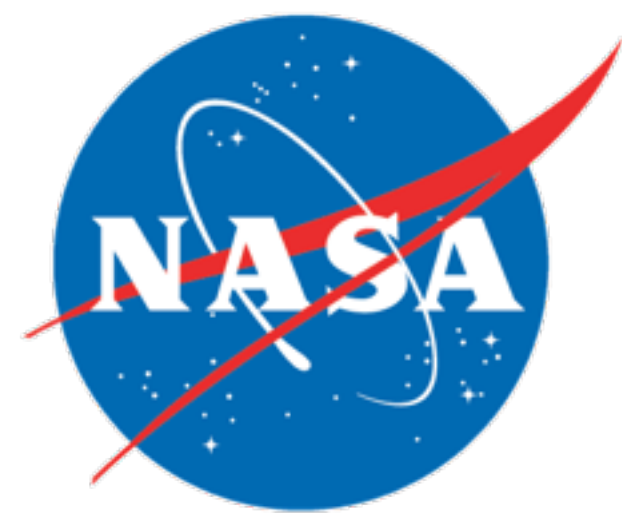




Methods to reduce communication workload for UAM operations

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Background

- UAM is the implementation of air passenger transportation systems in metropolitan areas
- **Purpose of UAM**
 - Achieve mobility for the public given rising traffic congestion
- Projected high consumer demand for UAM flights (Thipphavong et al., 2018)
- One constraint for high density, high tempo UAM traffic is air traffic controller's workload and frequency congestion
- Necessary to streamline verbal communication for UAM without adversely impacting airspace safety
- One method to reduce communication workload is to design and use Letter Of Agreements (LOAs)

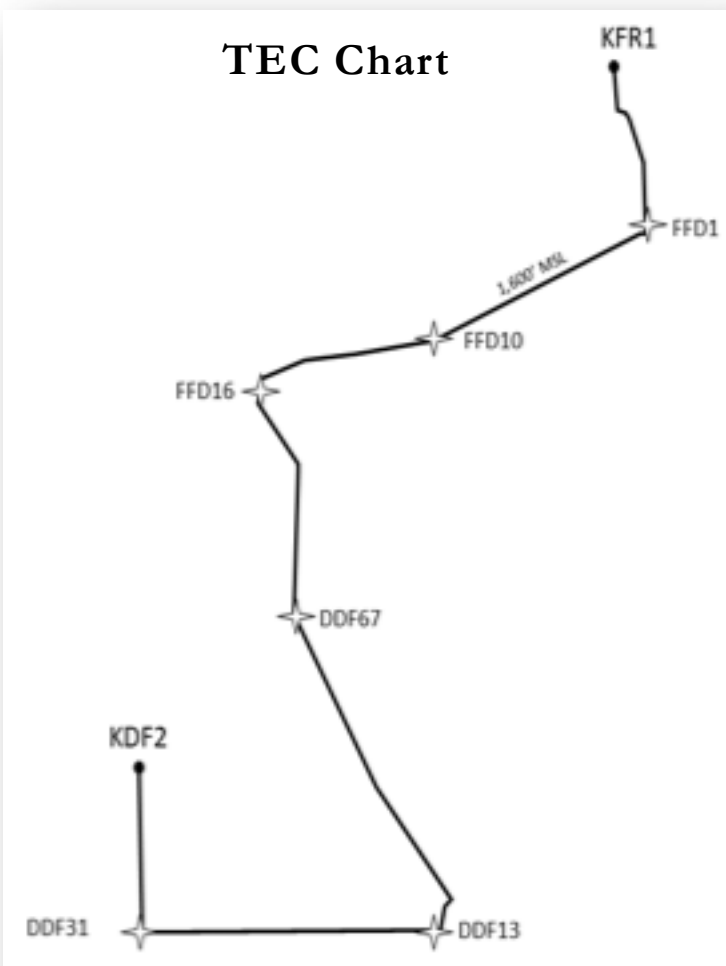


What defines an LOA?

- LOA is a legal document signed by parties entering a contract regarding operations within a given airspace
- **Common characteristics:**
 - Defined purpose
 - Responsibilities for each signatory
 - Procedures for operations
 - Definitions for scratchpad entries (ARTS)
 - Verbal descriptive routes available
 - Visual depictions of the airspace and its class boundaries
- **Proposed additions to LOAs for UAM operations:**
 - Pre-assigned beacon codes
 - Tower En Route Control (TEC) routes
 - Transition points for handoffs
- Help to minimize verbal clutter and workload by detailing steps to be taken in advance for the UAM pilot and controller

Verbal Descriptive Example
DFW1 (DFW to Frisco) - Depart from KDF2 southbound via Spine Road. Turn left and proceed eastbound on Route 183 at 1,000' MSL. At Loop 12, turn left and proceed northeast bound to I-35 East until Highway 121 at 1,100' MSL. Follow Highway 121 northeast. At the intersection of Highway 121 and North Dallas Tollway turn left and proceed northbound direct to KFR1.

Tower En Route Control (TEC) Example
DFW1 (DFW to Frisco) - KDF2 DDF31 DDF13 DDF67 FFD16 FFD10 FFD1 KFR1



Communication Examples

Departure (Without LOA)	
UAM Pilot	"Dallas Fort-Worth Tower, this is UAM193 at Vertiport. Ready for departure with information Echo. Requesting departure to Frisco via Spine Road to Route 183 East, Grapevine, and Highway 121."
Controller	"UAM193, approved as requested for Frisco via Spine Road to Route 183 East, Grapevine, and Highway 121. Take off at pilot's own risk. Squawk 7421."
UAM Pilot	"Squawking 7421. Getting airborne, UAM193."
Controller	"UAM193, copy."

Departure (With LOA)	
UAM Pilot	"Dallas Fort-Worth Tower, this is UAM193 at vertiport. Ready for departure with information Echo. Requesting DFW1."
Controller	"UAM193, you're approved for DFW1."
UAM Pilot	"Dallas Fort-Worth, thank you. Getting airborne, UAM193."
Controller	"UAM193, copy."

Traffic Call (Without LOA)	
Controller	"UAM193, traffic at your three o'clock. Akuna departure about a quarter of a mile away going southbound at 1,300 and climbing."
UAM Pilot	"Dallas Fort-Worth, traffic in sight. Thank you, UAM193."
Controller	"NASA205, UAM traffic at your nine o'clock. Heading southbound on Spine Road about a quarter of a mile away at 1,600."
Commercial Pilot	"Dallas Fort-Worth, copy on that UAM traffic, AAL205."

Traffic Call (With LOA)	
With LOA, all signatories will be aware of surrounding airspace operations. Traffic calls will not be necessary during normal operations. Controllers may still give traffic advisories in the event of potential conflicts.	

Sector Handoff (Without LOA)	
Controller	"UAM193, at NEWW8 contact Dallas Love on 120.8"
UAM Pilot	"At NEWW8, contact Dallas Love on 120.8, UAM193."

Sector Handoff (With LOA)	
With LOA, exiting sector transition points can be predefined. UAM pilots can switch over to the next sector's frequency without having to verbally coordinate with the current sector's controller.	

Proposed Preliminary Study

- Potential issues for LOAs:
 - Training existing controllers for UAM operations
 - Formatting styles for routes
 - Verbal descriptive routes are information dense
 - TEC routes requires familiarity with new UAM specific waypoints
- Compare usability and acceptability of verbal descriptive and TEC routes
- Proposed study focuses on the current helicopter routes in Dallas Fort-Worth area
- Another study is planned to focus on current and modified routes

Research Questions

- What route formatting style – Verbal Descriptive or TEC routes - do controllers prefer for LOAs?
- Does type of route formatting influence workload, situation awareness, and throughput?

Design

- Within Subjects ($n = 3$)
 - **Independent Variable**
 - Route formatting style (Verbal descriptive routes versus TEC routes)
 - **Dependent Variables**
 - Subjective measures of perceived acceptability, workload, and situation awareness
 - Objective measures of throughput

Expected Results

- We expect that participant controllers will prefer TEC routes compared to the verbal descriptive routes
 - Simplicity, availability of visual information
 - Lower overall workload
 - Greater overall SA
 - Higher throughput

References

Thipphavong, D. P., Apaza, R., Barmore, B., Battiste, V., Belcastro, C. M., Burian, B., ... & Savita, V. A. (2018). Urban Air Mobility Airspace Integration Concepts and Considerations. In *2018 Aviation Technology, Integration, and Operations Conference* (p. 3676).

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