



National Aeronautics and
Space Administration



Scalable Traffic Management for Emergency Response Operations (STEReO)

Tabletop Simulation Brief

Airborne Traffic Autonomy Topic

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➤ Design Reference Mission Example (Aerial Surveillance)

A UAS equipped with airborne traffic detection is tasked with searching an area frequented by hobbyists near an active fire. The onboard traffic detection system is capable of detecting and identifying aircraft and sharing that information with the USS. During the mission a sUAS is detected and its position and classification is shared with the USS. The sUAS location does not correspond to any known UAS operations and is declared to be a rogue operation.



Hobbyist sUAS
(Non-cooperative)



Emergency Response
Aircraft (STEReO)



Airborne Traffic Detection
sUAS (STEReO)



Airborne Traffic Autonomy Technology

Referencing NASA Machine Vision DAA Research

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➤ Machine Vision Detection

- Collision avoidance model?
- Well clear 500ft?



Camera Sensor

Preliminary NASA Test Results for GA and sUAS intruders

Sortie Number and Description	Initial Establish Track for Intruder Range (m)	Minimum Detection Range to satisfy 500ff well-clear model that incorporates closing velocity (m)
Fixed-wing vs multirotor	1022	840
Fixed-wing vs multirotor	1078	840
Fixed-wing vs multirotor	980	840
Fixed-wing vs multirotor	987	840
Fixed-wing vs multirotor	1150	840
GA vs multirotor	2297	1890
GA vs multirotor	3247	1890
GA vs multirotor	2404	1890
GA vs multirotor	2936	1890

Ref: Detection and Tracking of Aircraft in the Far-Field from Small Unmanned Aerial Systems, Journal of Aerospace Information Systems, C. Dolph, C. Minwalla, L. Glaab, M. Logan, D. Allen, K. Iftekharuddin, Under Review



Airborne Traffic Autonomy Technology

Referencing NASA Radar DAA Research

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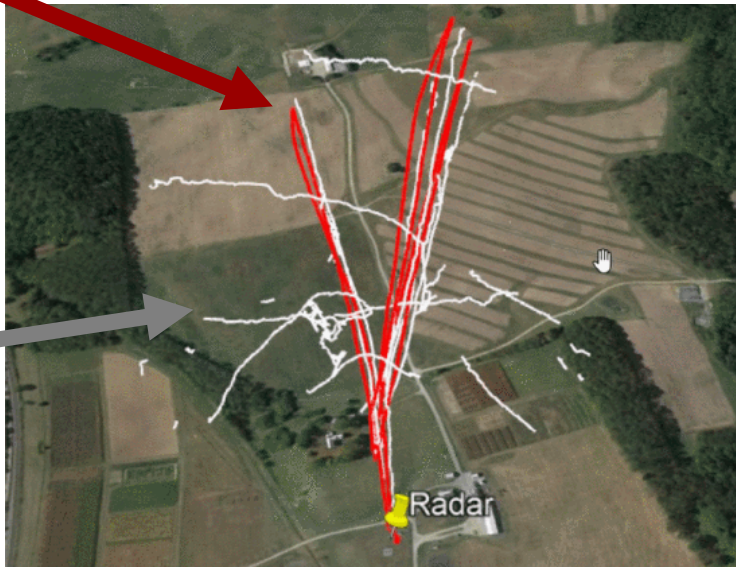
➤ Low SWAP-C Radar



sUAS Tracks

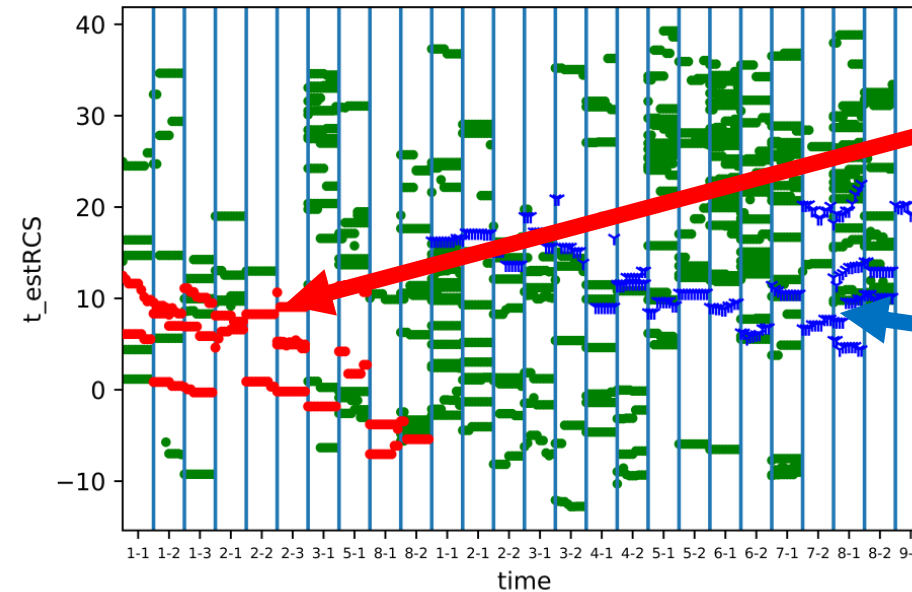


Non-aircraft
Tracks



Ref: G. N. Szatkowski, A. Kriz, L. A. Ticatch, R. Briggs, J. Coggin and C. M. Morris, "Airborne Radar for sUAS Sense and Avoid," 2019 IEEE/AIAA 38th Digital Avionics Systems Conference (DASC), San Diego, CA, USA, 2019,

Preliminary Aircraft Classification using RADAR features



sUAS



GA
Aircraft

Ref: Aircraft Classification Using RADAR from Unmanned Aerial Vehicles for Scalable Traffic Management for Emergency Response Operations, Abstract in preparation for submission to AIAA Aviation 2021.



Airborne Traffic Autonomy Technology

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➤ Sensor Fusion

- Integrate RADAR + Vision sensors.
 - Low SWAP-C Radar
 - Camera



Camera Sensor



Radar Sensor



Multi-sensor System



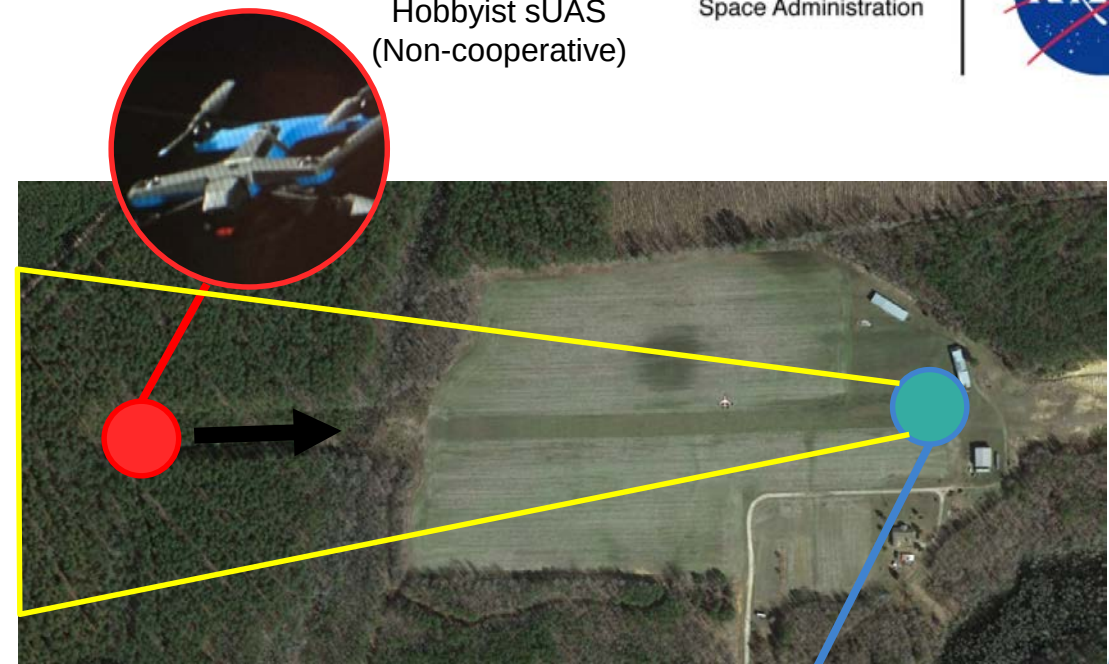
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➤ Flight Testing

- Developing flight test plans with head-on encounters and traffic monitoring





STEReo

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