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DANTi: A Tool for Assistive Detect and Avoid Research

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Contributions

DANTi: Open-source research tool for the development of Assistive Detect and Avoid (ADAA) technologies for General Aviation

- Electronic Flight Bag (EFB) application prototype
- Integrated analysis environment for fast-time simulations
- DAA guidance provided by the DAIDALUS reference library

Available under NASA Open-Source Agreement
at <https://github.com/nasa/DANTi>

Research Context

The future airspace will be safer, greener, and quieter

New airspace services and new types of vehicles, from passenger carriers to package delivery aircraft, must be safely integrated into National Airspace System

Automated navigation systems could improve coordination and information sharing and help pilots fly in a more crowded airspace



From DAA to Assistive DAA (ADAA)

Detect and Avoid (DAA) is a technology that provides situational awareness and maneuver guidance to UAS operators

DAA is safety-critical technology which, when ultimately approved, is intended to provide an alternate means of compliance with see-and-avoid regulations for remote UAS pilots

The DANti research aims to **evolve DAA into an Assistive technology** providing safety augmentation to see-and-avoid for onboard pilots

Key Research Questions

1. Can ADAA be used effectively by onboard pilots to assist with maneuver guidance well before conflicts become collision hazards?
2. Can ADAA support onboard pilots in advanced urban air mobility (UAM) scenarios operating in high traffic densities at low altitudes?
3. What procedures should be followed by onboard pilots when using ADAA?
4. How complex would it be to certify an ADAA technology?

Impact and Use Cases

DANTi is used within large research projects investigating future Urban Air Transportation Systems

- NASA Air Mobility Pathfinders

www.nasa.gov/directorates/armd/aosp/amp/

- Joint NASA/FAA Laboratory Integrated Test Environment

www.faa.gov/about/office_org/headquarters_offices/ang/offices/tc/library/Storyboard/detailedwebpages/nflite.html

- NASA Design Integrity Lab @ NASA LaRC

Overview of the talk

Design and functionalities of the DANTi research tool

- EFB Display
- Integrated Analysis Environment
- Example Application

EFB Display

<https://shemesh.larc.nasa.gov/fm/DANTi/>

- Moving map
- Compass
- Tape indicators
- Guidance shown as color-coded bands
- Aural annunciations
- Suggestive maneuver guidance



Integrated Analysis Environment

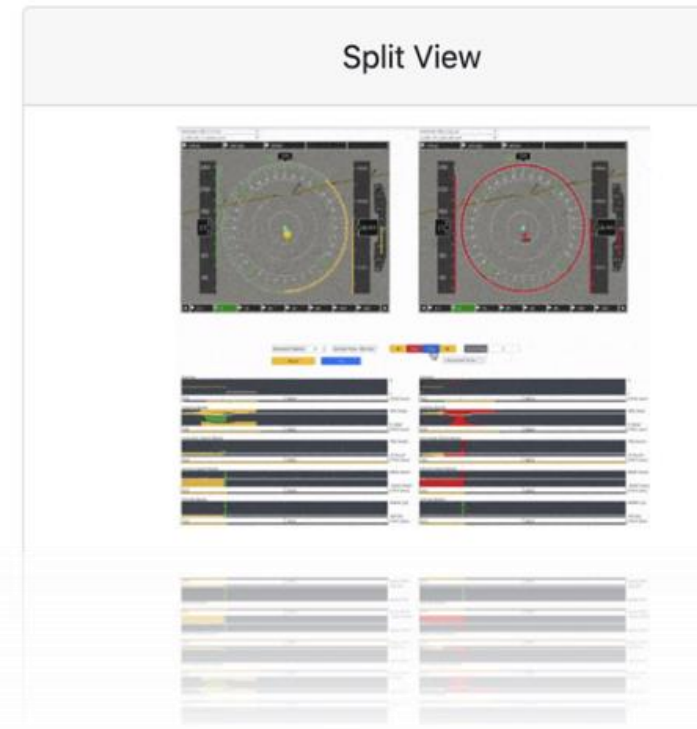
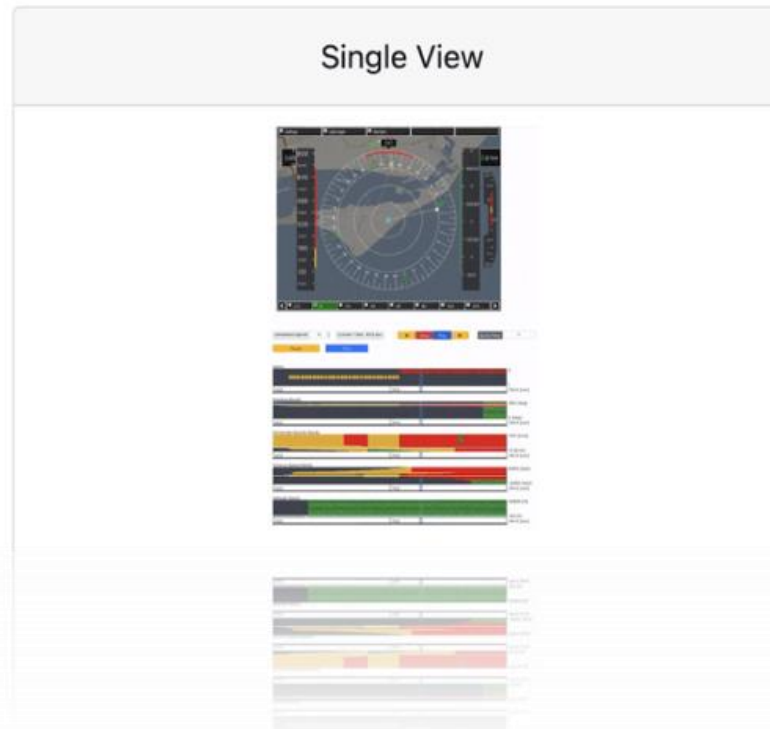
Dedicated "views"

Fast-time simulation

Comparative analysis

Analysis over time

Modular architecture

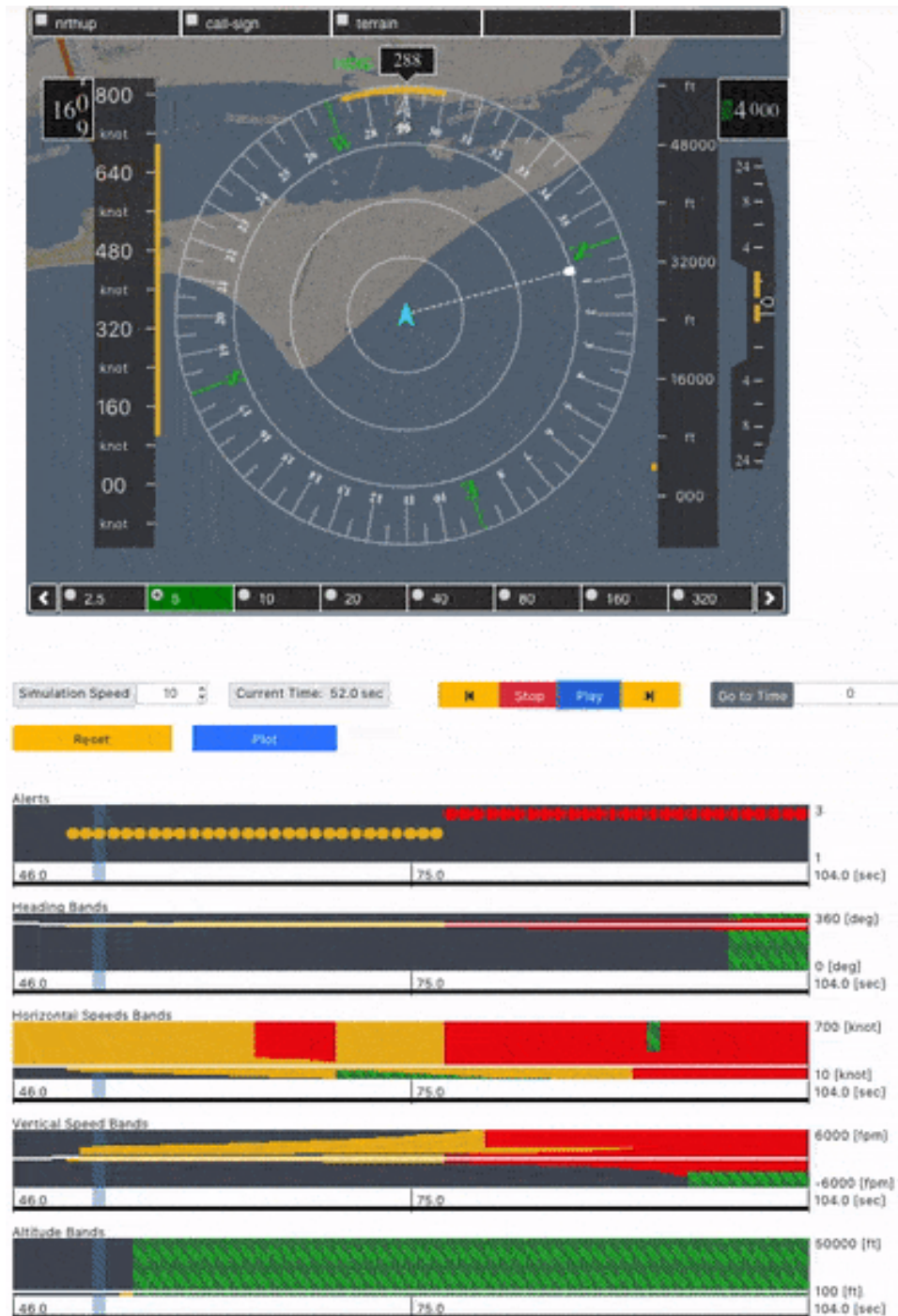


Single View App

Enables analysis of DAA guidance

Spectrogram plots facilitate the analysis of DAA capabilities over time

Behaviors in the alerting and maneuver guidance logic (e.g., alert flickering) can be identified visually by looking at the plot diagrams



Split View and Multi View Apps

Enables comparative analysis of DAA guidance

- Compare DAA implementations
- Compare DAA configurations
- Check how DAA guidance changes in the presence of wind
- Check compliance between DAA implementations and reference specifications

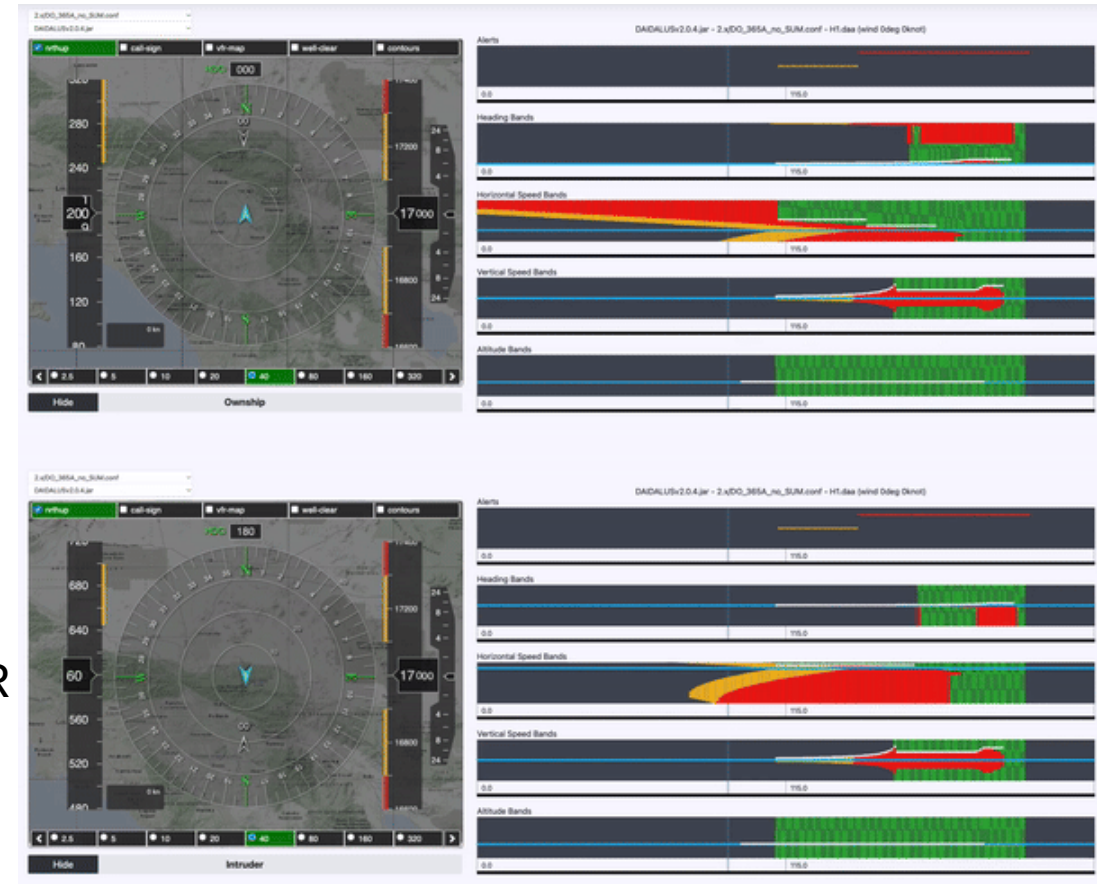


Multi View App

Enables consistency checking of DAA guidance for multiple aircraft

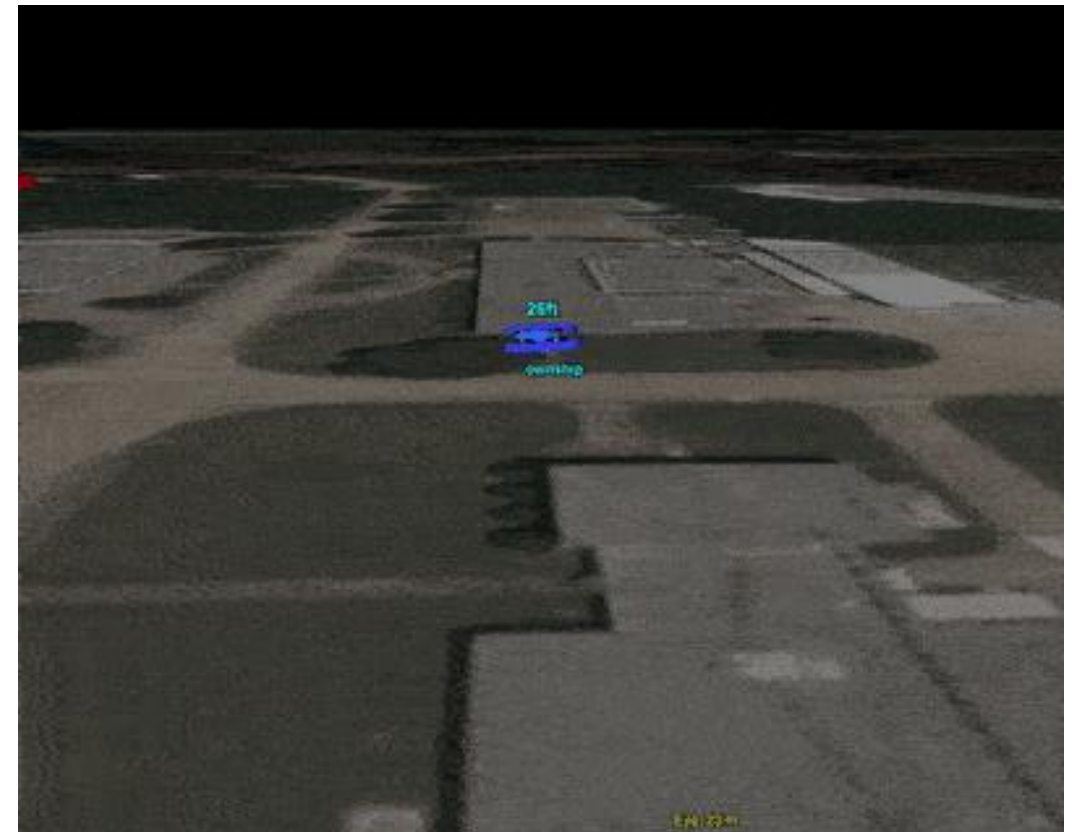
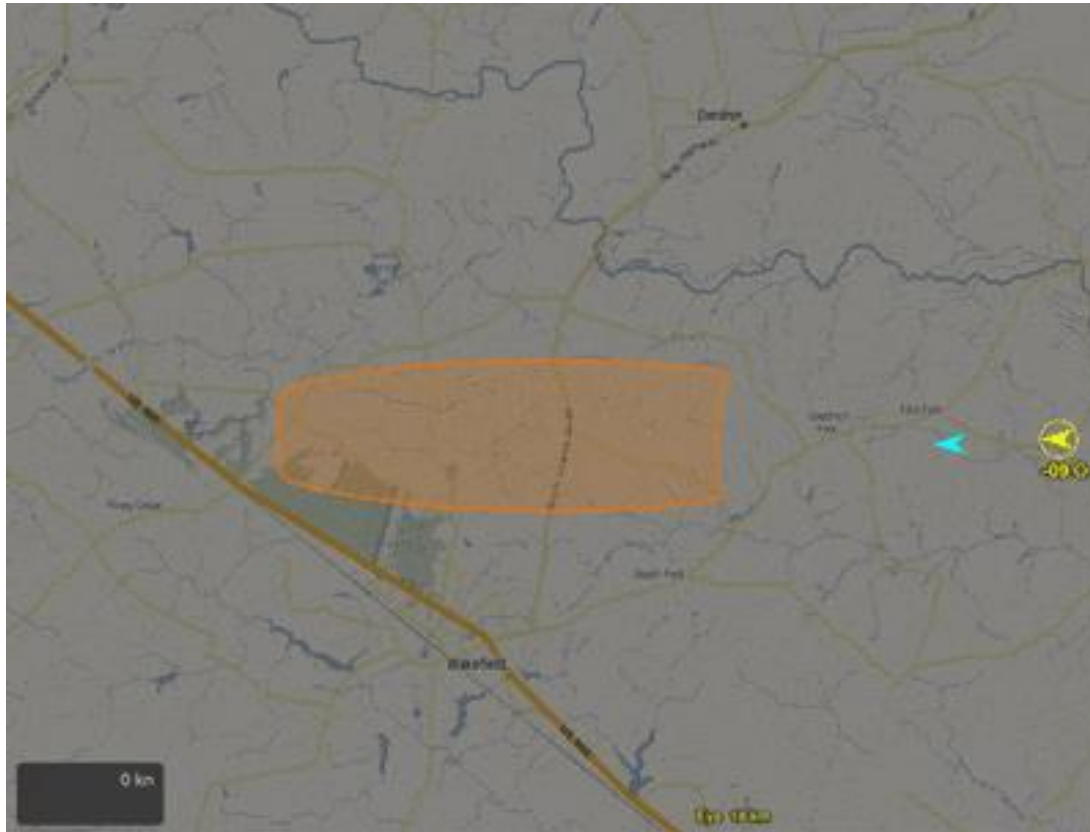
Check that flight conflict is resolved when both ownship and intruder follow DAA maneuver guidance provided in the cockpit of each aircraft

OWNSHIP
DISPLAY



Top View and 3D View

Enable analysis of hazard zones, contours, and vertical maneuvers



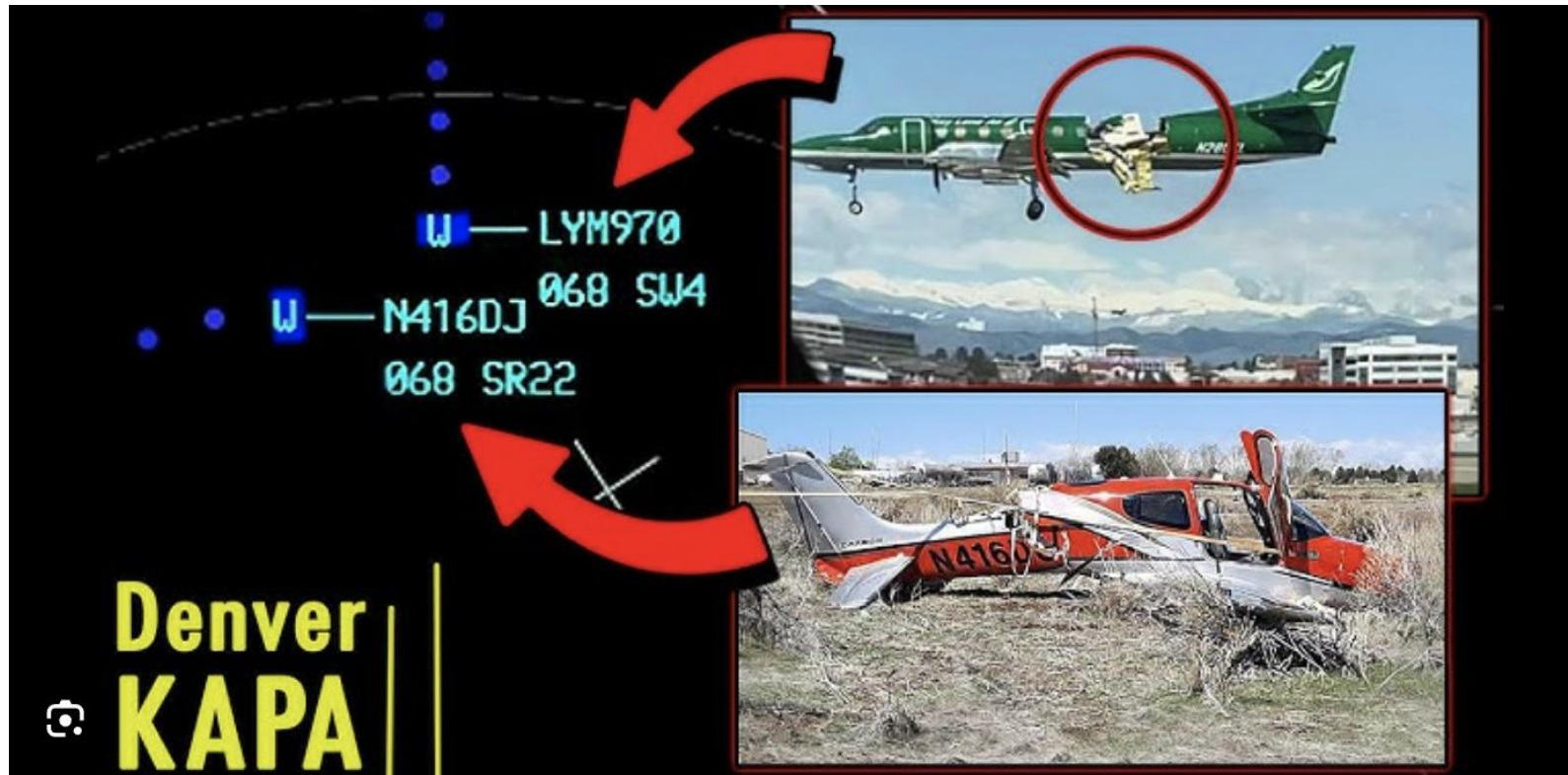
Connecting DANTi to a Flight Simulator

Enable pilot-in-the-loop research of DAA technologies

- Out-of-the-window view
- DAA guidance



Example: Centennial Accident



An SR22 and a Metro SA226 on approach to land on parallel runways, controlled by different control tower frequencies

The Metroliner was established on final on left runway

The SR22 was turning on right on final to right runway, but 50kts too fast, it crossed the left runway colliding with the Metroliner.

No casualties

While the official probable reasons for the accident point to excessive speed (SR22 pilot) and ATC (omission to alert the Metroliner pilot), DANTi guidance would have alerted pilots of the impending accident.

Replay of Centennial Accident with DANti



Final Remarks

DANTi is a prototype tool that enables research on the use of Assistive Detect and Avoid for advanced air mobility concepts such Future Urban Air Mobility

- Realistic Display Prototype
- Integrated Analysis Environment
- DAA guidance provided by DAIDALUS
- NASA Open-Source Agreement

Ongoing work: integration of DANTi in the cockpit of a real-world research aircraft for urban air mobility operations

Thank you for your attention

Questions?

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