HorizonUAM - Forschung zum urbanen Luftverkehr am Deutschen Zentrum für Luft- und Raumfahrt

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HorizonUAM Project Framework

- Urban Air Mobility (UAM) research, focus on urban air taxi services
- DLR internal research project, initiated by DLR executive board
- 07/2020 – 06/2023
- 10 DLR institutes and facilities involved
  - Flight Guidance
  - Combustion Technology
  - Flight Systems
  - Air Transport and Airport Research
  - Communications and Navigation
  - Air Transportation Systems
  - Aerospace Medicine
  - System Architectures in Aeronautics
  - Atmospheric Physics
  - Unmanned Aircraft Systems
- Project budget 9.0 M€
Project Content

- UAM system simulation
  - Scenarios, demand forecast, economy
- Vehicle
  - Vehicle family concepts, system technology, cabin
- Safety/Security
  - Autonomy, multi sensor navigation and communication, risk assessment, U-space concept
- Vertidrome
  - Infrastructure, flight guidance, UAM network management, airport integration
- Acceptance
  - Acceptance of civil drones and air taxis, citizen participation
- Demonstration/Assessment
  - UAM cabin simulator, tower simulator, scaled flight guidance/ navigation demonstrations
UAM as a System

Further reading:

• Schuchardt et al., Urban Air Mobility Research at the DLR German Aerospace Center – Getting the HorizonUAM Project Started, AIAA Aviation 2021, 08.2021
• L. Asmer et al., Urban Air Mobility Use Cases, Missions and Technology Scenarios for the HorizonUAM Project, AIAA Aviation 2021, 08.2021
## Vehicle Family Concepts

### Aircraft architecture

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<thead>
<tr>
<th></th>
<th>Multirotor</th>
<th>Quadrotor</th>
<th>Lift+Cruise</th>
<th>Tiltrotor/wing</th>
<th>Vectored Thrust</th>
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<tbody>
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<td>Disc loading</td>
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<td>Hovering efficiency</td>
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<td>Downwash speed &amp; noise</td>
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<td>Forward flight speed &amp; efficiency</td>
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<td>Gust resistance and stability</td>
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<td>Preferred use case</td>
<td>Air taxis (inner-city point-to-point services)</td>
<td>Air taxis and airport shuttles</td>
<td>All</td>
<td>All</td>
<td>Airport shuttles and intercity</td>
</tr>
</tbody>
</table>

### HorizonUAM use cases

- **Intra-City**
- **Airport Shuttle**
- **Sub-Urban**
- **Inter-City**
- **Mega-City**

Figure based on: Roland Berger GmbH, "Urban Air Mobility the Rise of a New Mode of Transportation," Nov. 2018.

**Further reading:**
- P.S. Prakasha, et al., Towards System of Systems driven Urban Air Mobility Aircraft Design, DICUAM, 03.2021
Safety and Security

- Safe and secure autonomy
- System architecture for multi sensor navigation and communication
- Airspace integration through U-space services
- Risk assessment and collision detection in urban environments
- Cyber-physical security aspects

Further reading:
- P. Nagarajan et al., ASTM F3269 - An Industry Standard on Run Time Assurance for Aircraft Systems, AIAA Scitech 2021, 01.2021
- S. Schopferer, et al., ML Applications in Unmanned Aviation: Operational Risks and Certification Considerations, Machine Learning in Certified Systems - DEEL Workshop, 01.2021
- Becker et al., Approach for Localizing Scatterers in Urban Drone-To-Drone Propagation Environments, EuCAP European Conference on Antennas and Propagation, 03.2021
- C. Torens et al., HorizonUAM: Safety and Security Considerations for Urban Air Mobility, AIAA Aviation 2021, 08.2021
Vertidrome

- Demand
- Regulation
- Location
- Vehicle

Environmental Integration
Physical Integration
Power System Integration
Airspace Integration

Requirement Proposals: UAM Aerodrome/Vehicle

Non-nominal environment
Aerodrome2 Aerodrome Connection
Scheduling/Sequencing
Layout (Pads, Gates, Safety Margins)

Vertidrome Operation

Approach/Departure Path
Flow, Delay
Charging Characteristic

Critical Dimension
Approach/Departure/Taxi Performance

Further reading:
- K. Schweiger et al., UAM Vertidrome Airside Operation: What needs to be considered?, DICUAM, 03.2021
- K. Schweiger et al., Urban Air Mobility: Vertidrome Airside Level of Service Concept, AIAA Aviation 2021, 08.2021
- F. Naser et al., Air Taxis vs. Taxicabs: A Simulation Study on the Efficiency of UAM, AIAA Aviation 2021, 08.2021
- K. Schweiger, UAM Vertidrom Operationen - Vision als Treiber der aktuellen Forschung, to be presented at DLRK 2021, 09.2021
Public Acceptance

- Analysis of public acceptance towards civil drones and air taxis
- Participatory noise measurements
- Perception of drones and air taxis by pedestrians
- Air taxi passenger interaction and comfort

Further reading:
- A. End et al., Gender differences in noise concerns about civil drones, ICBEN Congress on Noise as a Public Health Problem, 06.2021
Demonstration and Assessment

• Tower simulation for integration of UAM at airports

• Scaled flight demonstrations for showing communication, navigation and flight guidance concepts with drones in model city

• Final assessment of chances and risks associated with UAM

• Annual HorizonUAM Symposium
Conclusion

- HorizonUAM is DLR’s most recent collaborative research project on urban air mobility
- Project runtime: 07/2020 – 06/2023
- 10 DLR institutes are bringing in a variety of expertise
- Main focus of the project lies on urban air taxi services, including
  - Vehicle design
  - Vertidrome infrastructure
  - Airspace integration and operation
  - Public acceptance
- NASA-DLR collaboration on UAM air traffic management is integrated in HorizonUAM
- Annual HorizonUAM Symposia planned for scientific exchange beyond project boundaries
Join us at https://dlr.expert/horizonuam2021
Virtual symposium
Free to register before 12 September

Thank you for your attention!

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