What if we simply fly to work?

myCopter – Enabling Technologies for Personal Aerial Transportation Systems

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mycopter

Project funded by the European Union under
the 7th Framework Programme

http://www.mycopter.eu

The dream of flying cars is not new

- Many flying vehicles have been envisioned, but none made it to the market

ConVairAir, 1940s

Taylor Aerocar, 1950s

American Historical Society, 1945

Recent developments

- Technology exists to build aircraft for individual transport
  - Many concepts have already been developed
- Drawbacks of current designs
  - Not for everyone (needs a pilot license)
  - Could represent a compromised design

PAL-V

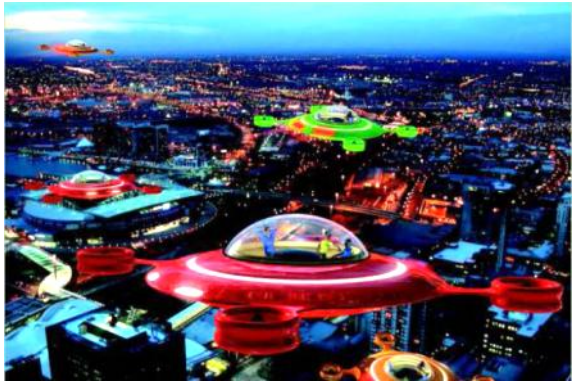
E-volo, Syntern GmbH

Transition® street-legal aircraft, Terrafugia

Many challenges ahead

- Our goal is not to design a specific Personal Aerial Vehicle (PAV)
  - "Designing the air vehicle is only a relative small part of overcoming the challenges… The other challenges remain…" [*EC, 2007*]

We want to address the challenges of building a Personal Aerial Transportation System (PATS)



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

Rationale for the project

- **Money:** *100 billion Euros* in the EU are lost due to congestion
  - 1% of the EU's GDP every year [EC, 2007]
- **Fuel:** *6.7 billion gallons* of petrol are wasted in traffic jams in USA
  - Each year, 20 times more gasoline than consumed by today's entire general aviation fleet. [Schrank, 2009]
- **Time:** In Brussels, drivers spend *50 hours* a year in road traffic jams.
  - Similar to London, Cologne and Amsterdam [EC, 2011]

Our vision:

Use the third dimension!

[EC, 2008] "Green Paper - Towards a new culture of urban mobility," Sept. 2007, Commission of the European Countries, Brussels.

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

[EC, 2011] "Roadmap to a Single European Transport Area," 2011

Current transportation systems

Long-distance transportation

+ High-speed (planes / trains)
– Specific locations (airport / stations)
– expensive infrastructure (ATC, rails)

Short-distance transportation

+ Door-to-door travel (cars)
– Relatively slow (traffic jams)
– expensive infrastructure (roads, bridges, …)

Neuwieser, Flickr

Hoff1980, Wikipedia

Ian Britton, FreeFoto.com

Existing road traffic has big problems
maintenance costs, peak loads, traffic jams, land usage

Future transportation systems: EU-project myCopter

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

SEVENTH FRAMEWORK PROGRAMME

Max-Planck-Institut für biologische Kybernetik

UNIVERSITY OF LIVERPOOL

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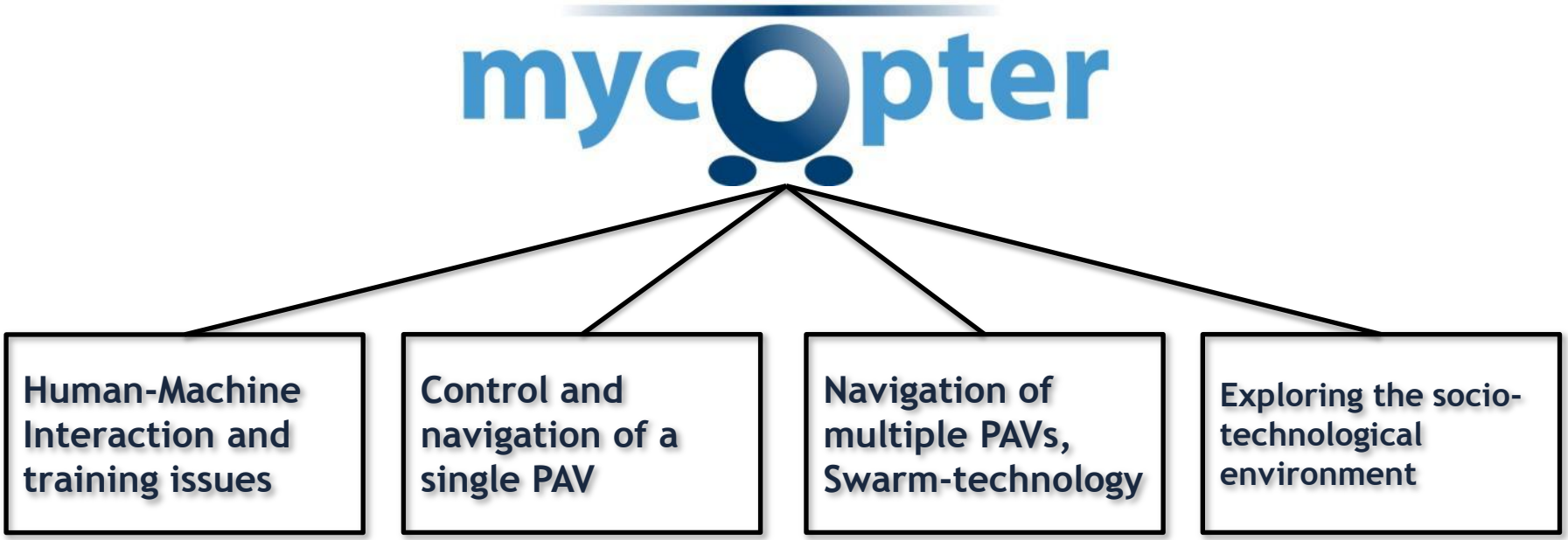
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Karlsruhe Institute of Technology

DLR

Enabling technologies for a short distance commute



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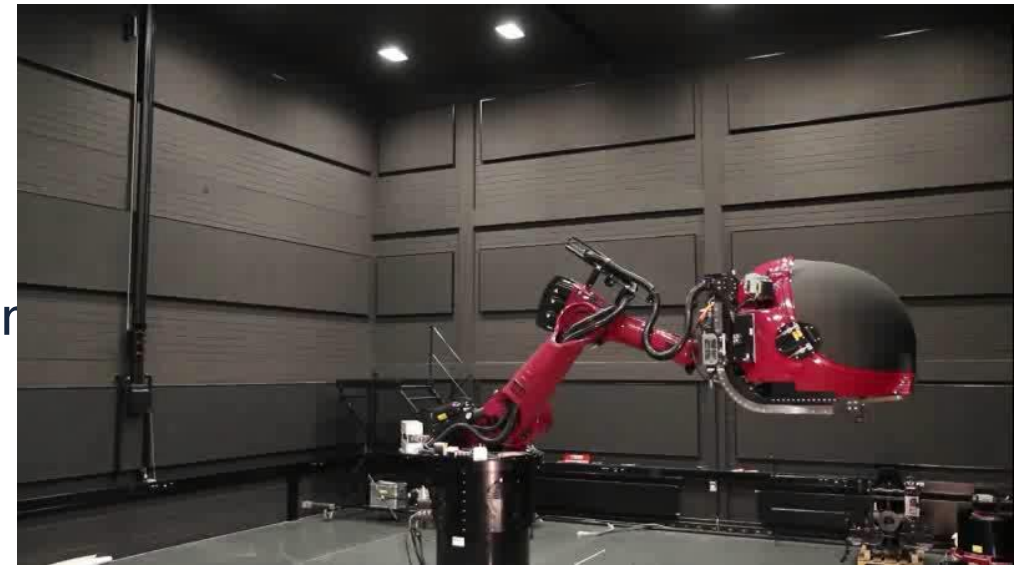
Novel Human-Machine Interfaces

Make flying as easy as driving

- Multisensory approach: provide additional information with fast and easily understandable cues
  - vision
  - vestibular
  - haptics
  - auditory
- Test Interfaces in simulators
  - MPI CyberMotion Simulator
  - DLR Flying Helicopter Simulator



CyberMotion Simulator, MPI

Max-Planck-Institut
für biologische Kybernetik

Novel Human-Machine Interfaces

Novel HMIs are needed for safe and efficient operation of PAVs

- Assess the perceptual and cognitive capabilities of average PAV users
- Evaluations with Highway-in-the-Sky displays
- Support the pilot with haptic cues

Highway in the Sky display, DLR

UNIVERSITY OF LIVERPOOL

Training for “ab-initio” PAV users

Develop training requirements for PAV users

- Develop a model that provides very good handling qualities for easy flying
- Determine the level of training with non-pilots / car drivers
- Investigate **emergency** situations and the implications for training

Heliflight-R, The University of Liverpool

ETH
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Swiss Federal Institute of Technology Zurich

A novel approach to control

Develop robust novel algorithms for *vision-based* control and navigation

Vision-aided localisation and navigation

- Estimate position in dynamic environments
- Build a 3D map for autonomous operation

Ascending Technologies GmbH

Out of the Box, EC 2007

Markus W. Achtelik, ETH Zürich

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Vision-aided automatic take-off and landing

No ground based landing guidance, everything on board

- Proper landing place assessment and selection are paramount for safe PAV operations
- Onboard surface reconstruction to recover 3D surface information using a single camera
- Autonomous landing with visual cues

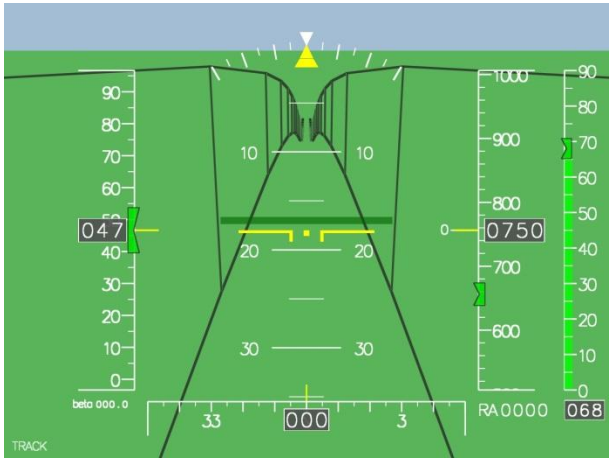
Landing place detection, EPFL CVLab

Decentralised air traffic control

Formation flying along flight corridors

- Global traffic control strategies require swarming behaviour
- Develop flocking algorithms with UAVs
- Evaluations of a Highway-in-the-Sky human-machine interface

Flocking behaviour

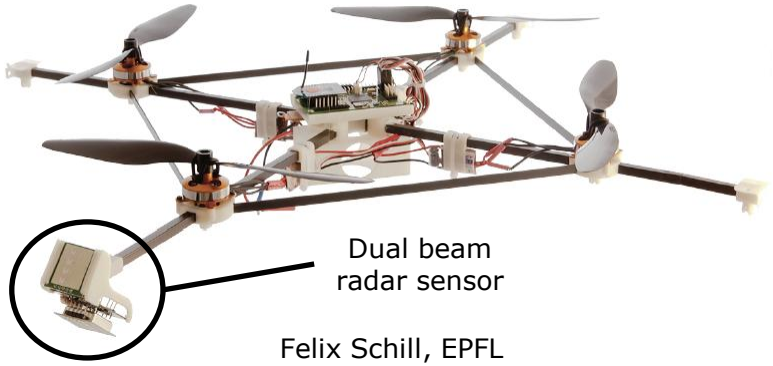


Highway-in-the-Sky, DLR

Collision avoidance in three dimensions

Novel sensor technologies for onboard sensing

- Determine range and bearing of surrounding vehicles
- Active (laser, sonar, radar) vs. passive sensors (vision, acoustic)
- Evaluation with many small flying vehicles
- Light-weight sensor technology for PAVs



Felix Schill, EPFL

Ascending Technologies GmbH

Explorations of social and economic impact

The biggest hurdle is acceptance by society

- Safety concerns
- Legal issues
- Ecological aspects
- Noise

Out of the Box, EC (2007)

Expectations, requirements and challenges

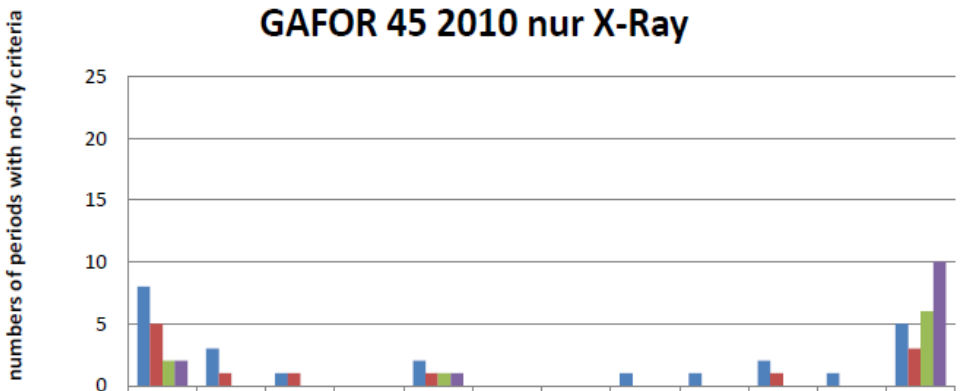
- Structured interviews with experts
- Focus group workshops on a PAV vision and associated requirements

Focus group workshop, KIT

A PAV scenario and its implications

Our view of a typical PAV mission

- Single person commuting to and from work
- Vertical take-off and landing capabilities
- Flyable in Visual and Instrumental Meteorological Conditions
- Availability: 90% of the year



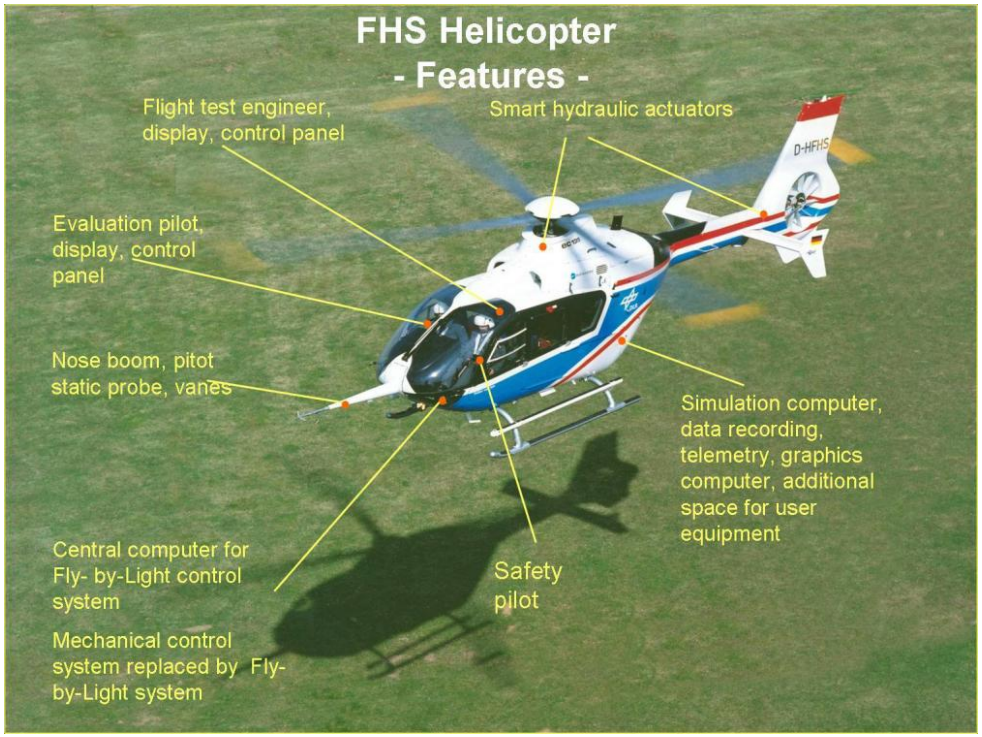
	Jan	Feb	March	April	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
6-8 Uhr	8	3	1	0	2	0	0	1	1	2	1	5
8-10 Uhr	5	1	1	0	1	0	0	0	0	1		3
17-19	2	0	0	0	1	0	0	0	0	0	0	6
19-21 Uhr	2	0	0	0	1	0	0	0	0	0	0	10

Weather analysis for Frankfurt (GAFOR Met data)

DLR

Experimental validation of proposed technologies

Verify selected developed technologies in flight



Flying Helicopter Simulator, DLR

Flying Helicopter Simulator

- Fly-by-wire / fly-by-light experimental helicopter
- Equipped with many sensors, reconfigurable pilot controls and displays
- Validate HMI concepts and automation technologies

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Flying Helicopter Simulator, DLR

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Innovations of myCopter

Envisioned human-machine interface
Gareth Padfield, Flight Stability and Control

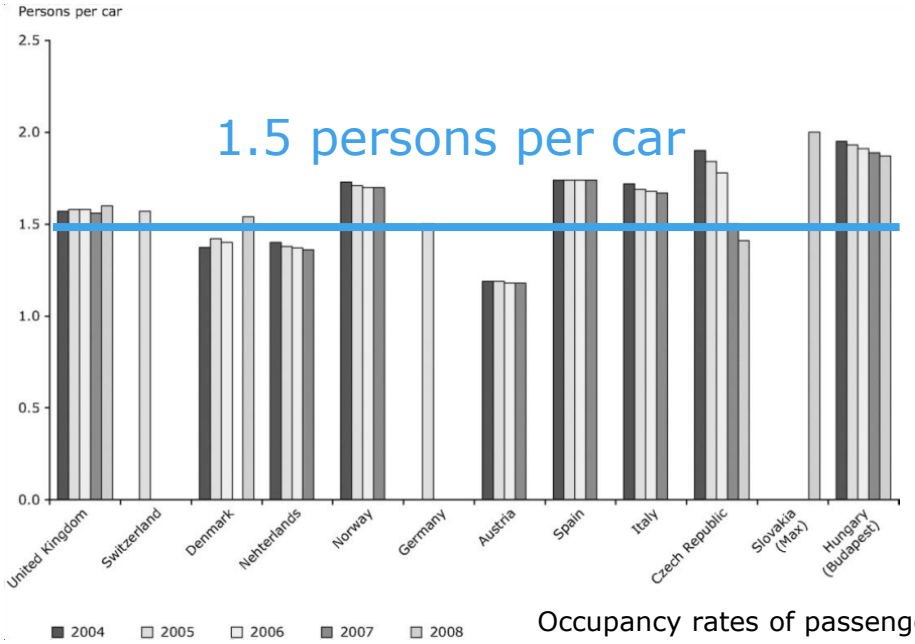
Flock of birds; D. Dibenski, Wikipedia

- Design of a user-centred multi-sensory HMI
- PAV handling qualities and training paradigms for the average user
- Autonomous control strategies
- Formation flying using embedded sensing and distributed control
- Insight into socio-economic impact factors
  - Sao Paulo (world largest helicopter fleet)
- Public 3D transport in Future Cities
  - Masdar City (Abu Dhabi)
  - Seoul Commune 2026
  - Songdo, South Korea

PATS: a solution to congestion?

Volume of road transportation continues to increase

- Average occupancy rate: 1.5 persons per car
- For commuting: 1.2 persons per car!
- Severe congestion: 100 Billion € lost to European economy yearly



Occupancy rates of passenger vehicles, eea.europa.eu

Strategic impacts of a PATS on the longer term

1. Potentially environmental benefits
   - Spending less time and thus energy in traffic
   - Energy efficiency with future engine technologies
2. Use developed technologies for general aviation
   - Automation, navigation, collision avoidance
3. Enhanced flexibility in urban planning
   - Fewer roads, bridges and less maintenance
   - Less conflicts in land usage


André D Conrad, Wikipedia

Past


Skybum, Wikipedia

Present


Out of the Box, EC, 2007

Future

My dream PAV

An envisioned Personal Aerial Vehicle, Gareth Padfield, Flight Stability and Control

Thank you for your attention

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