

Investigating Safe Transitions between Vertiport Configurations

Samiksha Rajkumar Nagrare

Institute of Flight Guidance, German Aerospace Center (DLR); samiksha.nagrare@dlr.de;

The safe and efficient integration of Innovative Air Mobility (IAM) into urban and regional transport systems requires vertiports that can adapt to changing operational demand, infrastructure requirements and airspace conditions. The German Aerospace Center (DLR) addresses this need through the project VERTIFIED (Vertiport Research Infrastructure for Innovation Exploration and Demonstration). The project focuses on the conceptual development, construction and validation of vertiports for urban and airport environments. As part of the project, two full-scale, modular and flexible vertiport demonstrators are being developed at the National Test Center for Unmanned Aircraft Systems at Magdeburg-Cochstedt Airport. These demonstrators are intended to support realistic flight tests, operational experiments and the validation of new vertiport concepts, technologies and U-space services.

Existing research on vertiports has been primarily focused on their static design, location and capacity. Recent studies have also applied discrete-event simulation to investigate vertiport throughput, practical capacity, infrastructure utilisation and the influence of different vertiport topologies [1]. However, limited attention has been given to the transition between different configurations of an already operational vertiport. In particular, there is a lack of established methods for estimating the minimum transition time, quantifying temporary capacity loss and determining safe construction and operational sequences during vertiport reconfiguration.

This study investigates how a vertiport can be safely and efficiently reconfigured between different infrastructure and operational configurations. The research considers changes to Touchdown and Lift-Off areas (TLOFs), stands, taxi routes, passenger-processing resources and associated operating procedures. The reconfiguration process is represented as a sequence of transition states in which individual infrastructure elements may be available, restricted, closed, under modification or undergoing inspection. The technical definition of vertiport areas, including TLOFs, stands, taxiways and obstacle-free volumes, is based on the applicable EASA (European Union Aviation Safety Agency) design guidance [2].

A discrete-event simulation model will be developed to represent aircraft arrivals, landing and take-off operations, surface movements, stand occupancy, turnaround processes, charging, passenger handling and infrastructure availability. Reconfiguration activities will be modelled as time-dependent events that dynamically modify the available resources and operational rules of the vertiport. The model will be used to compare alternative transition strategies, including sequential closure of individual TLOFs, parallel modification of independent resources, operation with reduced infrastructure availability and reconfiguration during periods of low demand. The phased safety approach used in airport construction provides a

methodological analogy, particularly for identifying affected areas, temporary operational restrictions, construction phasing, inspection requirements, and safety risk mitigation.

The main performance indicators will be the total transition time, aircraft throughput, temporary capacity loss, aircraft and passenger waiting times, queue length, resource utilisation, and the number of delayed, diverted or cancelled operations. The study will also determine the traffic-demand level at which continuous operation becomes infeasible and a partial or complete vertiport closure becomes necessary. Safety-related constraints will include the separation of construction and aircraft movement areas, the availability of required taxi routes, the protection of obstacle-free volumes, access for emergency services, the availability of alternative landing locations, and the completion of inspection and operational release procedures.

The expected outcome is a simulation-based framework to estimate the minimum feasible transition time and the associated temporary capacity loss across different vertiport configurations. The results will support the VERTIFIED project by providing a structured method for planning, simulating and evaluating configuration changes before or during experimental implementation. The framework will also generate practical decision-support information for vertiport operators, infrastructure planners, service providers and regulatory authorities.

The principal contribution of this study is to treat vertiport reconfiguration as an explicit operational state rather than considering the vertiport only as a fixed configuration or a fully closed facility. By combining the VERTIFIED research infrastructure, discrete-event simulation, capacity analysis, phased transition planning and safety constraints, the proposed approach establishes a basis for investigating adaptable vertiports for future IAM operations.

Bibliography

- [1] Schweiger, K., & Preis, L., "Urban air mobility: Systematic review of scientific publications and regulations for vertiport design and operations," *Drones*, 6 (7), Article 179, 2022.
- [2] EASA, Vertiports Prototype Technical Specifications for the Design of VFR Vertiports for Operation with Manned VTOL-Capable Aircraft Certified in the Enhanced Category (PTS-VPT-DSN), Cologne, Germany: European Union Aviation Safety Agency, 2021.

Biography

Samiksha Rajkumar Nagrae



Dr. Samiksha Rajkumar Nagrae is a researcher at the German Aerospace Center (DLR) with a primary focus on modular vertiports, vertiport operations and integrating them in conjunction with U-space and drones. Earlier, she was with the Indian Institute of Science (IISc), Bangalore, for her PhD, specialising in Unmanned Aerial Vehicle (UAV) Traffic Management (UTM). She is also an avid drone pilot.