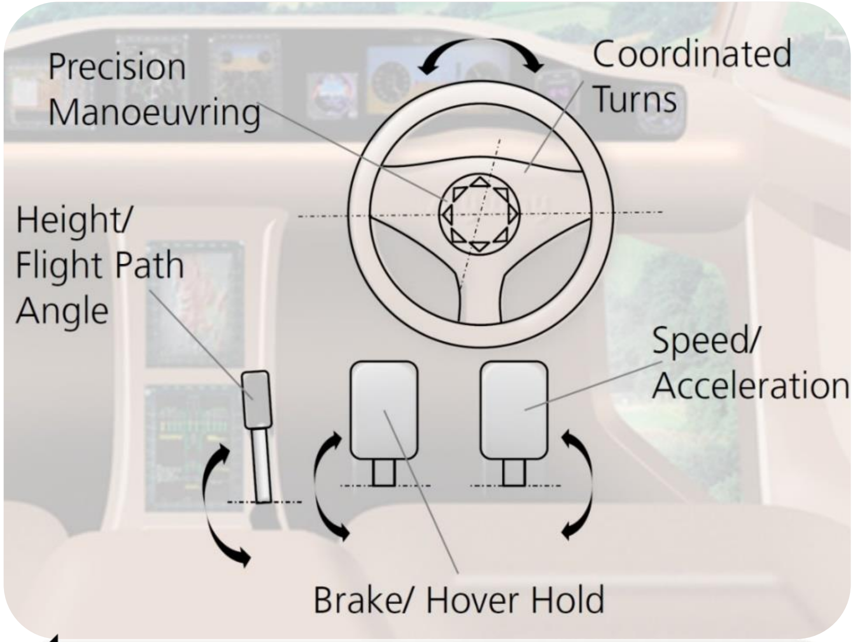
Objective Measures for Workload

Human-Machine Interfaces

Exchange helicopter flight controls with a steering wheel and pedals



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HMI Demonstration in DLR Simulator

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

Societal Expectations and Preferences

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.

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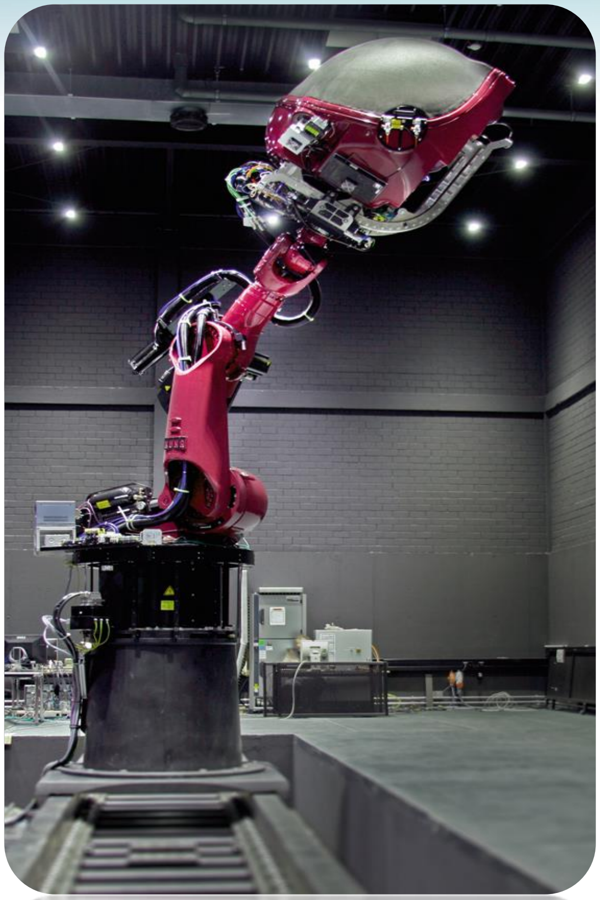
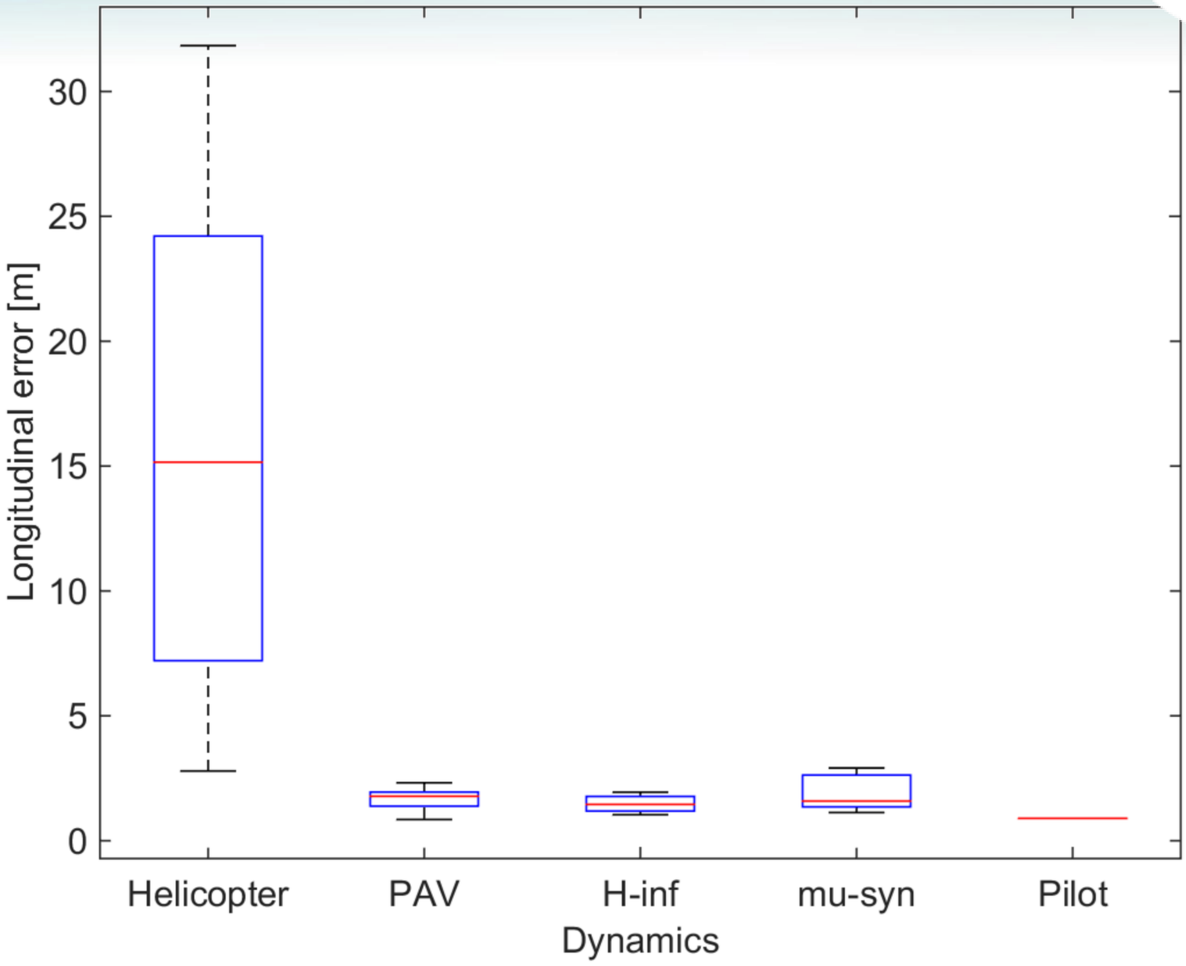
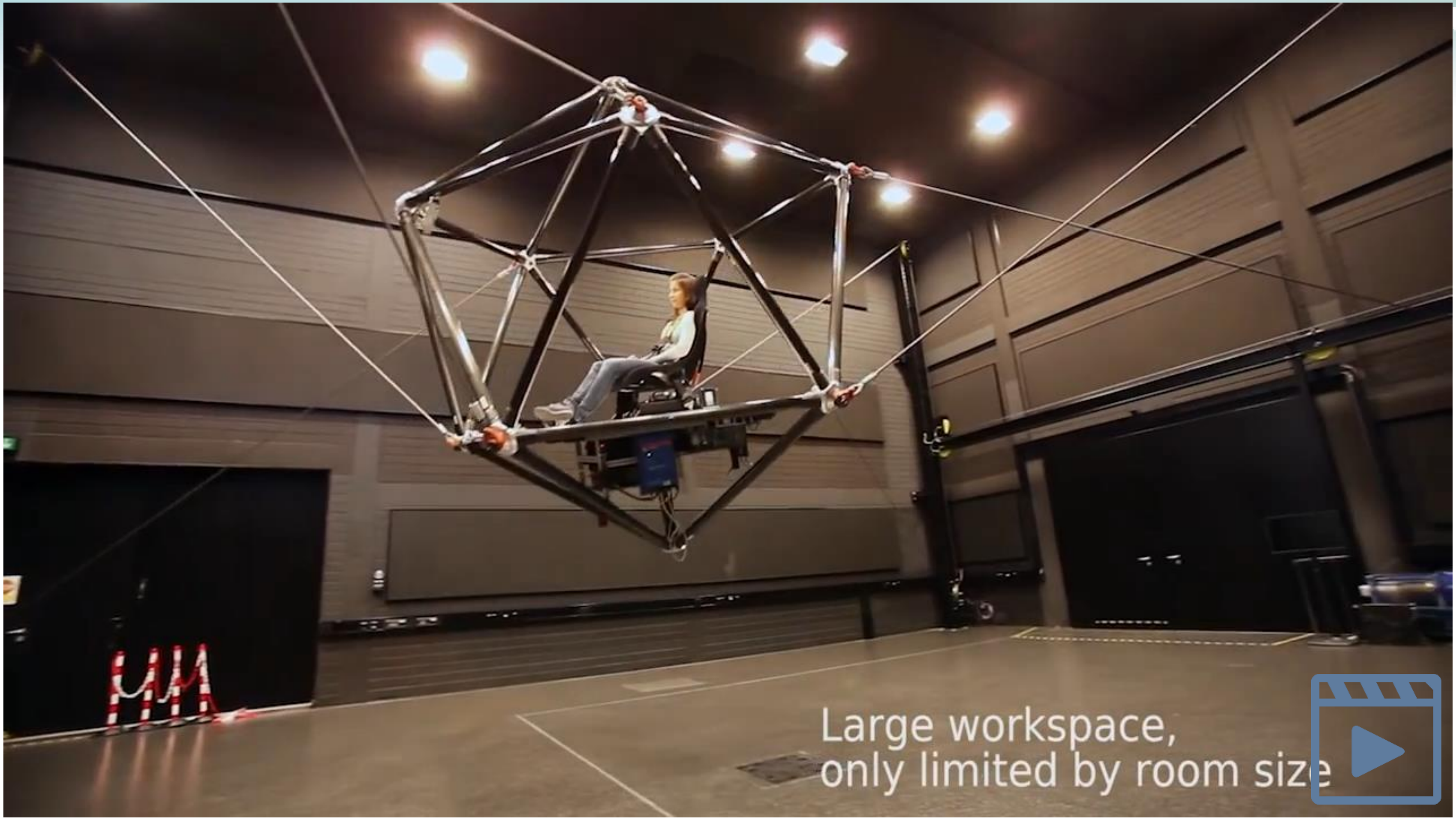
Ongoing work: helicopter augmentation





Ongoing work: CableRobot Simulator



CableRobot Simulator https://youtu.be/cJCsomGwdk0

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