Personal Aerial Vehicles
A world in motion

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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 a pilot license
  • Need for infrastructure (e.g., landing strip)

Focus often on vehicle design instead of transport system
“Designing the air vehicle is only a relative small part of overcoming the challenges... The other challenges remain...” [EC, 2007]

- Accessibility to general public?
- Vehicle dynamics? Training?
- Automation? Human interaction?
- Safety, noise, ... ?
- Integration?
**EU-project myCopter**

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

[EU flag]

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Enabling Technologies for Personal Aviation

Human-machine interfaces and training
- Control interfaces and displays
- Shared control
- Multi-sensory feedback

Automation and autonomy
- Navigation
- Landing place assessment
- Sensor-fusion for collision avoidance

Socio-technological environment
- Acceptance: noise, safety, fuel, cars in the sky
- Integration into current transport systems
Goal: Develop robust novel algorithms for vision-based control and navigation

Challenges

- Recognize obstacles and other traffic
- Recognize landing areas
- In all season and in adverse weather conditions
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
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
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.
Goal: Develop human-machine interfaces that make flying as easy as driving a car

Challenges

- Current flight controls and displays are not intuitive
- Multisensory perception is not taken into account
- No reliable objective measurements of pilot workload
• Highway-in-the-Sky display
• Haptic aid: active sidestick to “feel” the highway
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
Exchange helicopter flight controls with a steering wheel and pedals
HMI Demonstration in DLR Simulator
Ongoing work: helicopter augmentation
Ongoing work: CableRobot Simulator

CableRobot Simulator  https://youtu.be/cJCsomGwdk0
Are Personal Aerial Vehicles the next big game-changer?
A lot of research has been done in EU.
NASA Silicon Valley Urban VTOL Air-Taxi Study

Authors: Kevin R. Antcliff, Ken Goodrich and Mark Moore
NASA Langley Research Center, Hampton, VA

Presented: March 2016, On-Demand Mobility and Emerging Technology Joint NASA-FAA Workshop, Arlington USA

Objective: Investigate the early adopters market for urban VTOL air-taxis in the Silicon Valley area
Operational Aspects of On Demand Mobility

Objective: Identify the set of constraints that may impact the implementation or operation of ODM
Thin-Haul Aviation Operations Study

Author: Brian J. German
Georgia Institute of Technology

Presented: March 2016, On-Demand Mobility and Emerging Technology Joint NASA-FAA Workshop, Arlington USA

Objective: Study the economic effect of distributed electrical propulsion aircraft concepts on thin-haul networks
Examples of current thin-haul airlines:

**Scheduled operations**
- Cape Air®
- SURF AIR
- BOUTIQUE AIR
- MOKULELE AIRLINES

**On-Demand operations**
- NETJETS®
- IMAGINE Air
- JETLINX
- LINEAR
- a-te
Flying prototypes: Volocopter

Volocopter VC200: First flight

https://www.youtube.com/watch?v=OazFilhwAEs
Prototypes: Ehang-184

“… The idea is that passengers hop in, enter their destination on a 12-inch touchscreen and hit the take-off button. …”

Gizmag.com | Ehang 184 taxi drone to undergo flight testing in the US | Nick Lavars | June 8, 2016

“… The State of Nevada, will help guide EHang through the FAA regulatory process with the ultimate goal of achieving safe flight," . …”

Tom Wilczek | GOED’s Aerospace and Defense Industry Specialist
“... Zee is developing a revolutionary new form of transportation ...”

Gizmag.com | Zee.Aero's flying car concept would fit in a standard parking space | Francis X Govers III | November 21, 2013

“... According to illustrations included with the patent filings, one version of the vehicle is narrow enough to fit into a standard shopping center parking space... ...”
New projects: Airbus Vahana

“…Airbus Group is harnessing its experience to make the dream of all commuters and travellers come true one day: to fly over traffic jams at the push of a button…”

www.airbusgroup.com

“…it's not crazy to imagine that one day our big cities will have flying cars making their way along roads in the sky…”

Tom Enders | CEO Airbus Group
New projects: Uber Elevate

“...urban air transportation will use three-dimensional airspace to alleviate transportation congestion on the ground...”

Uber Elevate | “Fast-Forwarding to a Future of On-Demand Urban Air Transportation”
VTOL Cost Breakdown

**Source:** Uber Elevate | “Fast-Forwarding to a Future of On-Demand Urban Air Transportation”

VTOL battery costs (not included above) are assumed to be $56K (initial), $28K (Near-Term), $14K (Long-Term). Dealer Markup is only shown for R-44 helicopters.
PAVs are becoming a reality
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