



Special issue on urban air mobility: research on aircraft, infrastructure, operation, and public acceptance

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Urban Air Mobility (UAM) as part of Innovative Air Mobility (IAM) is envisioned to be a new air transportation system for passengers and cargo in urban environments. It is enabled by new technologies in the fields of aircraft technology, electric propulsion, and air traffic management. A core idea is to integrate UAM into existing multimodal transport systems. The vision of UAM is to achieve safe, secure, and sustainable air transport in urban and suburban environments, complementing existing transportation systems. UAM is expected to benefit users and to also have a positive impact on the economy by creating new markets, employment opportunities for manufacturing and operation of UAM aircraft, and the construction of related ground infrastructure. However, there are also concerns about noise, safety and security, privacy, and environmental impacts. Therefore, the UAM system needs to be designed carefully to become safe, affordable, accessible, environmentally friendly, economically viable, and thus sustainable.

Recognizing this need, the German Aerospace Center (Deutsches Zentrum für Luft und Raumfahrt, DLR) launched the comprehensive research initiative HorizonUAM, which brought together ten of its institutes, as well as international partners, such as NASA and Bauhaus Luftfahrt. From 2020 to 2023, the project explored the areas of UAM aircraft, related infrastructure, operation of UAM services, and public acceptance. With this Special Issue, we present selected insights and results that reflect the diversity, ambition, and depth of the HorizonUAM project. It comprises 20 peer-reviewed papers.

The paper *Can Urban Air Mobility become reality? Opportunities and challenges of UAM as innovative mode of transport and DLR contribution to ongoing research* by **Henry Pak et al.** offers a comprehensive overview of the key research areas in HorizonUAM, discussing both technological advancements and systemic challenges.

With *A city-centric approach to estimate and evaluate global Urban Air Mobility demand*, **Lukas Asmer et al.** present a global demand model, analyzing 990 cities based on economic, demographic, and infrastructural indicators.

In *HorizonUAM: operational challenges and necessary frameworks to ensure safe and efficient vertidrome operations*, **Karolin Schweiger et al.** turn their attention to the ground infrastructure, particularly vertidromes, and the required frameworks to ensure smooth integration of UAM into the air traffic system.

The simulation framework described in *A collaborative system of systems simulation of urban air mobility* by **Nabih Naeem et al.** enables domain-specific tools to interact and evaluate UAM system performance in a modular and collaborative way.

A societal perspective is provided in *Public acceptance of civilian drones and air taxis in Germany: A comprehensive overview* by **Albert End et al.**, who analyze large-scale telephone survey data to identify what factors shape public perception of drones and air taxis.

Sustainability concerns are addressed in *The feasibility of electric air taxis: balancing time-savings and CO₂ emissions—a joint case study of respective plans in Paris*, where **Nabil Hagag et al.** compare the environmental impact of air taxis with traditional ground transport modes.

Focusing on passenger experience, *Experiencing urban air mobility: how passengers evaluate a simulated flight with an air taxi* by **Anne Papenfuss et al.** uses a mixed-reality simulator to explore how users perceive and evaluate air taxi rides.

How does it feel to fly in an air taxi? Exploring modern head-mounted display capabilities for mixed reality flight

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simulation by **Johannes M. Ernst et al.** continues this thread, demonstrating how immersive technologies can aid in design and acceptance studies.

Airspace management concepts are assessed in *Applying a comparative performance assessment framework to different airspace management concepts for urban air mobility* by **Rabeb Abdellaoui et al.**, evaluating performance and complexity in three management strategies.

Operational workload is investigated in *Impact of air taxi operations in the control zone on air traffic controllers* by **Sebastian Schier-Morgenthal et al.**, which analyzes controller workload during air taxi integration scenarios.

From a digital infrastructure perspective, *Integrating vertidrome management tasks into U-space* by **Bianca I. Schuchardt et al.** presents a digital vertiport management system integrated into the European U-space services framework.

Wildlife hazards are the subject of *Extending air traffic control tasks to control air taxis and to warn of critical wildlife: an impact analysis*, where **Isabel C. Metz et al.** explore the integration of wildlife monitoring into control tower responsibilities.

An experimental study is offered in *Experimental evaluation of bird strikes in urban air mobility* by **Aditya Devta et al.**, validating a theoretical bird strike model through simplified physical tests.

Simulation-based validation is used in *Evaluation of collision detection and avoidance methods for urban air mobility through simulation* by **Isha Panchal et al.**, showing how a rule-based avoidance system can enhance flight safety.

A systems design focus is taken in *Battery-electric powertrain system design for the HorizonUAM multicopter air taxi concept* by **Florian Jäger et al.**, describing the development of a certifiable electric propulsion architecture.

In *Applied design thinking in urban air mobility: creating the airtaxi cabin design of the future from a user perspective*, **Fabian Reimer et al.** apply design thinking methods to co-create cabin interiors with potential users, aiming to improve acceptance and usability.

Runtime monitoring of operational design domain to safeguard machine learning components by **Christoph Torens et al.** develops a runtime assurance concept for onboard vision-based machine learning systems, tested in real landing scenarios.

Navigation challenges are discussed in *Vertiport navigation requirements and multisensor architecture considerations for urban air mobility* by **Omar García Crespillo**

et al., proposing a multisensor system validated in field trials.

Robust communication is addressed in *Toward robust and efficient communications for urban air mobility* by **Dennis Becker et al.**, who present the DroneCAST system for drone-to-drone communication in dense urban environments.

Finally, a broader regional integration perspective is offered in *Operational integration potential of regional uncrewed aircraft systems into the airspace system* by **Tim Felix Sievers et al.**, who assess airport readiness for unmanned cargo aircraft in Germany and the US.

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Data availability Data sets generated during the studies are available from the corresponding authors on reasonable request.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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