

Innovative system developed to regulate surge in urban drone traffic

Employing a comprehensive airspace framework, researchers underscore the importance of structured airspace design for safe drone operations over city skylines.

SHARJAH, EMIRATE OF SHARJAH, UNITED ARAB EMIRATES, May 18, 2026 /EINPresswire.com/ -- Researchers have developed a new machine-learning-based method capable of organizing drone traffic in a congested urban airspace, such as that over the cosmopolitan city of Dubai in the United Arab Emirates (UAE).



Dubai skyline. Photo by Wael Hneini on Unsplash

Drones are becoming increasingly common in densely populated urban centers, supporting applications ranging from parcel delivery to surveillance. However, their growing presence has introduced significant challenges related to safety, congestion, and coordination in low-altitude airspace.

Recent research published in the journal *Annals of Operations Research* seeks to address these challenges by proposing a comprehensive system to organize and manage drone traffic over complex city skylines in a safe and efficient manner.

“At the heart of the study, there is a new way of structuring urban airspace using a grid-based design aligned with city infrastructure, such as road networks and building layouts,” explained the study’s lead author, Ali Cheaitou, professor of supply chain, aviation, and transportation management at the University of Sharjah. “This system divides the airspace into organized corridors and layers, ensuring that drones can move without interfering with each other or with existing structures.”

The approach is particularly suited to cities like Dubai, where high-rise buildings add complexity to aerial navigation. To operate the system, the researchers developed advanced mathematical

models that optimize drone routing while accounting for factors such as demand patterns, capacity constraints, and delivery time requirements.

Congested city skies

The study, coauthored by researchers affiliated with the University of Sharjah and AlSinah University in the UAE, Linköping University in Sweden, and Bangor University in the United Kingdom, introduces a traffic load-balancing mechanism designed to distribute drones across the airspace and prevent congestion in high-demand areas.

Given the complexity of these challenges, the researchers employed intelligent algorithms to efficiently identify near-optimal solutions, even for large-scale scenarios. By integrating airspace design, route optimization, traffic balancing, and real-time visualization, they developed a comprehensive framework for managing drone operations in dense urban environments.

Grounded in real-world data from Dubai – including detailed maps and high-rise infrastructure – the study demonstrates how a grid-based airspace system, aligned with city layouts, can structure low-altitude corridors and layers to enable safer, more efficient drone movement.

“Dubai provides a unique and challenging testbed where high-rise density and rapid urban development demand innovative approaches to structuring and managing aerial mobility,” said Imad Alsyouf, professor of reliability, maintenance, and quality engineering at the University of Sharjah and a co-author.

He added, “The strength of this work lies not only in its technical contributions but also in the collaboration between academia, industry, and government across borders, enabling solutions grounded in real operational needs in the context of what is known as the Triple-Helix Approach.”

From theory to practice

The advanced mathematical models and intelligent algorithms further enhance the system by identifying optimal routes and dynamically distributing traffic to minimize congestion, offering practical insights for planners and operators.

A key strength of the research is its integration of theory and real-world application. The proposed system was tested using actual maps and building data from Dubai, enabling the simulation of realistic scenarios and performance evaluation. The results indicate that the system can significantly improve efficiency, reduce congestion, and enhance safety in urban drone operations.

“Overall, this research offers a practical and scalable framework for future urban air mobility systems,” Prof. Cheaitou emphasized. “It not only advances academic knowledge but also

provides valuable tools for city planners, regulators, and industry stakeholders working to safely integrate drones into modern cities.”

AI-powered framework for drone traffic

Beyond structuring the airspace, the study introduces mathematical models that assign optimal routes to drones based on demand patterns, timing requirements, and operational constraints. A complementary traffic load-balancing mechanism further enhances the system by distributing drones across multiple pathways, reducing congestion and preventing localized overload.

“Advanced optimization, heuristics, and artificial intelligence (AI) algorithms are essential to transform complex urban air mobility problems into actionable, real-time decisions,” said Prof. Cheaitou. “As cities evolve into smarter and denser environments, managing low-altitude airspace is no longer optional but rather a necessity for ensuring safety, efficiency, and public trust in drone operations.”

The study moves beyond isolated solutions by integrating airspace design, routing optimization, and traffic management into a unified framework tailored to real-world environments, Prof. Cheaitou noted. “This work lays a foundational step toward scalable and safe urban air mobility, enabling cities to transition from experimental drone use to fully integrated aerial logistics systems.”

Strong regional and global interest

The project has attracted significant interest and active engagement from a wide range of stakeholders beyond academia in the UAE and internationally, underscoring its strong real-world relevance and impact.

Key aviation authorities and public organizations in the UAE – home to some of the world’s busiest aviation hubs, including Dubai International Airport and Abu Dhabi’s Zayed International Airport – have shown considerable interest in the research. These stakeholders have engaged with the project through validation sessions, technical meetings, and workshops.

Notable participants include the Department of Civil Aviation in Sharjah, Dubai Air Navigation Services (DANS), the General Civil Aviation Authority (GCAA), and Dubai Aviation Engineering Projects (DAEP). Their involvement highlights the practical importance of developing effective solutions to regulate increasingly congested airspace.

In parallel, international partners such as LFV (the Swedish Air Navigation Service Provider) and industry leaders like SAAB have contributed expertise and technological perspectives.

The project has also engaged urban planning and logistics stakeholders, including Dubai Municipality, the Roads and Transport Authority (RTA), and companies such as Aramex,

particularly through live demonstrations and feedback sessions on UAV traffic simulations and applications.

“These interactions, supported by high-level institutional and diplomatic participation (including representatives from the Swedish Embassy), highlight that the project has generated strong interest across government, industry, and regulatory bodies,” Prof. Cheaitou noted. “They also confirm its importance as a practical solution for future urban air mobility systems.”

Path to real-world implementation

Despite its strong potential, the study acknowledges several limitations that must be addressed before the framework can be implemented in real-world settings.

To date, the system has been validated primarily through simulation rather than live operational testing. While these simulations are based on real-world data, they assume relatively stable conditions and do not fully account for dynamic factors such as weather variability or unexpected disruptions. In addition, the model simplifies certain operational considerations, including battery usage and recharging processes.

The study also highlights the lack of full integration with existing air traffic management systems—an important gap that must be bridged to enable broader deployment.

To advance the framework toward practical application, the researchers outline several next steps. These include conducting real-world pilot projects, incorporating dynamic environmental conditions, and improving integration with existing aviation systems and regulatory frameworks.

Reflecting on the broader implications of the work, Prof. Alsyof noted, “The current work is validated through realistic simulations using Dubai data, but the next step is field implementation or pilot projects with partners like DANS or GCAA. This would allow testing the system under real operational conditions and validating safety, reliability, and scalability.”

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