CNA

THE FUTURE OF UAS

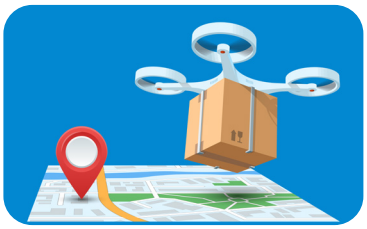
UCATS™
UAS Cooperative Airspace Traffic Simulation

CNA has developed a decision support tool called **UAS Cooperative Airspace Traffic Simulation (UCATS™)** to investigate the fair use of airspace for uncrewed aircraft system (UAS) operations. UCATS™ is designed to provide insights into future decision-making about how to manage large-scale, commercial UAS traffic. As demand for UAS operations increases, regulatory agencies must develop concepts to enable widespread UAS operations, and operators must develop approaches for dynamic and efficient collaboration. This will allow UAS operators of all types—whether commercial or private, large fleet or small fleet—a fair opportunity to access the airspace and fly according to their needs.

In the US, future UAS operations will be managed using a community-based, cooperative approach. This is very different from traditional air traffic management, which relies on the Federal Aviation Administration (FAA) to provide centralized traffic management for the national airspace. In UAS traffic management (UTM), the FAA will establish "rules of the sky," but the operators and third-party UAS service providers will be responsible for coordinating, executing, and managing operations.

BENEFITS OF UCATS™

UCATS™ is designed to help government and industry stakeholders simulate different flight planning scenarios. This data-driven, flexible model can investigate a variety of questions that operators and regulators will need to answer in order to make decisions about managing future UAS operations.



UAS TRAFFIC SIMULATION MODEL

UCATS™ evaluates UAS flight planning scenarios in a shared airspace. It is an agent-based model that builds on the success of other CNA agent-based models used on Navy ships and in correctional facilities. The model analyzes a system from the bottom up. It simulates the flight planning process for UAS operations in a defined region and time period. Each UAS flight plan, including intended departure time and trajectory, is filed in the order that it is submitted. A conflict between two flight plans occurs if any part of a trajectory will overlap with another trajectory at the same time interval. Faced with such a conflict, UCATS™ uses a preset deconfliction protocol to finalize flight plans in one of the following ways:

- **As planned,** without any changes
- **Replanned,** delayed, departing at a later time
- **Cancelled** because it is delayed past the defined time period or past the operator's threshold for delay

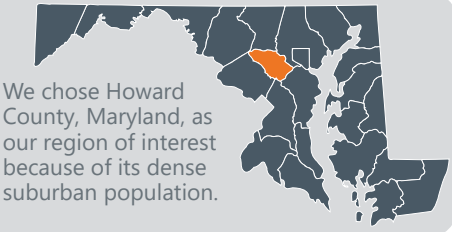
UCATS™ can consider the individual preferences of each operator to represent the diversity in operations that may occur in the future. Factors that can be varied in UCATS™ include:

- Location of distribution site
- Radius of operations
- Number of operations
- Time period of operations
- File-ahead lead time
- Tolerance for delay

The model accounts for uncertainty by randomizing delivery locations and departure times to simulate a range of potential outcomes. UCATS™ is also able to specify overall system-level preferences and assumptions to explore various traffic management scenarios, such as the impact of a first-filed-first-served protocol on different types of operations or the impact of different volumes of traffic on the overall delays and cancellations within the system.

USE CASE: SMALL PACKAGE DELIVERIES

In a recent study, CNA used UCATS™ to simulate four futuristic scenarios involving UAS package delivery operations in Howard County, Maryland. The four scenarios we designed followed a first-filed-first-served protocol to resolve conflicts in flight planning. Flight plans that conflicted with previously filed flight plans were delayed until their trajectories no longer conflicted with other plans. The four scenarios we developed included:


We chose Howard County, Maryland, as our region of interest because of its dense suburban population.

1. **Baseline:** Two package delivery operators with a total of 12,000 trips over a 12-hour period
2. **Varying Traffic:** A series of simulations with varying levels of traffic from 9,000 to 24,000 operations per 12-hour period
3. **Increasing Density:** Allowing up to two and then three UASs in the same grid square before a conflict occurs
4. **Food Delivery:** The addition of three time-sensitive food delivery operators that are active within a three-hour period

Our results showed that when flights are prioritized using a first-filed-first-served method, food deliveries and other flights that can't be planned far in advance have a higher chance of being delayed or canceled, as were flights scheduled later in the day. The model also found high congestion areas around distribution locations and along popular flight corridors. In addition, UCATS™ identified thresholds in traffic level and grid density that resulted in notable increases in delays and cancellations, which indicated when the overall system was stressed and when new deconfliction protocols may be needed.

FUTURE WORK

UCATS™ can provide informative, data-driven insights to help industry and government stakeholders plan for the fair usage of UAS airspace. There are many opportunities for future UCATS™ scenarios, including studying the feasibility of prioritization schemes other than first-filed-first-served, which might be based on specific operator preferences or package priorities. UCATS™ could also be adapted to explore Urban Air Mobility concepts such as air taxis and non-UAS use cases such as airport gate scheduling and commercial space operations.

POTENTIAL APPLICATIONS OF UCATS™

- Health care and medical deliveries
- First responder units
- Breaking news crews
- On-demand air taxis

ABOUT CNA

CNA is a nonprofit research and analysis organization dedicated to the safety and security of the nation. It operates the Institute for Public Research — which serves civilian government agencies — and the Center for Naval Analyses, the Department of the Navy's federally funded research and development center (FFRDC). CNA is dedicated to developing actionable solutions to complex problems of national importance. With nearly 700 scientists, analysts and professional staff, CNA takes a real-world approach to gathering data, working side-by-side with operators and decision-makers around the world. CNA's research portfolio includes global security and great power competition, homeland security, emergency management, criminal justice, public health, data management, systems analysis, naval operations and fleet and operational readiness.

For additional information, download our report, or to set up a time to discuss the model in additional detail, please contact:

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