

Unmanned Aircraft Systems (UAS) Traffic Management (UTM)

Key Lessons from Small UAS Operations and Performance Research and Future Work

NASA

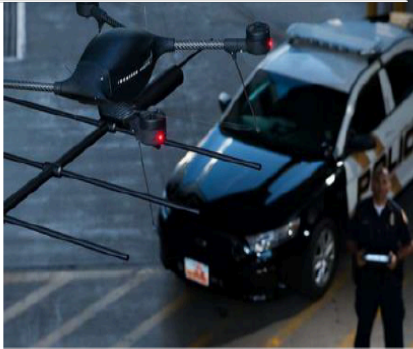
<http://www.utm.arc.nasa.gov>

Moffett Field, CA

Operations and UAS Performance research group

Applications of Unmanned Aerial Systems

Aerial Instruments



Public Safety

Cargo



Deliveries

Aerial Instruments



Surveillance

Aerial Instruments



Weather Monitoring

Aerial Instruments



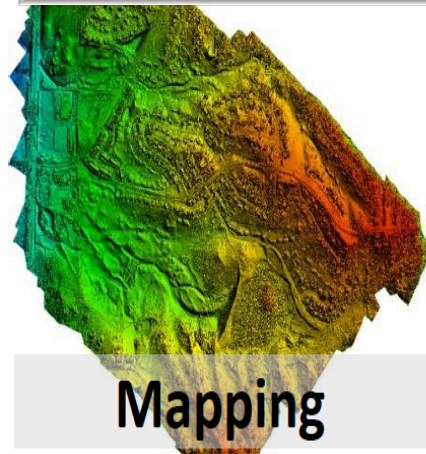
News Gathering

Aerial Instruments



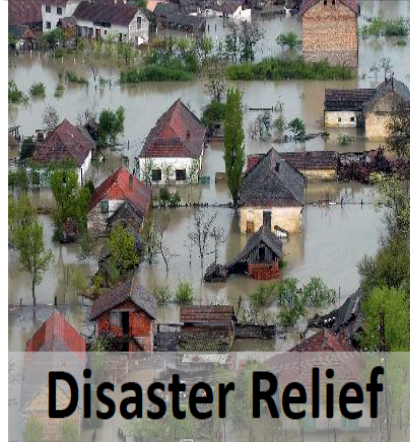
Agriculture

Aerial Instruments



Mapping

Aerial Instruments



Disaster Relief

Aerial Instruments



Entertainment

Aerial Dispersal



Spraying/Seeding

Stages of Traffic Management: Requirements are Different



http://www.kcet.org/updaily/socal_focus/history/la-as-subject/7th-and-broadway.html

1920, Photo Collection, Los Angeles Public Library

UTM Research Technical Capability Level



Each capability is targeted to type of application, geographical area and uses risk-based approach

CAPABILITY 1

- Reservation of airspace volume
- Over unpopulated land or water
- Minimal general aviation traffic in area
- Contingencies handled by UAS pilot
- Enable agriculture, firefighting, infrastructure monitoring

CAPABILITY 3

- Beyond visual line of sight
- Over moderately populated land
- Some interaction with manned aircraft
- Tracking, V2V, V2UTM and internet connected
- Public safety, limited package delivery

CAPABILITY 2

- Beyond visual line-of-sight
- Tracking and low density operations
- Sparsely populated areas
- Procedures and “rules-of-the road”
- Longer range applications

CAPABILITY 4

- Beyond visual line of sight
- Urban environments, higher density
- Autonomous V2V, internet connected
- Large-scale contingencies mitigation
- News gathering, deliveries, personal use

Current Research Areas



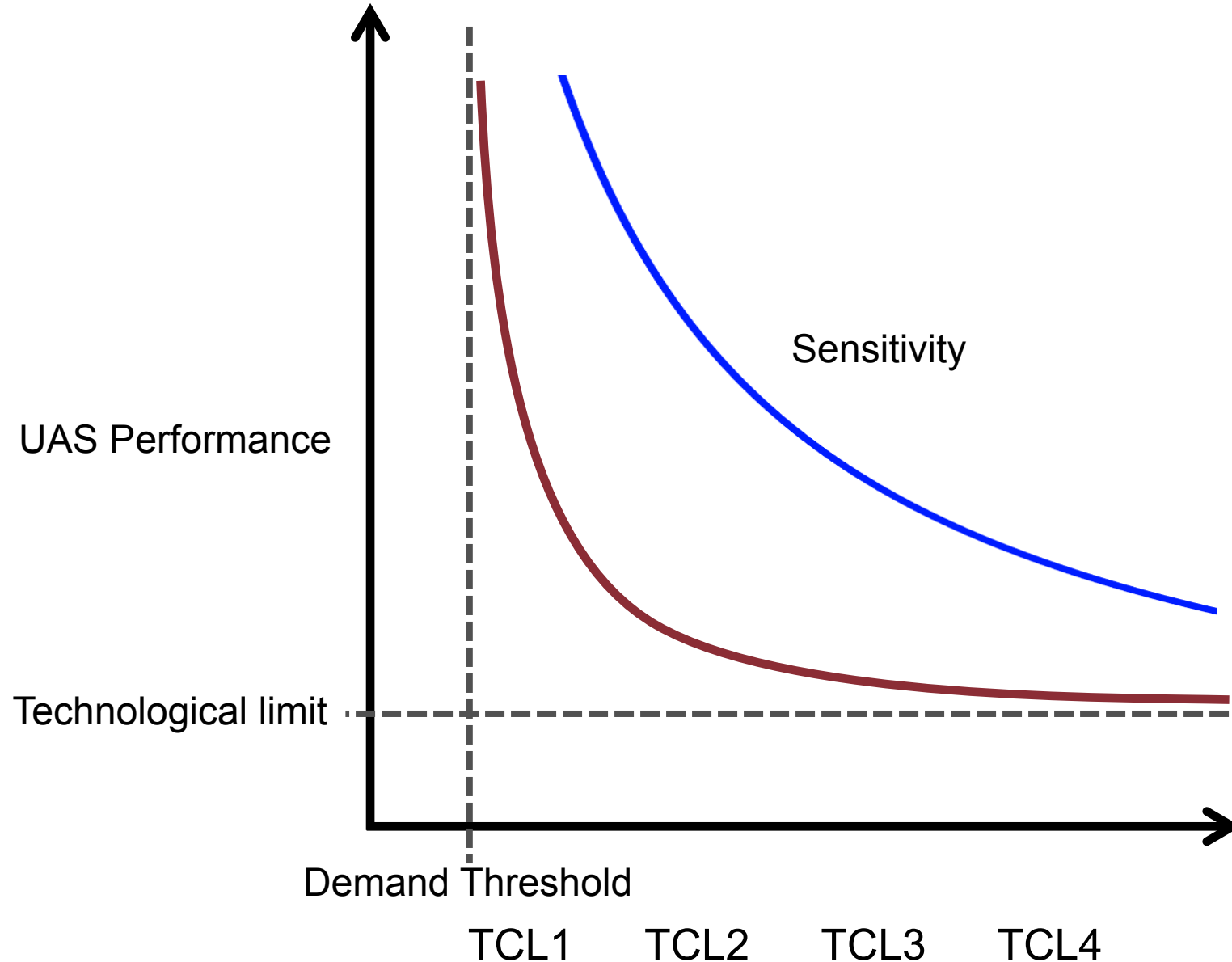
- TCL1-4 operations and UAS performance need
- Geo-fence conformance



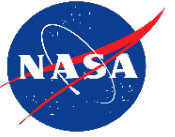
TCL1-4 Operations and UAS Performance Need



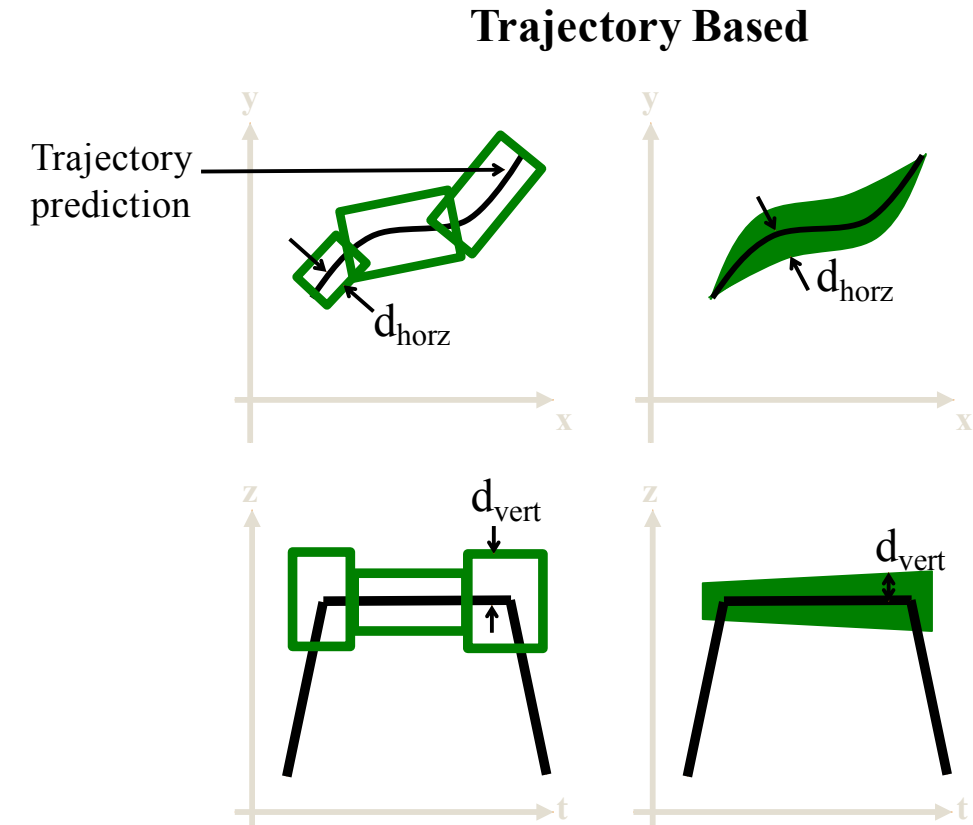
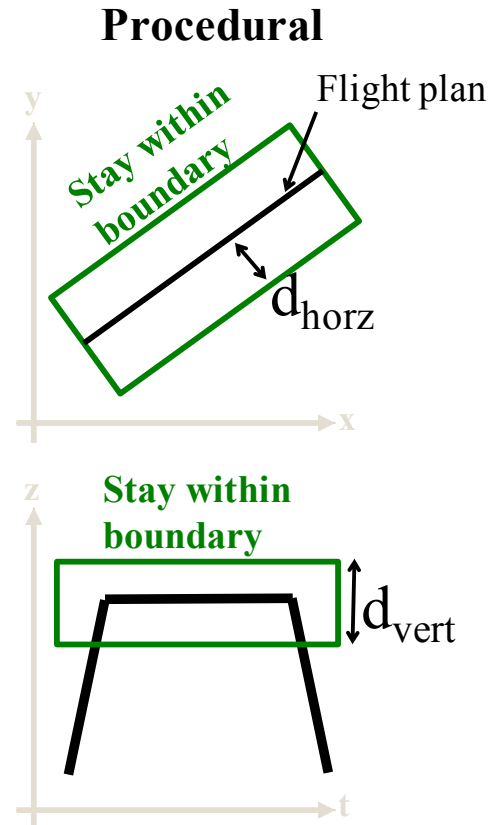
- **Why is this important?**
 - Demand drives traffic management
 - Type of operations and demand matter
 - Input to geo-fence setup



Conformance to Geo-fence



- Why is this important?
 - Inform requirements and standards for UAS Supplier Services
 - Identify use cases for large demand (structure where needed)
 - Understand actual challenges to operation with large variety of vehicles (wind)



Key Lessons and Future Work



- **UAS Performance requirements**
 - Depends on geographical need and use case
 - Understanding demand needed
- **Required Navigation Performance to capture navigation performance**
 - Lateral only
 - Performance validation needed
- **Trajectory modeling is a key component in Geo-fence conformance**
 - Feasible Geo-fence calculation
 - Conformance forecast with wind information
 - Model validation needed