Standards & Regulations

Team F: Falcon Eye

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Agenda

- Proposal for Air Safety Regulations involving small Unmanned Aerial Systems (sUAS)- Amazon

- **ASTM E2853-12**
  Standard Test Method for Evaluating Emergency Response Robot Capabilities: Human-System Interaction (HSI): Search Tasks: Random Mazes with Complex Terrain
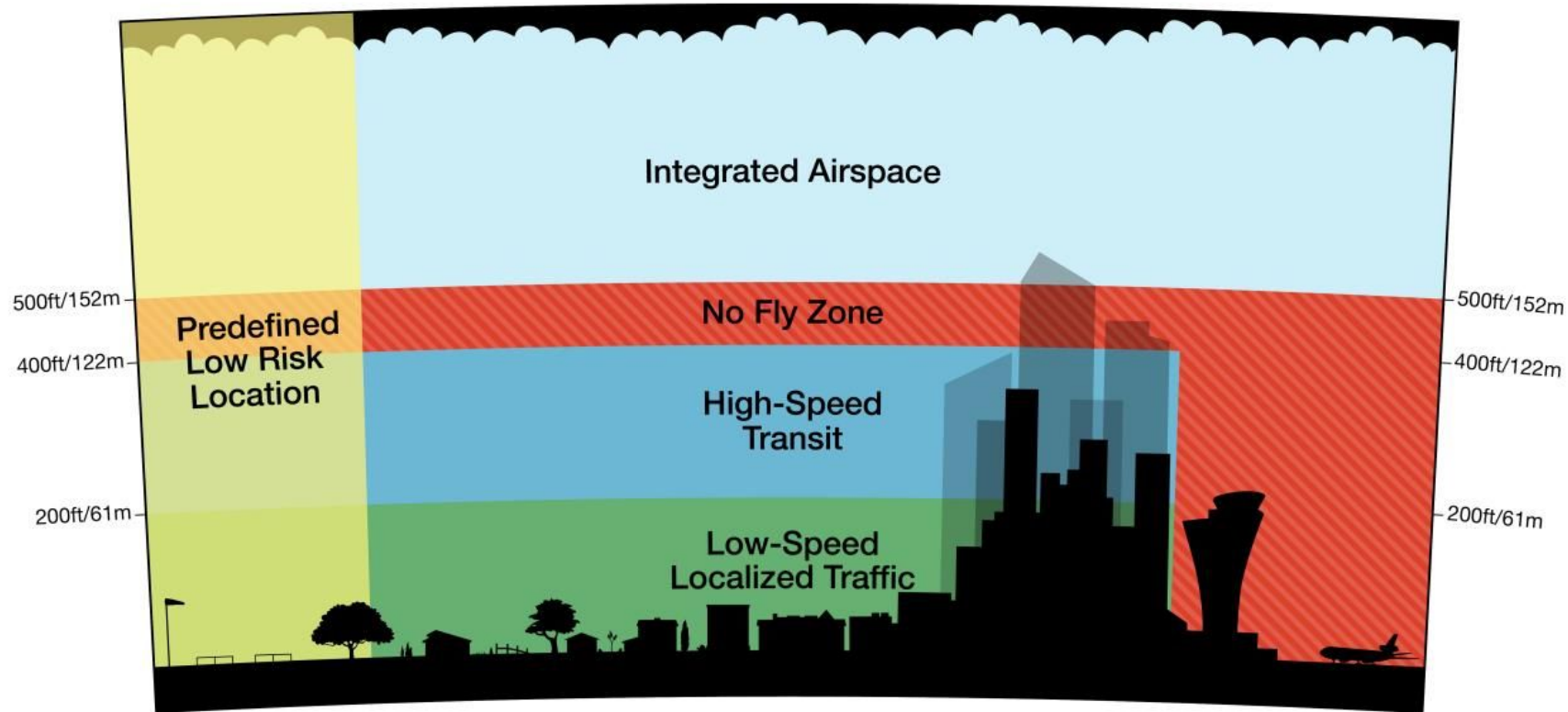
sUAS - What is it about

- Airspace regulations and laws mostly deal with large commercial and military aircraft that operate above 500 feet
- Over the past decade, there is a significant increase in small Unmanned Aircraft Systems (sUAS) which operate below 500 feet
- Need updated regulations to safely and efficiently manage this new airspace
- Amazon proposes a *segregated* civil airspace below 500 feet
- Also proposes a migration to a *distributed* management system
- Motivated by PrimeAir

Airspace segregation (What it prescribes)

- < 200 feet: Reserved for non-transit operations such as inspection or surveying and for aircraft without sophisticated sensors
- 200 - 400 feet: Airspace for aircraft with sophisticated sensors
- 400 - 500 feet: No fly zone except in emergencies
- Special Low-Risk locations: Predefined by aviation authorities for less restrictive flying (ie. academic use)

Airspace Design for Small Drone Operations

Integrated Airspace

No Fly Zone

Predefined Low Risk Location

High-Speed Transit

Low-Speed Localized Traffic

500ft/152m

400ft/122m

200ft/61m

Airspace management (What it prescribes)

- Airspace management and control is the single greatest limitation of airspace capacity
- The number of sUAS is projected to exceed commercial, military and general aviation operations in the next decade
- Require a paradigm shift in airspace control
- Proposes to migrate to a **more distributed** system

Applicability

Aircraft Operation:
- Pilot in command of a sUAS is directly responsible for the operation of sUAS.
- A person may not be the pilot of multiple sUAS at any given time.
- In Team F, Yuchi is the pilot and another person is the visual observer.

Autonomous Operations:
- The pilot must have the ability to regain control of the aircraft immediately at any given time
- This can be accomplished through direct manipulation or commands
- In our case, we can override the autonomous navigation and land the UAV at any time

Applicability

Aircraft Registration:
- UAV's must be registered.
- Our Bebop 2 is registered,

VO:
- Visual Observer (VO) is optional to supplement situational awareness and VLOS.
- One of the team member will act as VO.

sUAS Maintenance, Inspections, and Condition for Safe Operation:
- A sUAS must be maintained in a condition for safe operation.
- The pilot is responsible for verifying that the sUAS that it is actually in a condition for safe operation.
- We check that propellers and other parts are safely secured and not damaged before flight.

Applicability

VLOS Aircraft Operation:

The remote PIC and person manipulating the controls must be able to see the small UA at all times during flight. This requirement also applies to the VO.

Our area of operation is very small and a plane ground. So, the UAV will always be visible to us.

Operating Limitations for Small UA:

The small UA must be operated in accordance with the following limitations:

- Cannot be flown faster than a groundspeed of 87 knots (100 miles per hour).

- Cannot be flown higher than 400 feet above ground level (AGL), unless flown within a 400-foot radius of a structure and does not fly higher than 400 feet above the structure's immediate uppermost limit.

- Minimum visibility, as observed from the location of the CS, may not be less than 3 statute miles(sm)

Applicability

Prohibited Operation Over Persons:

Part 107 prohibits a person from flying a small UA directly over a person who is not under a safe cover, such as a protective structure or a stationary vehicle. However, a small UA may be flown over a person who is directly participating in the operation of the sUAS

Designate a separate area for all, to ensure the safety.

Operations while Impaired:

We also emphasize that part 107 prohibits a person from serving as a remote PIC, person manipulating the controls, VO, or other crewmember if he or she:

- Consumed any alcoholic beverage within the preceding 8 hours;
- Is under the influence of alcohol;
- Has a blood alcohol concentration of .04 percent or greater; and/or
- Is using a drug that affects the person's mental or physical capabilities.

All the Team Members will be sober in SVE.

ASTM E2853-12:
Standard Test Method for Evaluating Emergency Response Robot Capabilities:

Human-System Interaction (HSI): Search Tasks: Random Mazes with Complex Terrain

Purpose:

Quantitatively evaluate a teleoperated ground robot's capability of searching in a maze.

(Autonomous Behaviours allowed by changing testing score criterias)

Applicable Products

Courtesy US DoL, Mechanical Design 101, Kikuchi

- Mandatory for all robots used in InterAgency Board- US Govt. Agency respond safely and effectively to emergencies, disasters, and CBRNE incidents.

Applicable Products

Standard Test Methods For Response Robots
ASTM International Standards Committee on Homeland Security Applications;
Operational Equipment; Robots (E54.08.01)

Validation Exercises for Robot Developers
Various Robot Sizes and Capabilities To Ensure Tests Scale Effectively

iRobot 110 FirstLook
2.4kg (5.2lbs)

Qinetiq Dragon Runner 10
4.5kg (10lbs)

iRobot 310 SUGV
13.2kg (29lbs)

ICOR Caliber Mini
27kg (65lbs)

Remotec Titus
61kg (135lbs)

ICOR Caliber T5
64kg (140lbs)

Cobham Telemax
80kg (175lbs)

ICOR Caliber MK3
84kg (185lbs)

Remotec HD-SEL
111kg (245lbs)

iRobot 710 Kobra
166.5kg (367lbs)

Remotec F6B
220kg (485lb)

WM Robotics Knight
249kg (550lbs)

Remotec Mark 5-A
358kg (790lbs)

Remotec Wolverine
367kg (810lbs)

www.nist.gov/el/isd/ms/RobotTestMethods.cfm

20

Prescriptions of Standard

- Through a simulation of emergency response scenario, we determine
    - Common comparison of Technologies.
    - Quantitative performance data.
    - Helps agencies choose appropriate systems.
   - Encourages improved comm. Systems on emergency response robots

Prescriptions of Standard: Traversing

Target: Traverse a Maze, <u>Covering and Clearing</u> Targets
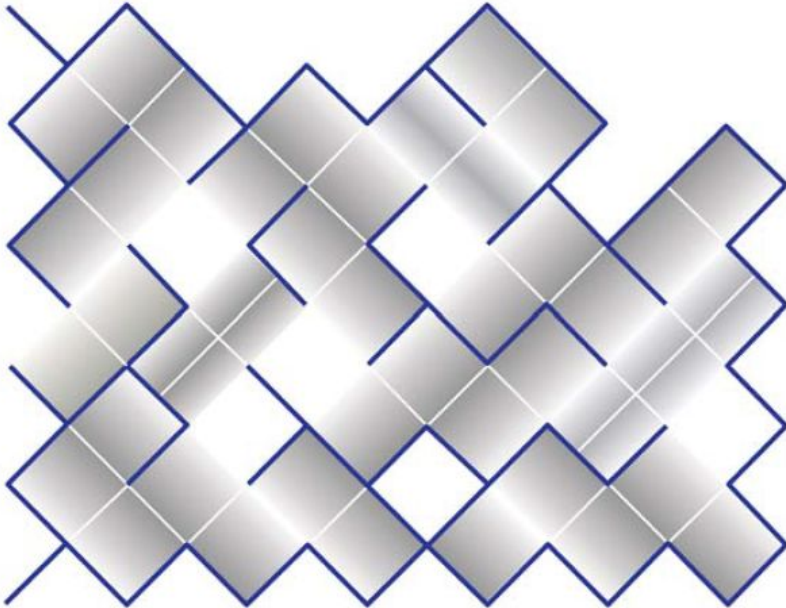
- 1.2m by 1.2m, 48 floor units

- Each 4 side can be a wall or open

- Walls - 2.4m high

- Material- Oriented Strand Board or plywood

- Ram Terrains used

- Gray shades indicate the elevations- the darker, the higher.

Prescriptions of Standard: Finding Targets
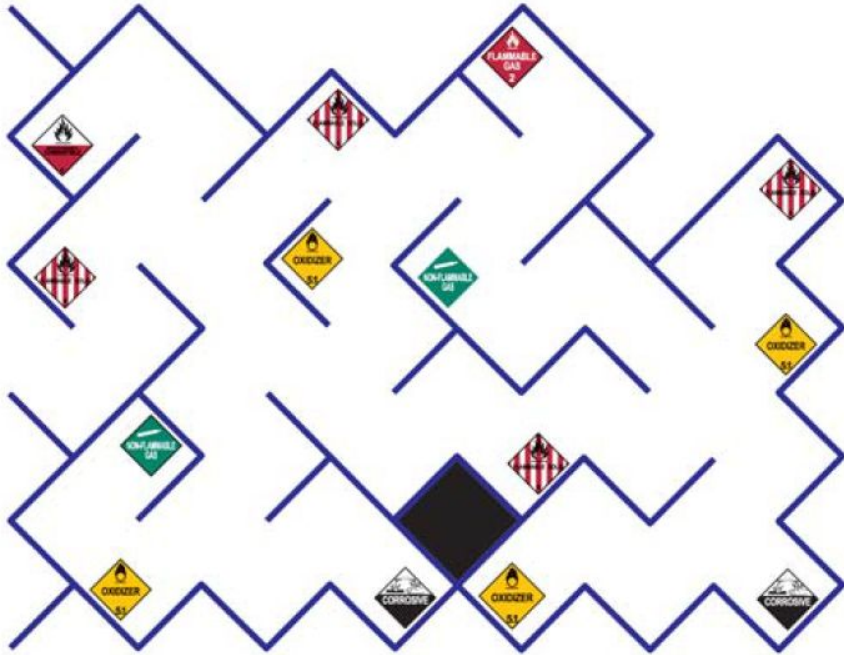
- Targets: Standard Hazardous materials (HAZMAT) labels.
- Coverage: detect **existence** of labels
- Clearance: convey **3/4 features** on labels
- Features:
  - Color
  - Icon
  - Number
  - Words

Testing Conditions

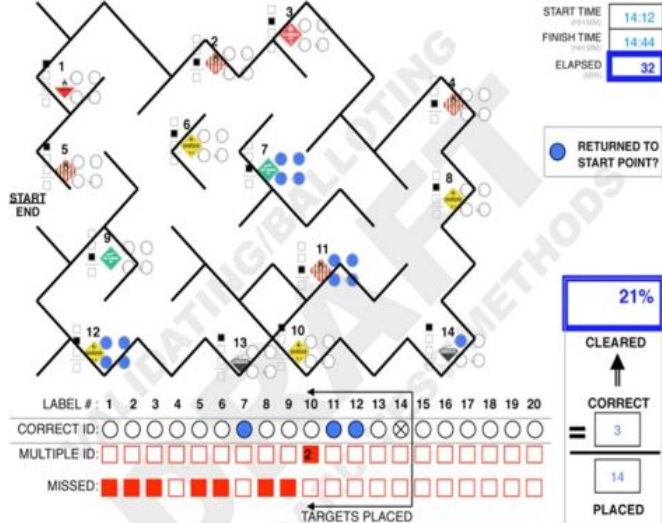Following information is required for conducting the test:
- Name of the Operator
- Name of the Administrator
- Date
- Facility and Location
- Robot Make and Model
- Robot Configuration for the test
- Environment Condition: Lighting condition, Temperature and Humidity
- Communication mode
- Trial Number

Testing Procedure

- Operator: Proceeds or Abstains

- Administrator: Sets and Verifies the test environment conditions.

- Operator: Places the robot at the start position

- Administrator: Instructs to start the test, starts the timer and records the elapsed time.

- Operator:

  - Controls the robot to traverse the maze.

  - Conveys the observation and action to the administrator.

- Administrator: Records the locations and features of the targets

- Test is completed upon the robot's returning to the starting point.

Report

- Important notes:
  - Fault conditions that occured
  - Reason for abstaining
- Testing conditions
- Repeatability results:
  - Confidence/Reliability for covering a target
  - Confidence/Reliability for clearing a target
- Elapsed Time
- Communication method
- Return to start point - Yes/No

START TIME 14:12
FINISH TIME 14:44
ELAPSED 32

RETURNED TO START POINT?

21%

CLEARED

CORRECT 3
────────
PLACED 14

LABEL # : 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
CORRECT ID:
MULTIPLE ID: 2
MISSED:
TARGETS PLACED

CORRECT 3 / PLACED 14

robot #B					
height range	trgt #	# of fea. cleared	C/R for covering a target (via clearing at least 1 feature)	R/C for clearing a target	C/R for clearing a target once covered it
A:	1	4	32 % / 60 %	32 % / 60 %	70 % / 60 %
1.6 m – 2.4 m	5	4	8 % / 80 %	8 % / 80 %	45 % / 80 %
(63 in – 96 in)	10	0	(3 out of 5 trgts)	(3 out of 5 trgts)	(3 out of 3 trgts)
	13	0			
	14	4			
B:	3	0	8 % / 60 %	8 % / 60 %	33 % / 60 %
0.8 m – 1.6 m	6	4	1 % / 80 %	1 % / 80 %	18 % / 80 %
(31½ in – 63 in)	8	0	(1 out of 4 trgts)	(1 out of 4 trgts)	(1 out of 1trgts)
	12	0			
C:	2	4	59 % / 60 %	59 % / 60 %	80 % / 60 %
0 m – 0.8 m	4	4	26 % / 80 %	26 % / 80 %	55 % / 80 %
(0 in – 31½ in)	7	4	(4 out of 5 trgts)	(4 out of 5 trgts)	(4 out of 4 trgts)
	9	0			

THANK YOU !!