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on Energy & Advanced Mobility, 15-16 October 2025, Brussels

Advanced Air Mobility at TU Delft – A Survey of Activities, Challenges and Strategic Opportunities

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• **Rotorcraft and
Advanced Air Mobility**





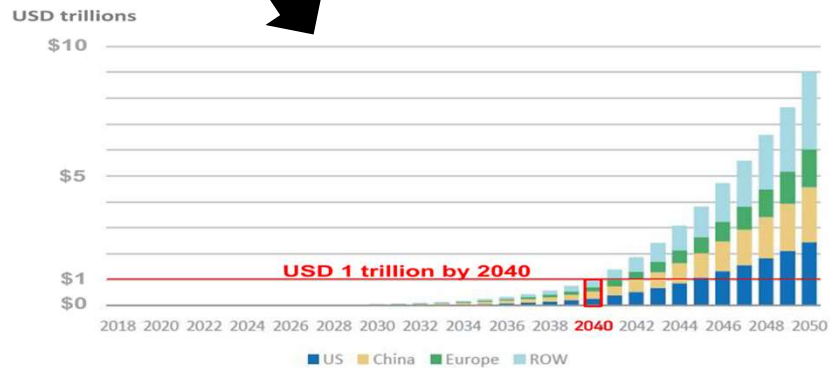
Air Mobility – Prelude

Brace yourselves, the future is up in the air and the next (r)evolution is just around the corner:

Advanced Air Mobility (AAM)



(Source: Aurora)



Source: Morgan Stanley Total Addressable Market Update 2021-05-06

Emerging Nomenclature: UAM – Urban Air Mobility, AAM – Advanced Air Mobility, IAM – Innovative Air Mobility, RAM – Regional Air Mobility, PAM – Personal Air Mobility

Supporting technologies: eVTOL – electric VTOL, VertiPort / SkyPort



AAM: an older vision



"If a man is in need of rescue, an airplane can come in and throw flowers on him, and that's just about all. But a direct lift aircraft could come in and save his life."

TU Delft Air Mobility: Our Vision

- **Society strives for mobility** due to increasing level of urbanization
 - **Air transport** can impact mobility by adding the 3rd dimension
 - **Why expanding routes** ? Urbanisation, natural obstacles, reduce surface infrastructure
- Air Mobility** is a **fast-growing** business relying on emergent **eVTOL technologies**



China's Wuzhuang toll station, 36 lanes stuck on 8th October 2025



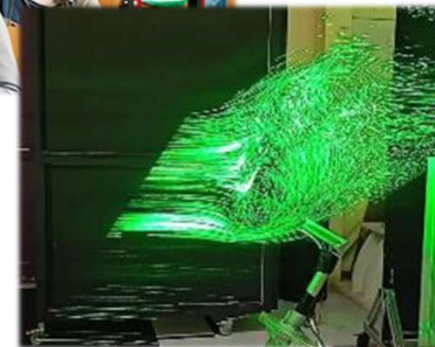


TU Delft Air Mobility: Our Vision

Education: introduce **AAM** in the **study curriculum** with disciplines and **inter-disciplinary skills**. **M.Sc. projects**, **Design Synthesis Exercise**, **On-line** courses and **internships** at selected world players companies.

Research: Component level research for aerodynamics and aeroacoustics, propulsion, lightweight materials and structures, flight stability and control. **Translate** know-how from **classical aviation to AAM** system level by design methodologies. Design of air space.

Dissemination: play a pivotal role in the knowledge processes associated with AAM. **Knowledge/data centre**, **conference centre** and **Summer school**, **scientific advisory** role for government agencies.





Example: PAL-V Fly Drive Mobility Solution developed in the Netherlands



PAL-V FLYING CAR

<https://www.pal-v.com/en/>

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NASA's Vision



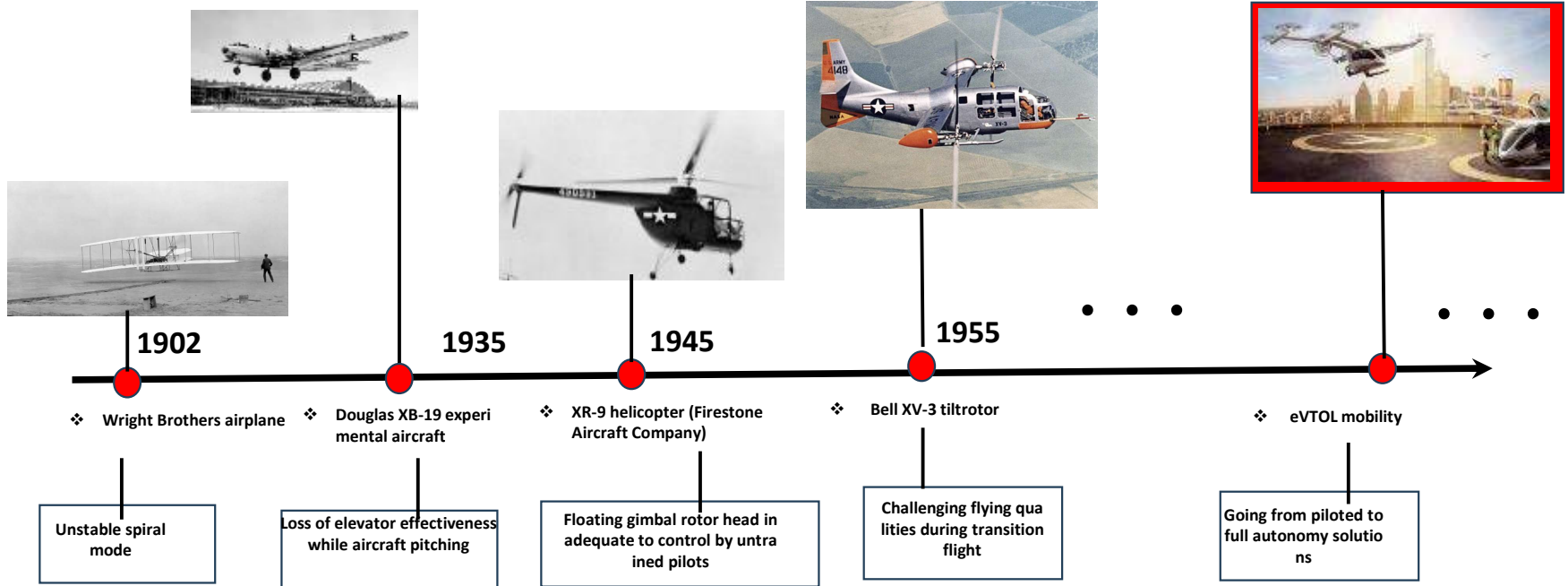
AAM Grand Challenge – 5 Pillars

- Design
- Piloting
- Design Of Airspace Architecture
- Real Time Operation Of Aerospace with the Increased Level Of Air Traffic
- Community Integration (Safely and with the Smallest Amount Of Noise Audio And Visual)



SAFETY, SAFETY AND AGAIN SAFETY!!!

New configurations, New Problems!





TU Delft AAM Team

Who are we?

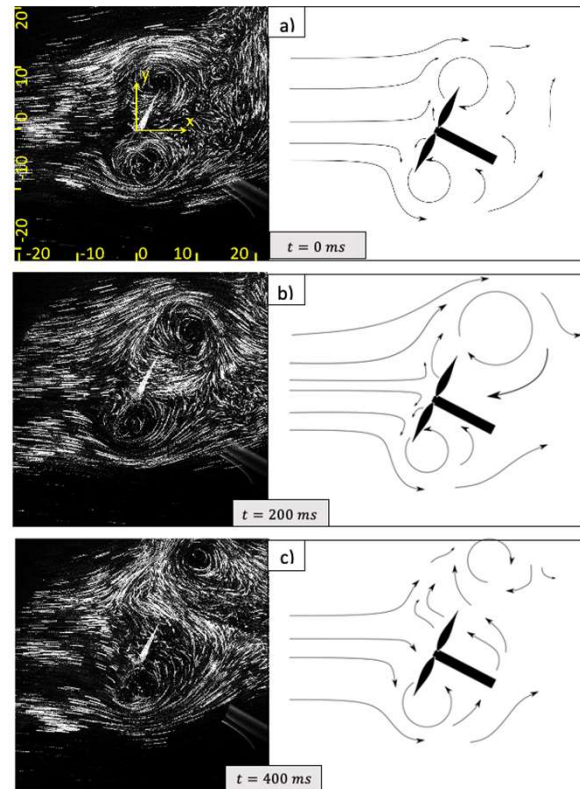
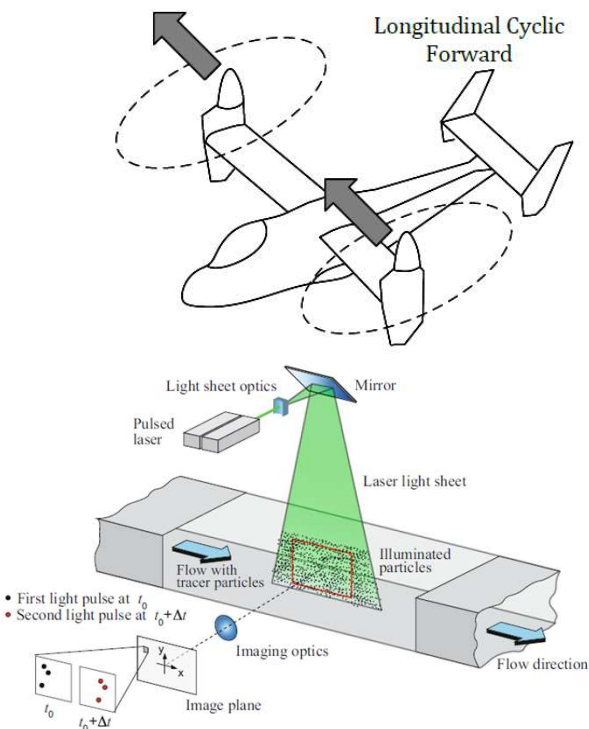
- Researchers that work on ALL aspects of contingency management of AAM
- We are a “small” team dealing with a huge new paradigm

We need to integrate AAM into future mobility for its success!

What do we do?

- Aero-propulsive modelling (novel configurations)
- Flight simulation development to enhance Safety
- Certification through Simulation
- Adaptive, Robust, Unified control
- Autonomy Benchmark Problems
- Flight Envelope Protection
- Architecture (Explainable AI, ML, deterministic, probabilistic...)
- Acoustic Noise
- Flight comfort in urban/gusty atmosphere
- Air traffic management

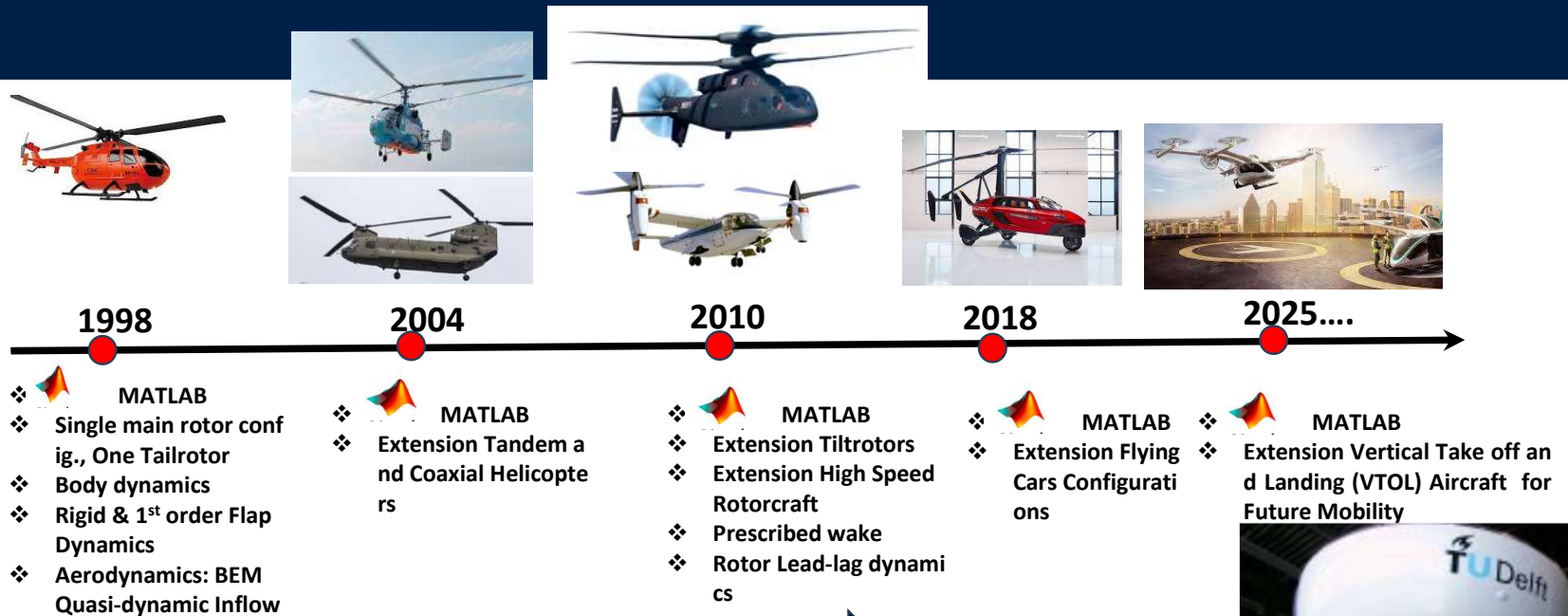
Aerodynamics Examples



Unsteady asymmetrical vortex release during descent at incidence



Aero-propulsive Modeling



SIMONA Simulator at TUDelft



Advanced Analytical Vertical Lift SIMulation (AAVISIM)

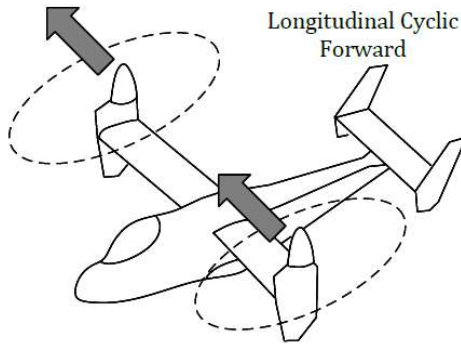
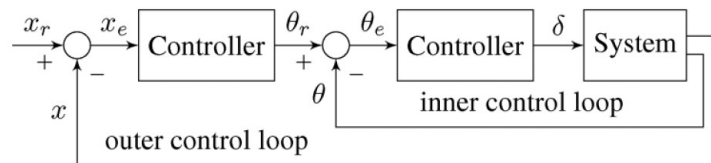
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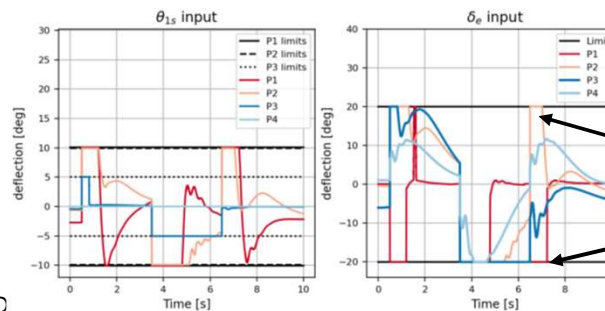
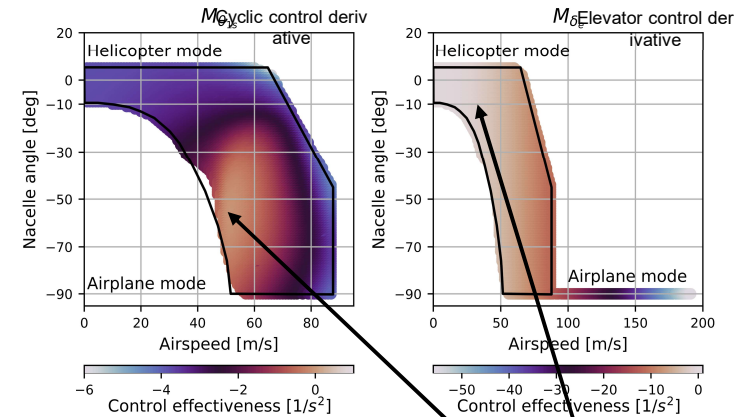
Advanced Control Solutions

Ex: Incremental Nonlinear Dynamic Inversion INDI for tiltrotor conversion flight



Source: Krook, R. & M.D. Pavel, Incremental nonlinear control applied to a nonlinear tiltrotor model, 2022

Control effectiveness of longitudinal cyclic control and elevator control in the tiltrotor corridor



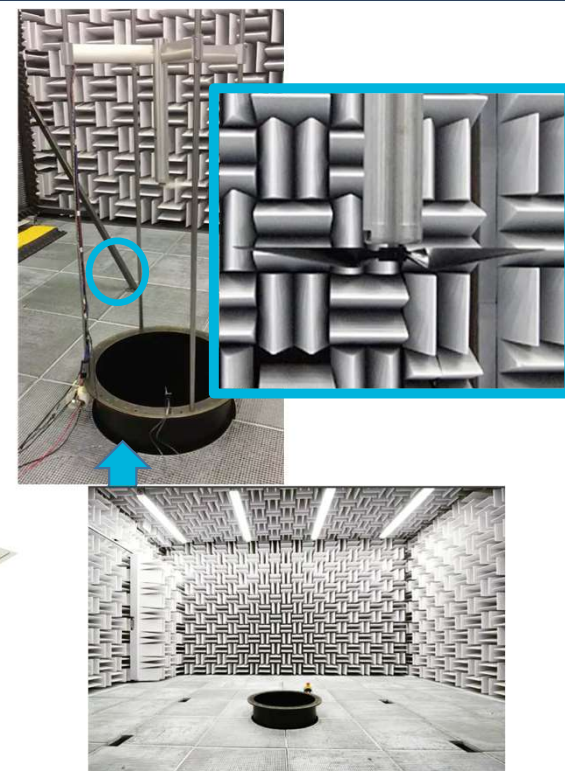
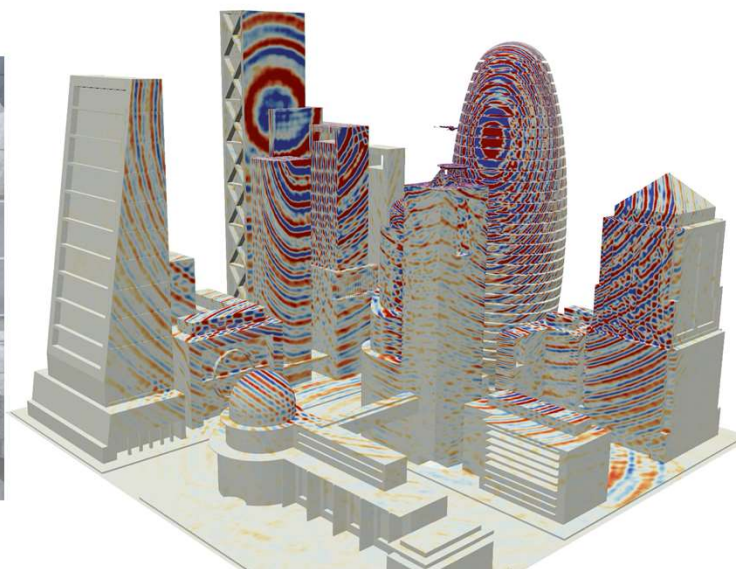
Low control effectiveness

Actuator saturation



Noise emission and propagation

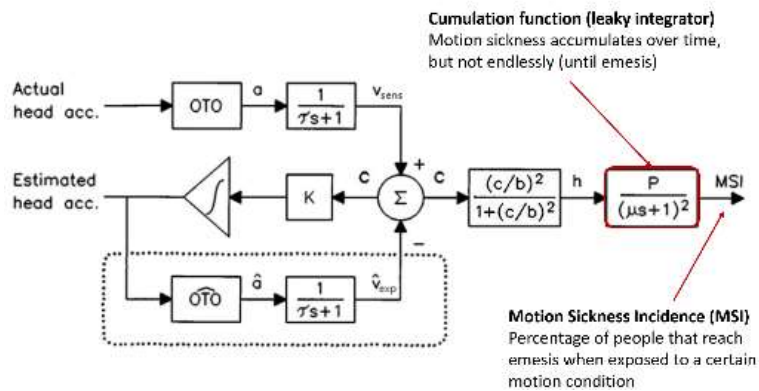
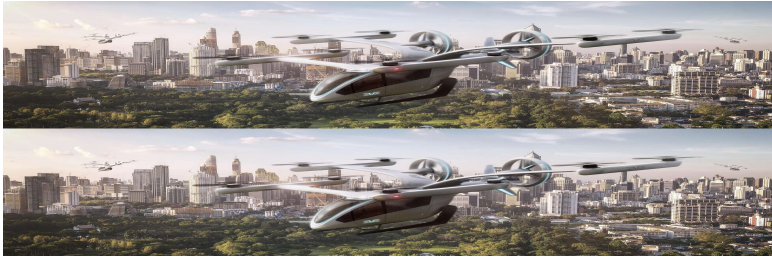
Computation of noise propagation and interaction with the built environment



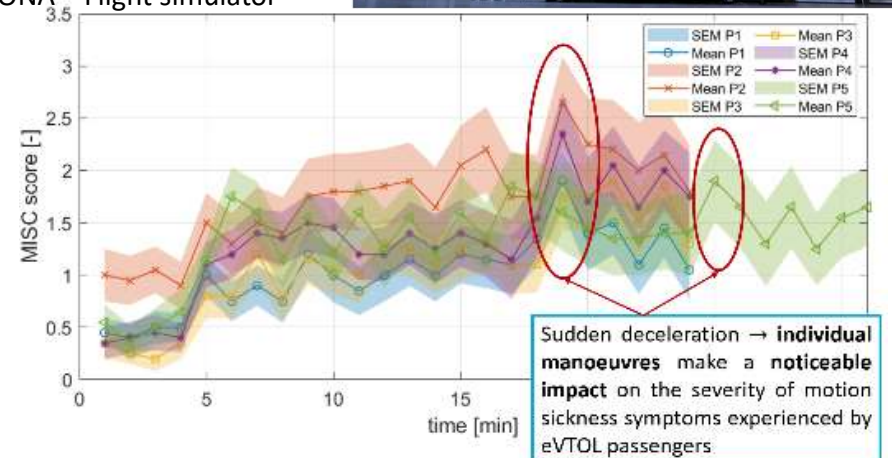


Flight Comfort

Embraer EVE Mobility

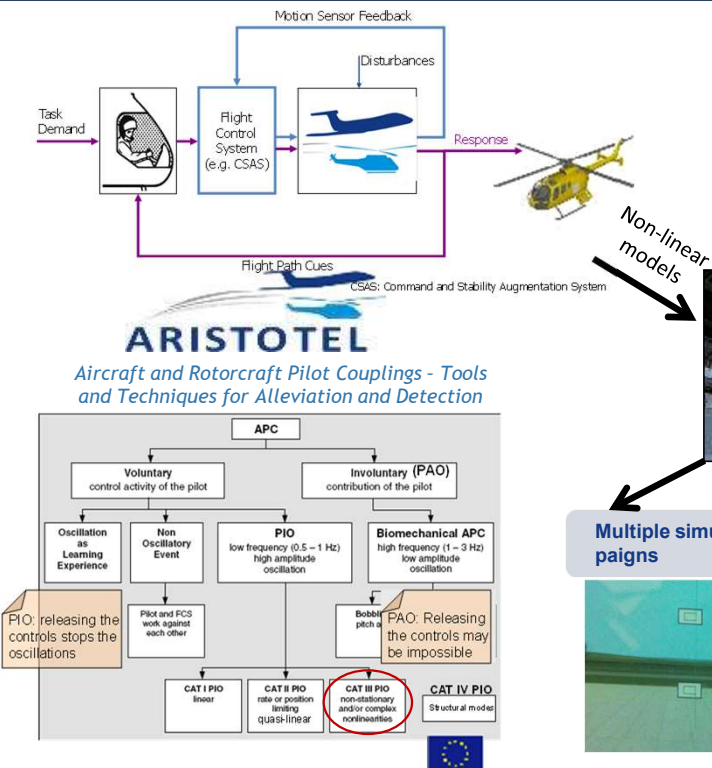


SIMONA – Flight simulator

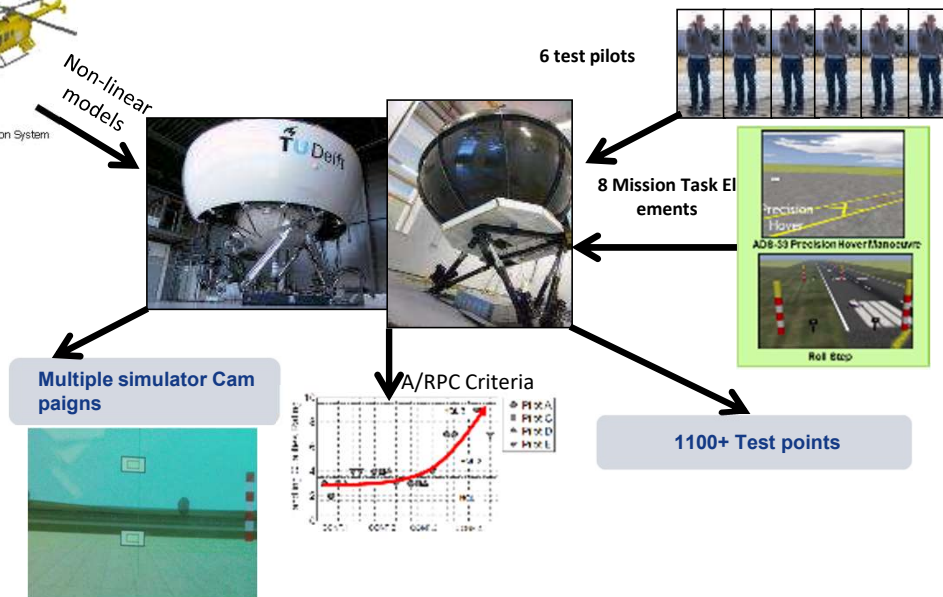




Dealing with undesirable Pilot-Vehicle Couplings



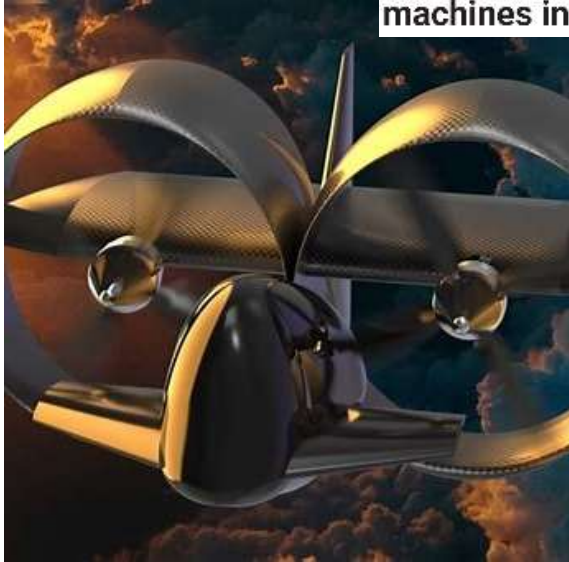
- A/RPC = An "inadvertent, sustained aircraft oscillation which is the consequence of an abnormal joint enterprise between the aircraft and the pilot" (McRuer, 1995)
- Occurrence of an A/RPC can be regarded as a failure of the design process (McRuer)





Student Teams and Spin Offs

Boeing-backed GoFly Prize puts 5 personal flying machines in spotlight, with fly-off ahead



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TU Delft students successful in Vertical Flight Society Student Competition



Connect to Project Ideas from Horizon Call

HORIZON-CL5-2026-10-D6-07

Supporting sustainable and smart urban mobility in Europe (CIVITAS)

HORIZON-CL5-2027-06-D6-08

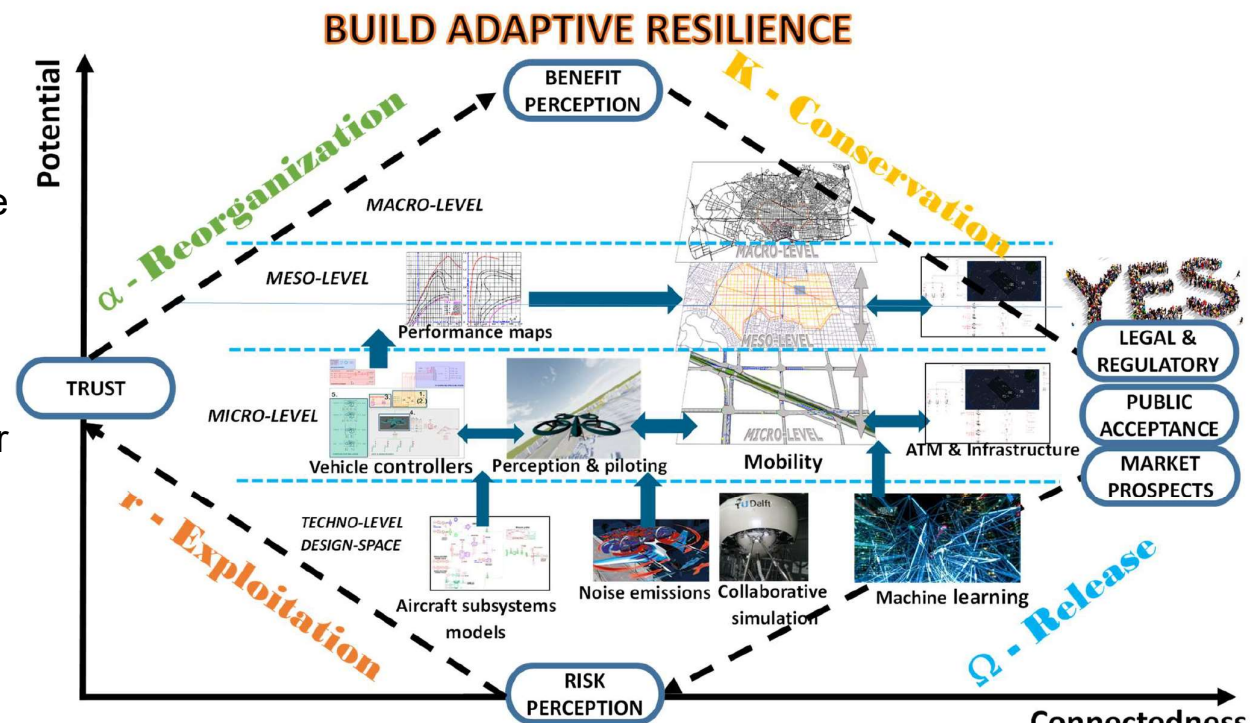
Enhancing Mobility for All: affordable, reliable and accessible multimodal transport for inclusive rural and urban connectivity – Societal Readiness pilot

HORIZON-CL5-2027-10-D6-10

Enhanced resilience in multimodal passenger transport through digital technologies and generative and discriminative AI

HORIZON-CL5-2027-10-D6-11

Enhancing Resilience and Accuracy in Positioning, Navigation, and Timing (PNT) Systems and e-conspicuity solutions



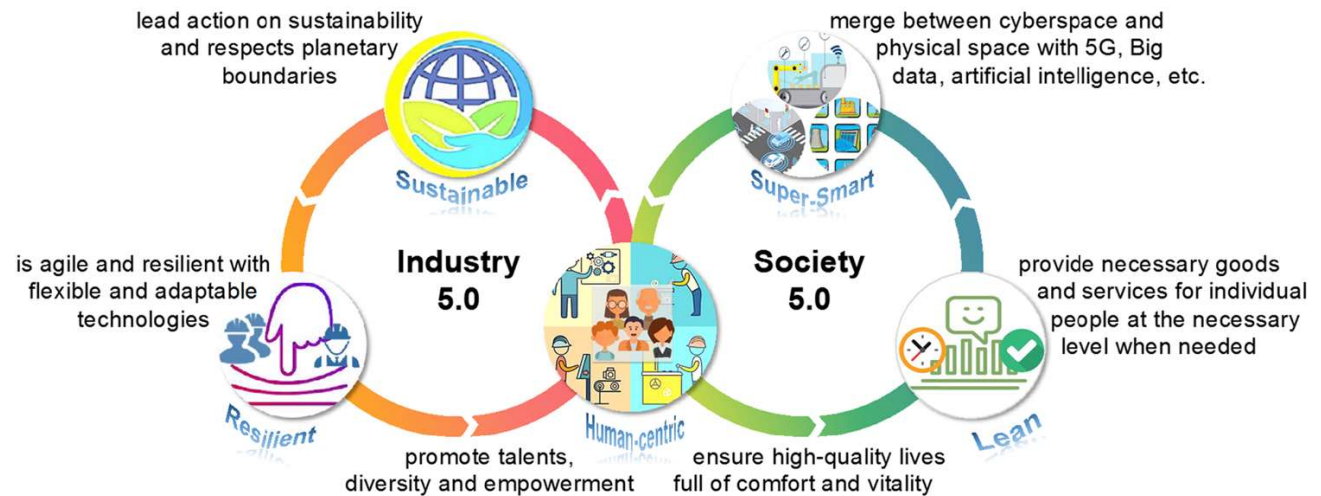
Dr. Marilena D. Pavel [m.d.pavel@tudelft.nl]

Profile You are Seeking and Why

Partners for HORIZON-CL5-2026 & 2027 CALLS

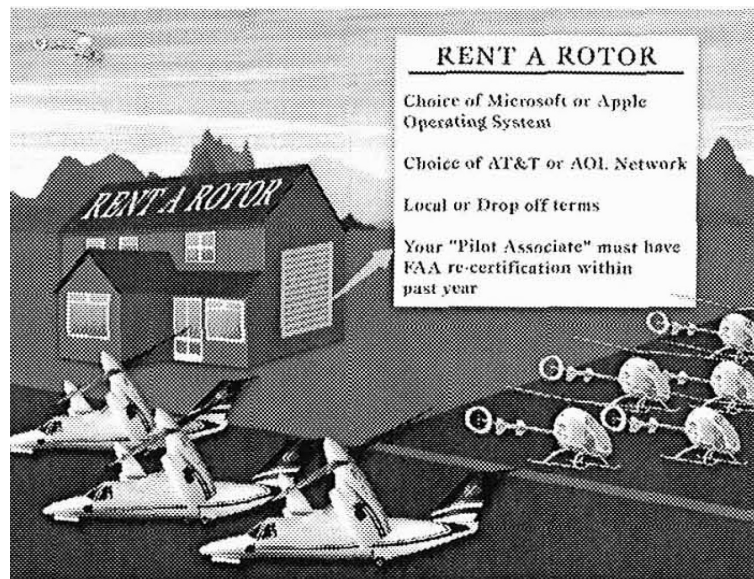
- What partners: Help to connect vertical mobility to other transport modes
- How: Extend technology evolution towards society transformation
- Why: Achieve societal acceptance for the Advanced Air Mobility

Create a future of industry towards a human-centric, sustainable, and resilient society





The Bright and Dark Side...



Source: Robert J. Huston (NASA Langley), “The Future of Vertical Lift”, The 18th Alexander Alexander Nikolsky Lecture of the American Helicopter Society, 1998

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2025-10-13

The Bright and Dark Side of the Future

To sense something of the potential for this kind of aircraft, just listen in to this conversation between a Richmond, Virginia father and his teenage son in the year 2031.

Teenager: “Pop, can I use the tiltrotor a week from Friday night? I’m taking Susie Que to the Junior Prom. Before the dance, we want to fly up and eat dinner at Hogates in Washington.”

Father: “Son, why can’t you take the SportsCopter? Its only 70 miles. You can hardly get the blades retracted before you are there. Besides, your mother and I were thinking about going to the Braves game in Atlanta that night.”

Teenager: “Well actually, Susie wants her two girl friends and their dates to go with us. I really need the tiltrotor. Please!”

Father: “Oh, all right. The Braves can wait. But spend a couple hours flying on your Macintosh to update your Pilot Associate before I sign your ATC clearance request for a minor pilot. And don’t forget to warn your friends that your Pilot Associate has been updated to include the latest United Nations population control sensors. No erotic activity in the back seat. The automatic system will terminate your flight plan and send you straight home. Also, the Federal illegal substance sniffers makes an automatic report to the Federal marshal’s office. That includes tobacco and alcohol.

But have a good time son.”

It’s going to be a brave new world.



Contact Details

Thank you!

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W <https://www.tudelft.nl/lr/tu-delft-advanced-air-mobility-ta2m>





Extra: ROADMAP FUTURE VERTICAL LIFT – NEXT 10 YEARS

Flight scenarios test & simulation

- ▶ Define the critical flight scenarios to be performed by a future VTOL/CTOL platform for public services and connect these to the initial design requirements. An attempt to reconcile all these scenarios would oblige to envelop them in a sole set of requirements with direct consequences on the system design. Consider within the aim of flight scenarios tests & simulation also the issues of safety, reliability, platform availability, etc.
- ▶ > **Depends on:**
 - Semi-automated public safety response, security, fire, rescue, disaster recovery
 - Initial hybrid VTOL/CTOL platform development
- ▶ > **Enables:**
 - Pilot/vehicle interface and handling qualities demo
 - Identify required new training Methods
 - Identify new certification requirements
 - Autopilot integrated for Simplified vehicle ops. and loss of control avoidance

