http://www.mycopter.eu

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myCopter – Enabling Technologies for Personal Aerial Transportation Systems

Heinrich Bülthoff & Frank Nieuwenhuizen

Max Planck Institute for Biological Cybernetics

- **MPI, Tübingen**
- UoL, Liverpool
- DLR, Braunschweig
- KIT, Karlsruhe
- ETH, Zürich
- EPFL, Lausanne

- Duration: Jan 2011 – Dec 2013
- Project cost: €4,287,529
- Project funding: € 3,424,534

SEVENTH FRAMEWORK PROGRAMME

UNIVERSITY OF LIVERPOOL

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich

KIT Karlsruhe Institute of Technology

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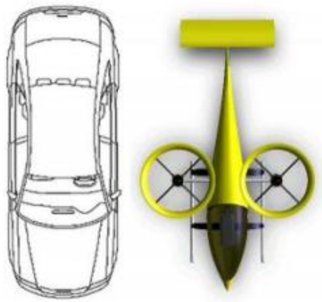
Rationale for the project

- Growing volume of ground and air based transportation
  - Air: fast, well-trained pilots, specific locations
  - Ground: slower, general population, door-to-door

- Start using the 3rd dimension for personal transportation!
  - Move towards a Personal Aerial Transportation System (PATS)
  - Our vision: travel between home and work on short distances



PATS not PAV

- The goal is not to build a specific PAV
  - "Designing the air vehicle is only a relative small part of overcoming the challenges… The other challenges remain…" [*EC, 2007*]

- but to address the challenges of building a PATS (Personal Aerial Transportation System)

[*EC, 2007*] European Commission, Out of the box- Ideas about the future of air transport, 2007

Objectives of the project

Provide enabling technologies for Personal Aerial Transportation Systems

- Without focusing on a specific design of a Personal Aerial Vehicle
- The myCopter project will investigate
  - User-centered design of human-machine interface for PAVs
  - Novel training techniques for the inexperienced 3D driver (PAV pilots)
  - New technologies for vehicle automation and control
  - Social and technological impact of a PATS

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Human-Machine interaction and training issues

- Interaction with a PAV is of crucial importance
- Human-machine interface should consider human perception and cognition
- How can we effectively train people?

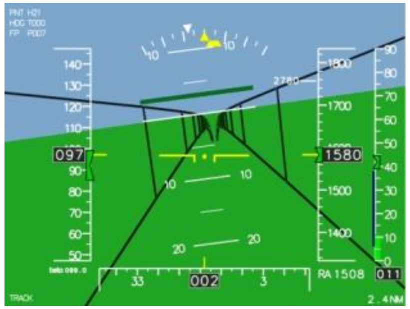
Automation of aerial vehicles

- PAVs should be autonomous to a very high degree
- Automatic take-off and landing
- Navigate in cluttered environments
- Swarm behavior of vehicles

Exploring the socio-technological environment

- Large impact on society can not be ignored
- What are the expectations of users and regulators?
- Integration into current transportation systems

User-centered design of a Human-Machine Interface and training requirements



Better understanding of the perceptual and cognitive capabilities of average PAV users is essential

Novel design of an HMI (MPI)

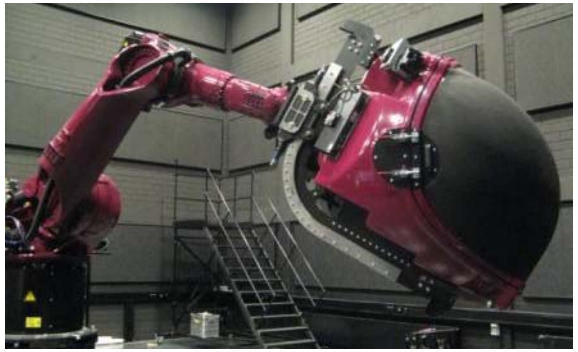
- How to display information to the pilot
- Provide additional senses with fast and easily understandable cues (multisensory approach)
  - Synthetic vision
  - Haptic cues and auditory cues

Training requirements (UoL)

- Quantify training effectiveness
- Examine emergency situations

myCopter research tools

MPI CyberMotion Simulator



DLR Flying Helicopter Simulator

UoL HeliFlight R

ETHZ and EPFL Unmanned Aerial Vehicles

HELI TRAINER

HELI AVIATION services · school · technology

KUKA

Automation of aerial vehicles

Some automation will be required for the average human to fly a PAV

Approach

- Control and navigation of a single PAV (ETH)
    - Vision-aided localization and navigation
    - Automatic take-off and landing
- Navigation in the air (EPFL)
    - Mid-air collision avoidance
    - Formation flying
    - Vision-based relative positioning
- Evaluation of automation and HMI on FHS (DLR)

Social and economic impact (KIT)

PAVs have been discussed already for many years, but the impact on society and the social expectations have not yet been evaluated

Main questions

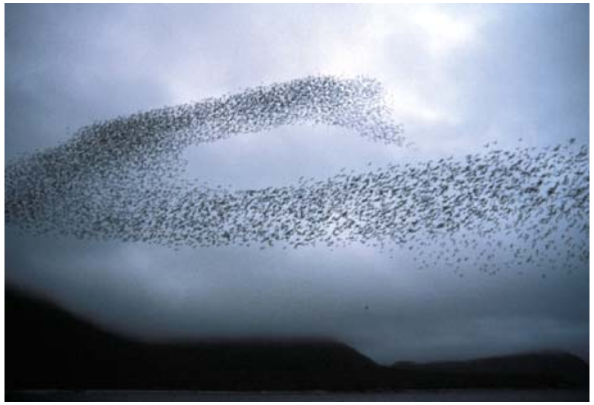
- How can PAVS be integrated into existing global transportation systems
  - Requirements on infrastructure and transport
  - Adaptation of the legal framework
- What degree of autonomy needs to be developed
- How does automation interact with the HMI
- What are the perspectives and expectations of a PAV user (Questionnaires and Interviews)

Strategic impacts of a PATS

- Environmental benefits
  - spending less fuel and time in traffic by using the 3rd dimension
  - fuel efficiency with future engine technologies
- Usage of PAVs will allow for enhanced flexibility in urban planning (fewer roads, bridges and also less maintenance)
- Results for integrating a user-friendly HMI, autonomous control, path planning, and collision avoidance for generic aerial systems

Innovations

- Design of a user-centred multi-sensory HMI
- PAV handling qualities and training paradigms for the average user
- Autonomous control inspired by swarm behavior (birds)
- Formation flying using embedded sensing and distributed control
- Insight into socio-economic impact factors



We are not interested in building a PAV ... *yet*

but our work on the enabling technologies should lead us there

Prof. Dr. Heinrich Bülthoff
Frank Nieuwenhuizen

University of Liverpool
Prof. Dr. Gareth Padfield
Dr. Michael Jump
Dr. Marc White

EPFL École Polytechnique Fédérale de Lausanne
Prof. Dr. Dario Floreano
Prof. Dr. Pascal Fua
Dr. Jean-Christophe Zufferey

ETH Eidgenössische Technische Hochschule Zürich, Swiss Federal Institute of Technology Zurich
Prof. Dr. Roland Siegwart
Dr. Samir Bouabdallah

KIT Karlsruhe Institute of Technology
Prof. Dr. Michael Decker
Jens Schippl

DLR
Marc Höfinger

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SUPRA– Upset recovery training

Nine established research organisations from six different countries collectively aim at enhancing flight simulator technology beyond its current capabilities to allow for effective upset recovery training.

The next generation of multisensory games

Car Model
Ferrari F2007 F1 racing car

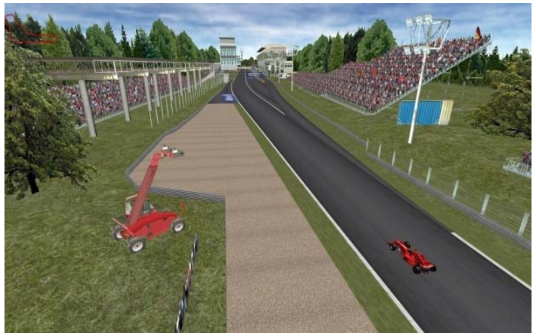
Race Track
Monza, Italy

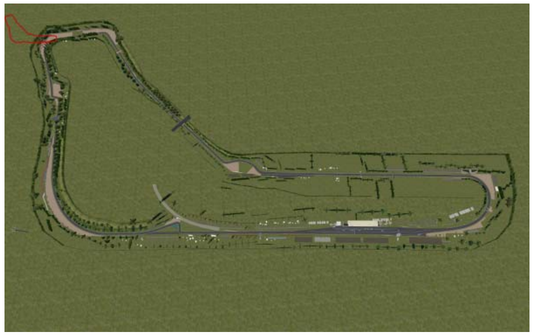
CyberMotion Simulator
based on Kuka KR500
6 axis robot, TÜV approved

Car Simulation and Control
Matlab/Simulink

3D Graphics Engine
Virtools

Extras
Force-feedback steering wheel
Recaro race shell seat
Curved video projection





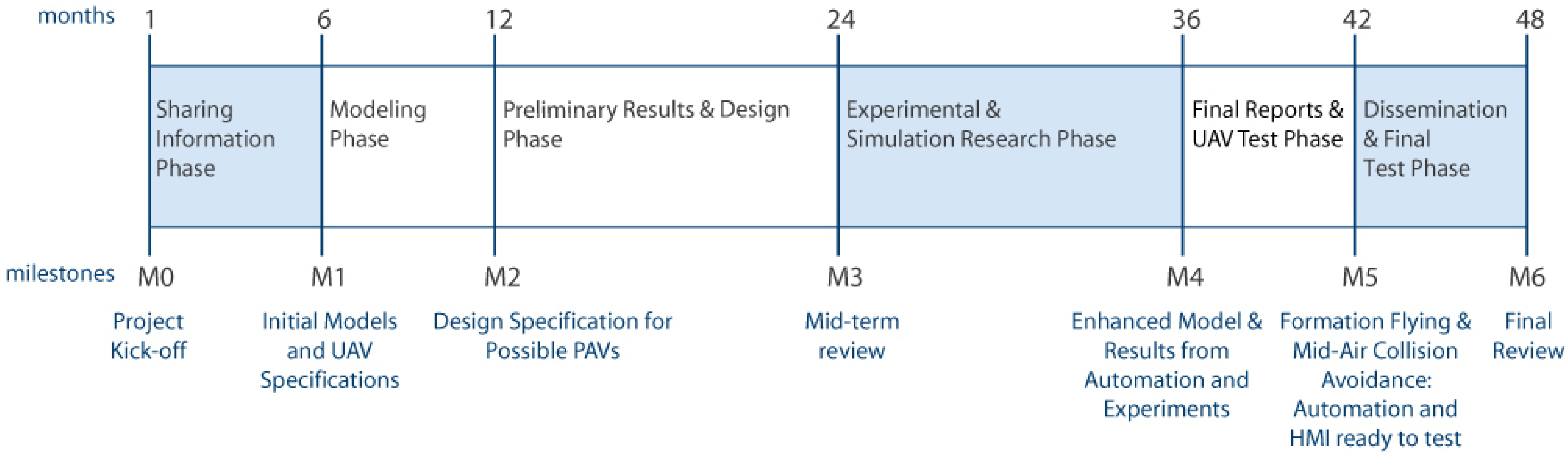
Future Developments

- Linear Axis (12m) October 2011
  - extend the linear workspace by 10m
  - for lane change manoeuvres in driving simulation
  - for autorotation manoeuvres in helicopter training

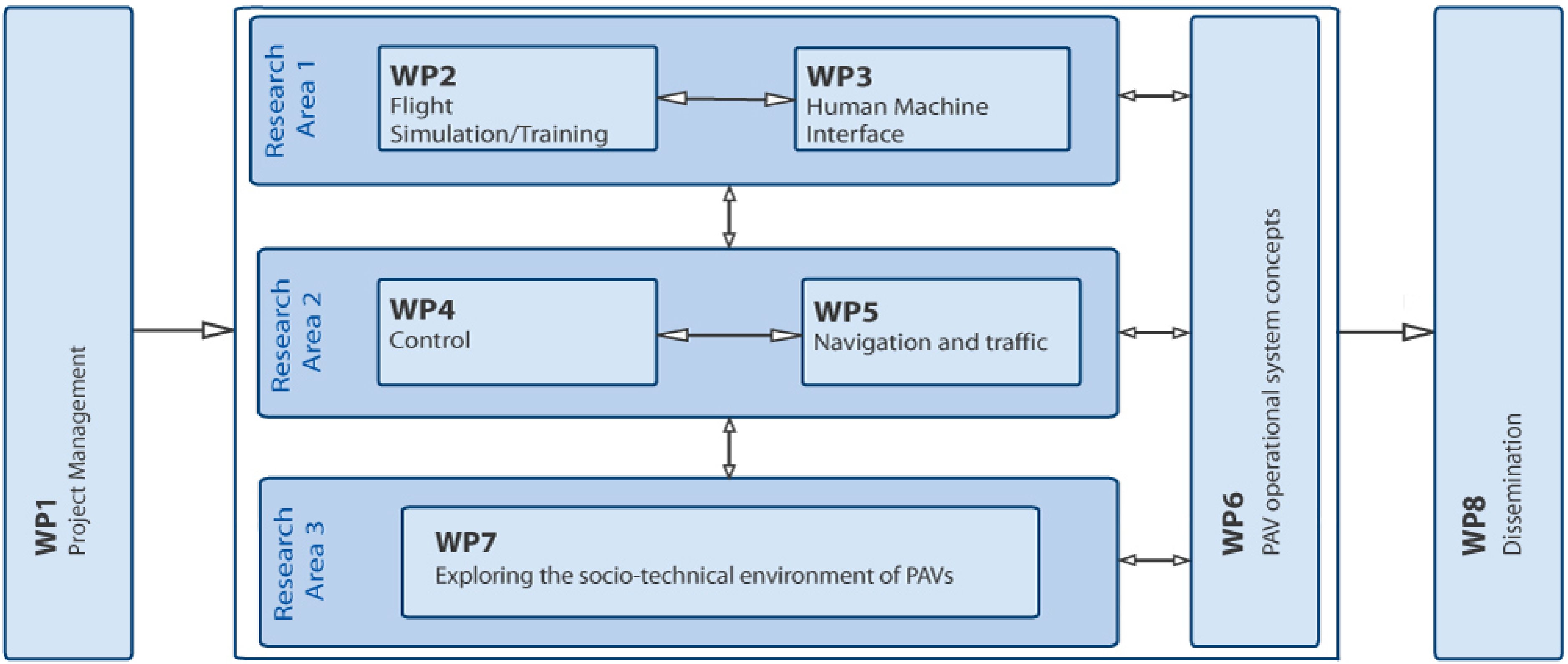
eCO2avia

- Concept by EADS Innovation Works
- Hybrid engine

Overall workplan



PERT Chart


WP1
Project Management
Research Area 1
WP2
Flight Simulation/Training
WP3
Human Machine Interface
Research Area 2
WP4
Control
WP5
Navigation and traffic
Research Area 3
WP7
Exploring the socio-technical environment of PAVs
WP6
PAV operational system concepts
WP8
Dissemination

Not focusing on a specific design of a PAV

Existing designs

- CarterCopter
- Urban Aeronautics X-Hawk
- Terrafugia Transition
- Gress Aerospace
- Entechno Hoverpod
- FALX Air
- etc.

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Goal of the myCopter project

- to address the challenges of building a PATS
  Personal Aerial Transportation System [*NASA, 2007*]
  - Simple piloting through a effective and intuitive human-machine interface
  - Solutions for autonomous control, collision avoidance, and traffic management
  - For acceptance by the public at large, PAVs need to be safe, reliable, and user-friendly

[*NASA, 2007*] NASA, The PAV Challenge – 2007 Results, 2007
[*EC, 2007*] European Commission, Out of the box- Ideas about the future of air transport, 2007

Thank you for your attention

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