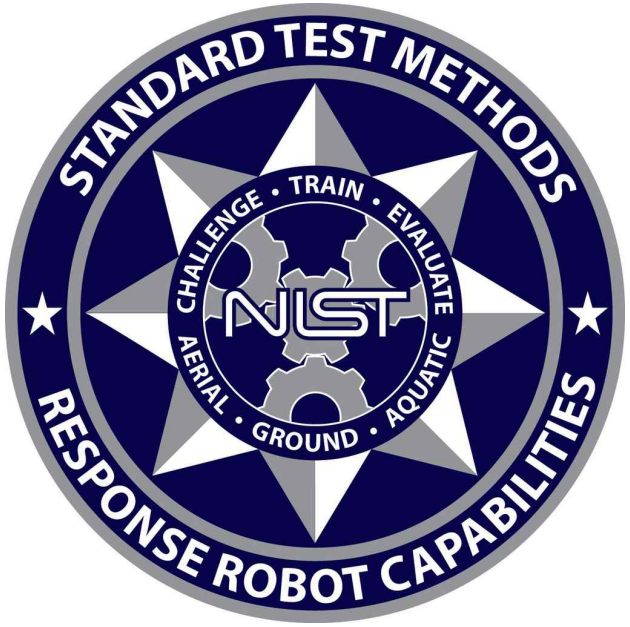
Sensor Tests

Ground Robots

Version 2020C



Test Director:
Adam Jacoff
Intelligent Systems Division
National Institute of Standards and Technology
U.S. Department of Commerce

Sponsor:
Science and Technology Directorate
U.S. Department of Homeland Security

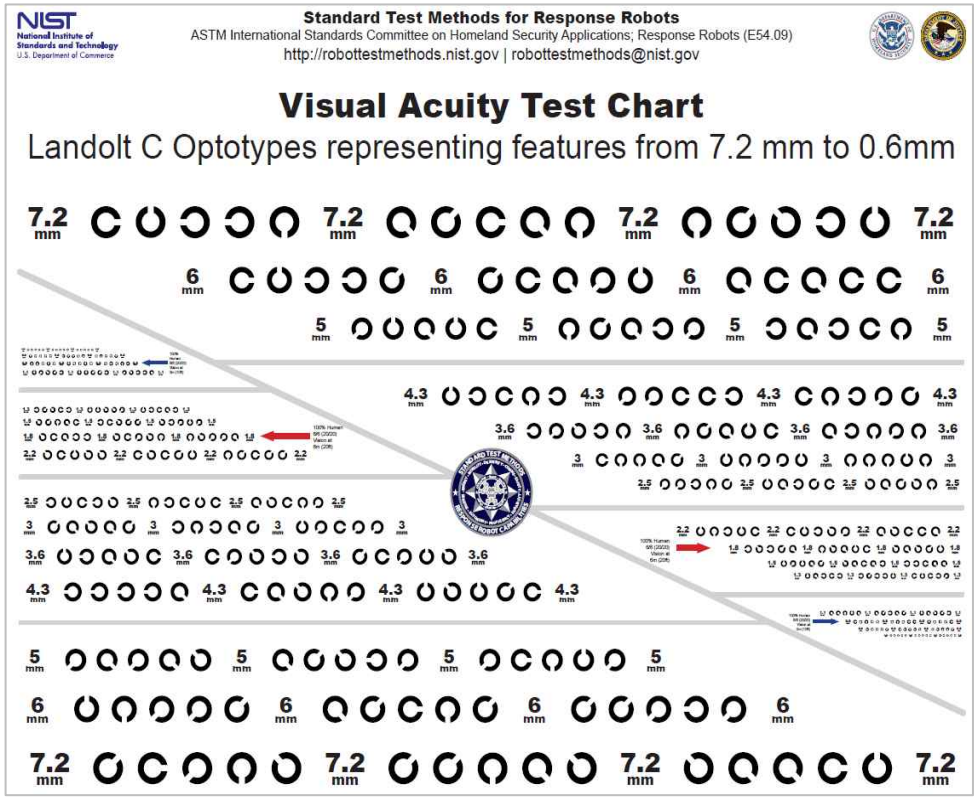
Internet
RobotTestMethods.nist.gov

Email
RobotTestMethods@nist.gov

Sensing: Visual Acuity Test

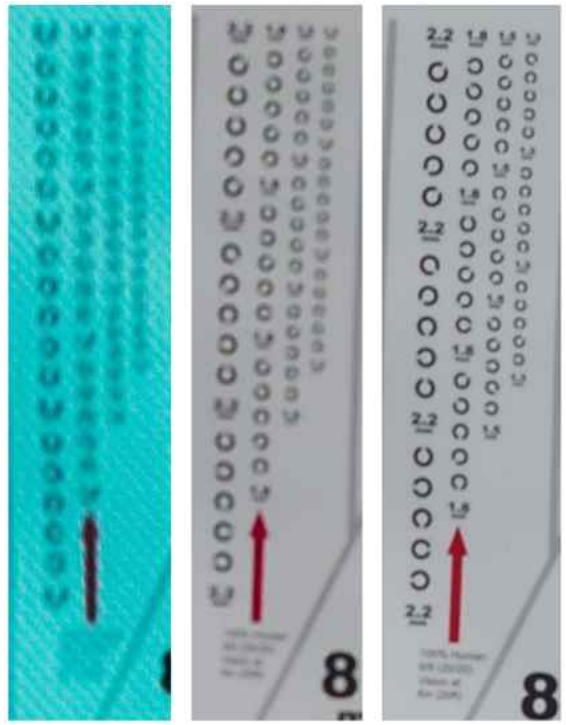
ASTM E2566-2017

MORE CONTINUOUS TARGETS

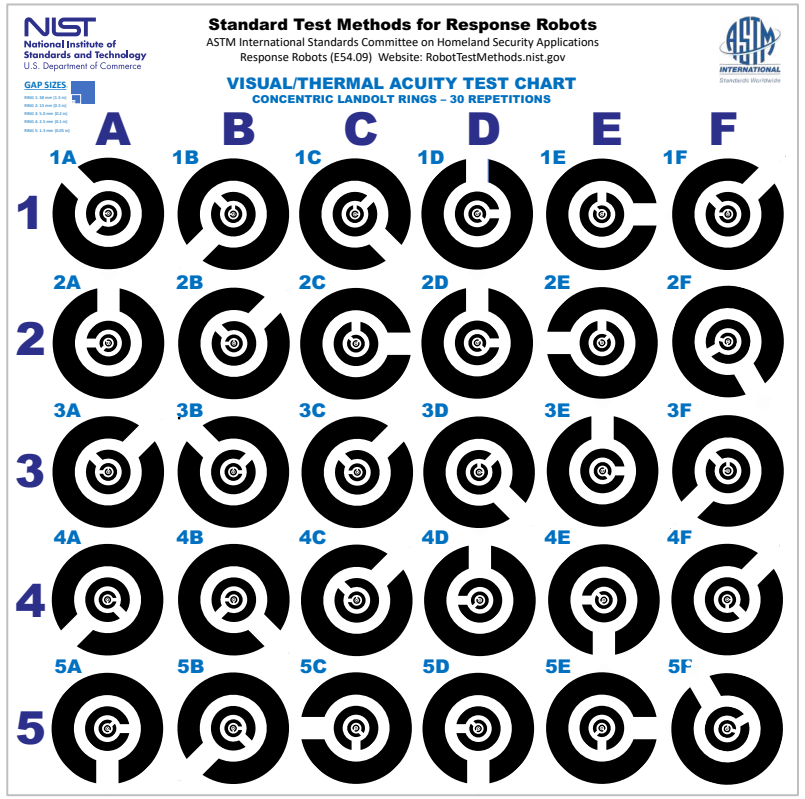


DIFFERENT LEVELS OF ACUITY

Interface LIVE | Streamed BETTER | Recovered BEST



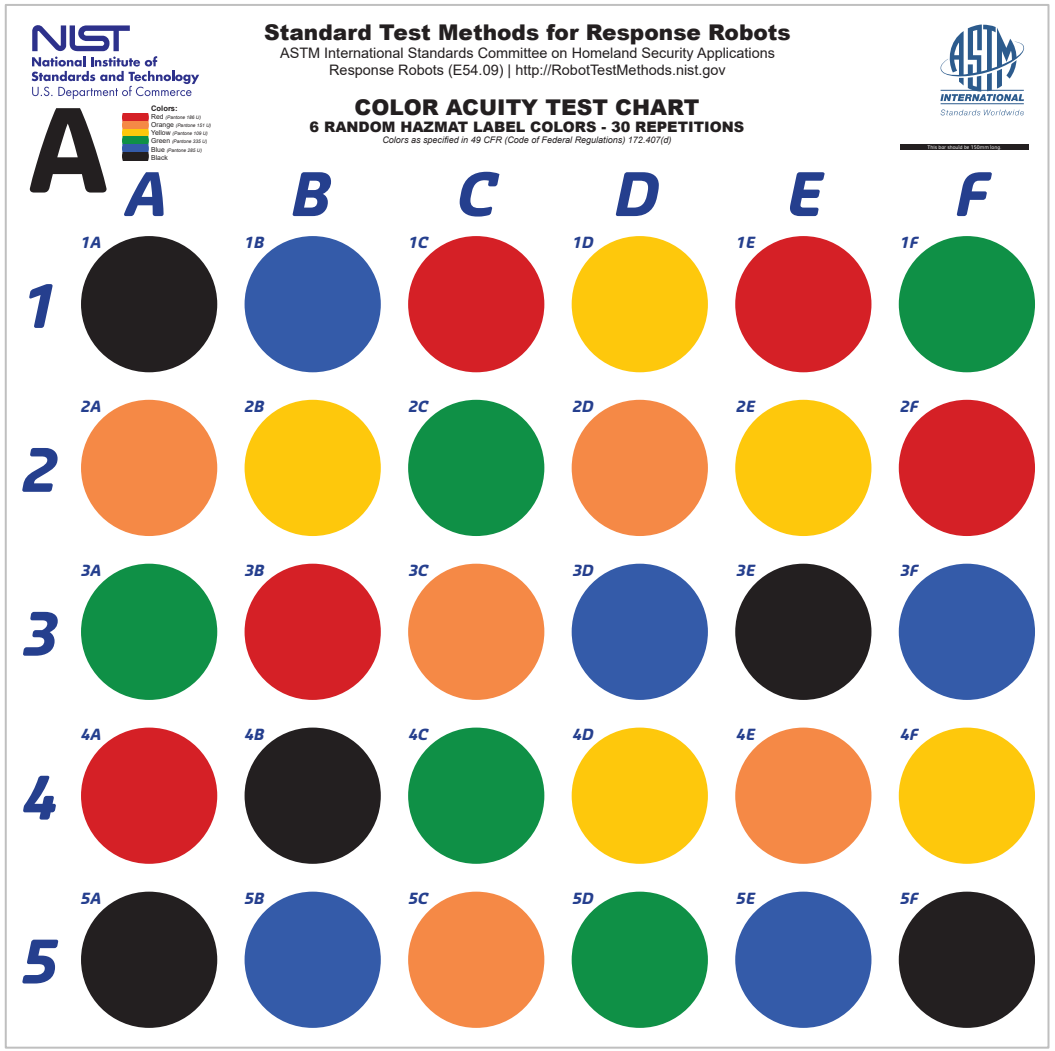
5 DEEP CONCENTRIC C TARGETS



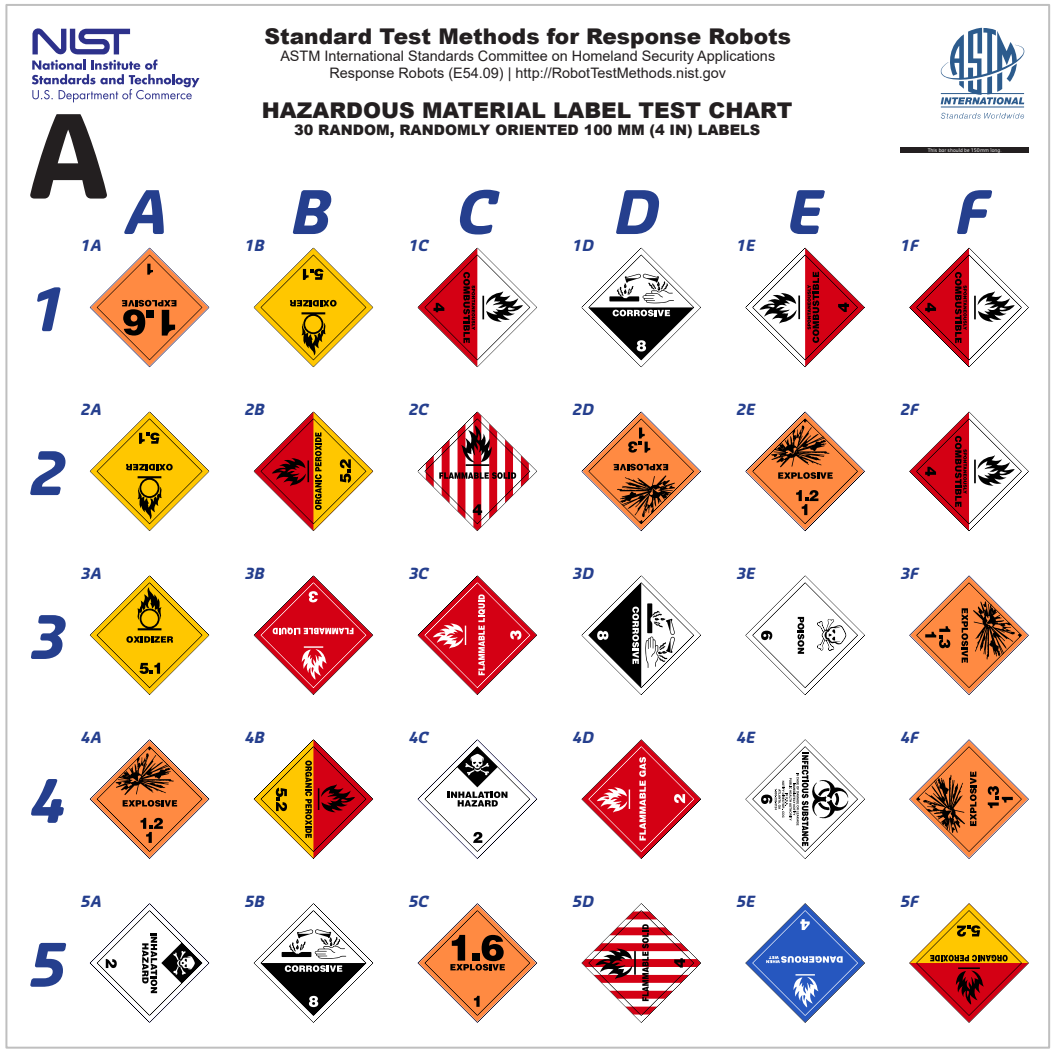
Sensing: Color Acuity Test

ASTM WK54755

COLOR DOTS



ROTATING HAZMAT LABELS



Sensing: Point and Zoom Camera Test

ASTM WK33261

Visual, Color, Motion, Thermal, and Operationally Significant Objects

LICENSE PLATES

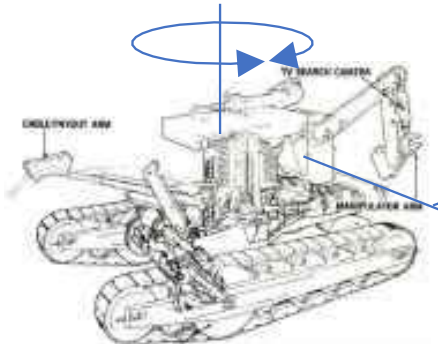
OBJECTS OF INTEREST

THERMAL HAND WARMER

Sensing: Point and Zoom Camera Test

ASTM WK33261

ROBOT ROTATES IN PLACE AND STAYS ENTIRELY BEHIND THE LINE

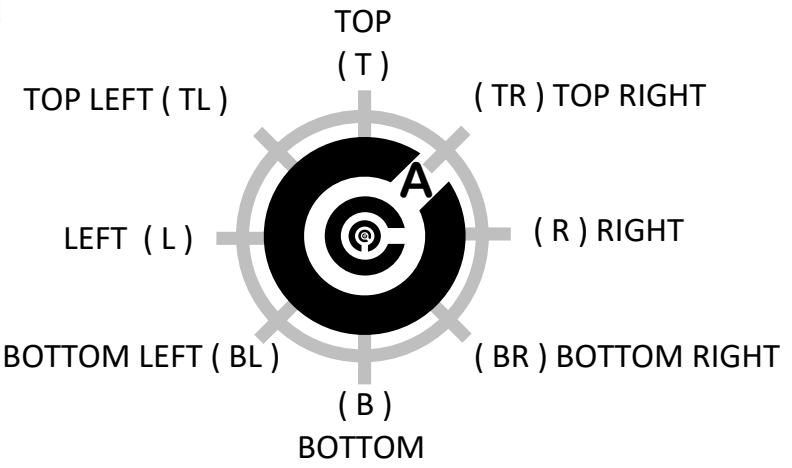


A
NEAR RANGE
2(S)

B
NEAR RANGE
2(S)

C
MID RANGE
4(S)

D
FAR RANGE
6(S)



Sensing: Point and Zoom Camera Test

ASTM WK33261

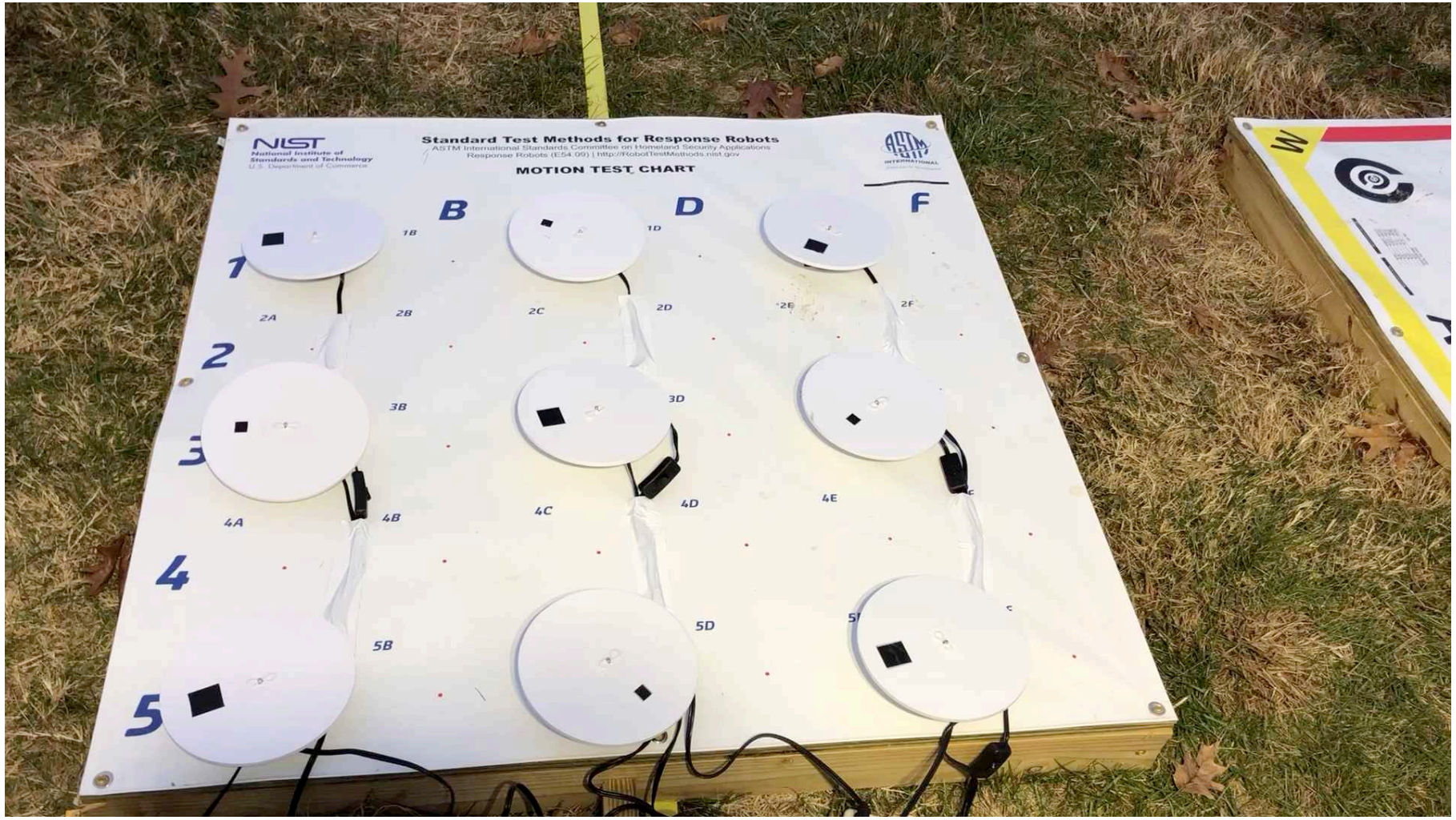
WATCH MOVIE OF ASSEMBLY PROCESS HERE

Thermal acuity circular hole patterns. The large holes are 1 inch diameter and small holes are 1/2 inch diameter. One of the 8 directions is missing, like the gap on the visual acuity targets. There is a sticker template to drill through in the Disk Insert file.

A simpler approach is to fold a hand warmer into roughly a line and staple it to the panel vertical, horizontal, or diagonal

Sensing: Motion Detection

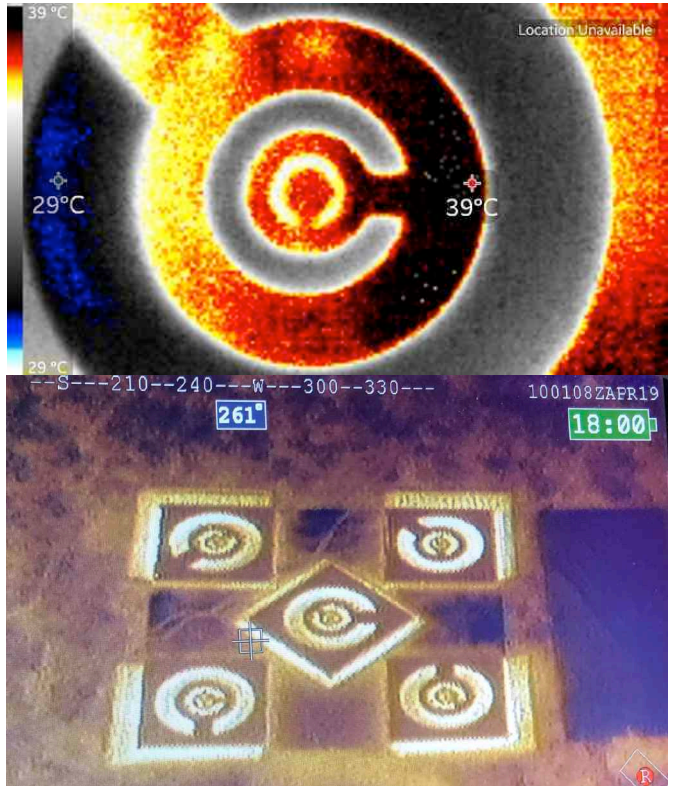
ASTM WK_____



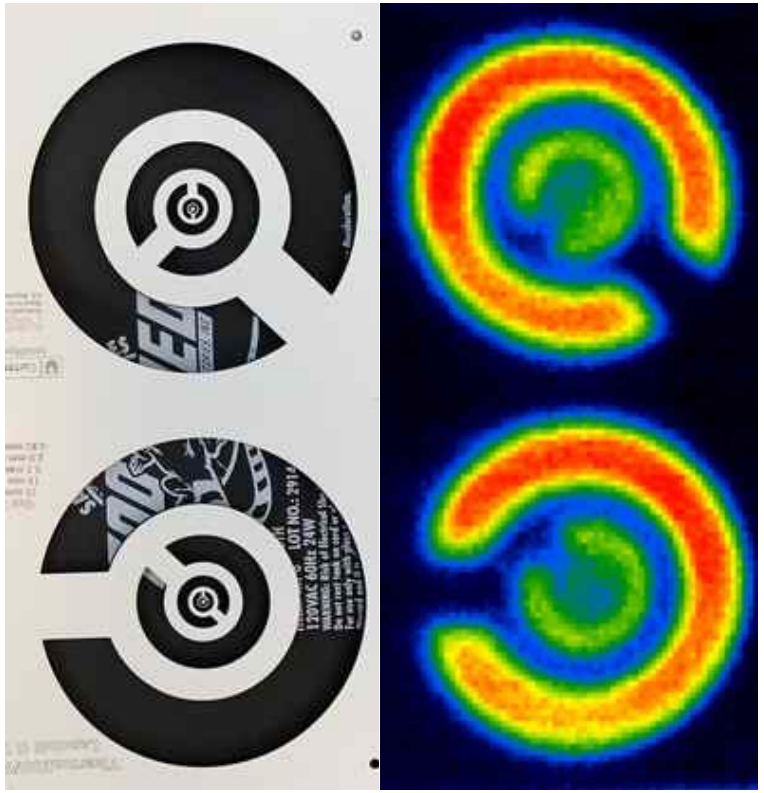
Sensing: Thermal Image Acuity

ASTM WK57967

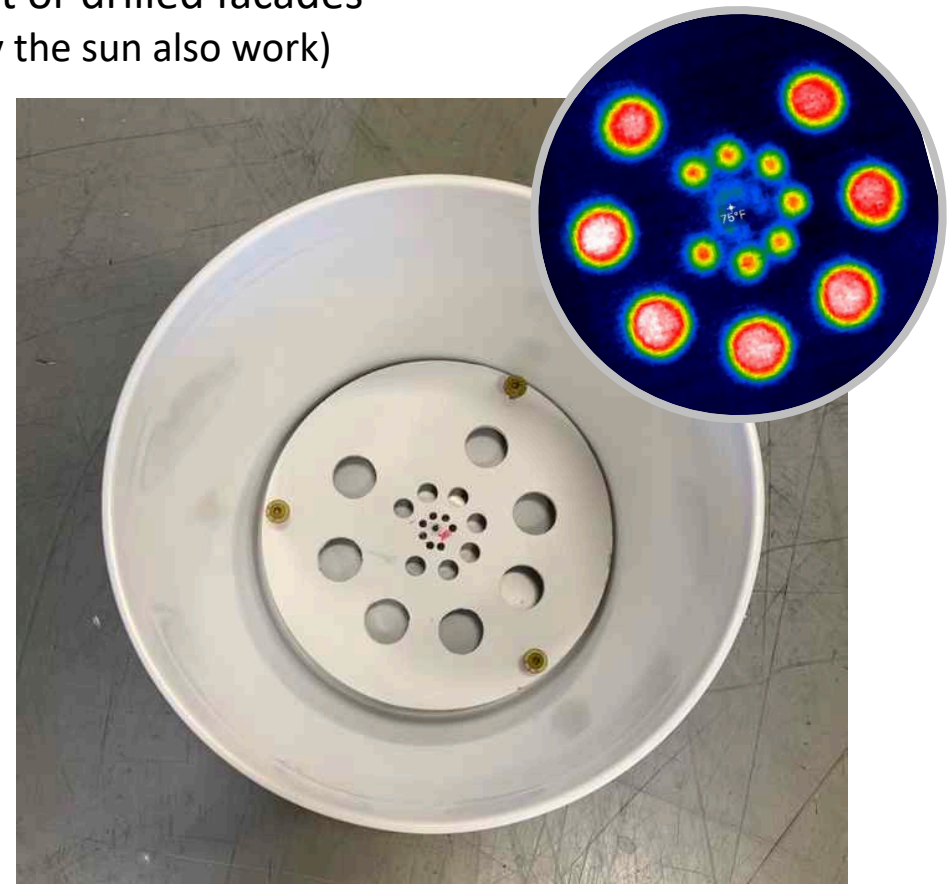
Heated reptile pads or hand warmers behind laser cut or drilled facades
(Indoor or outdoor use – typical sticker targets warmed by the sun also work)



An array of Concentric C thermal targets placed throughout a scenario (needs power).



Concentric Cs laser cut into MDF with a reptile heater. A metal backing helps diffuse the heat.



Drill Holes (1in, 1/2in, 1/4in) through plastic disks with hand warmers heating a metal disk backing.

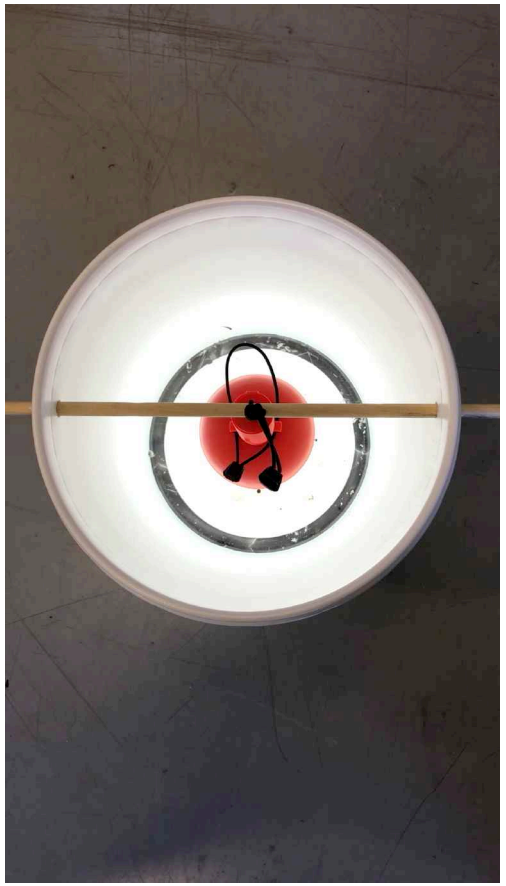
Sensing: Video Latency

ASTM WK46478

Latency test with flashing “SOS” beacon or other light

High speed camera video (240 fps) captures flash in field AND flash on display views simultaneously.

Count the frames between flashes

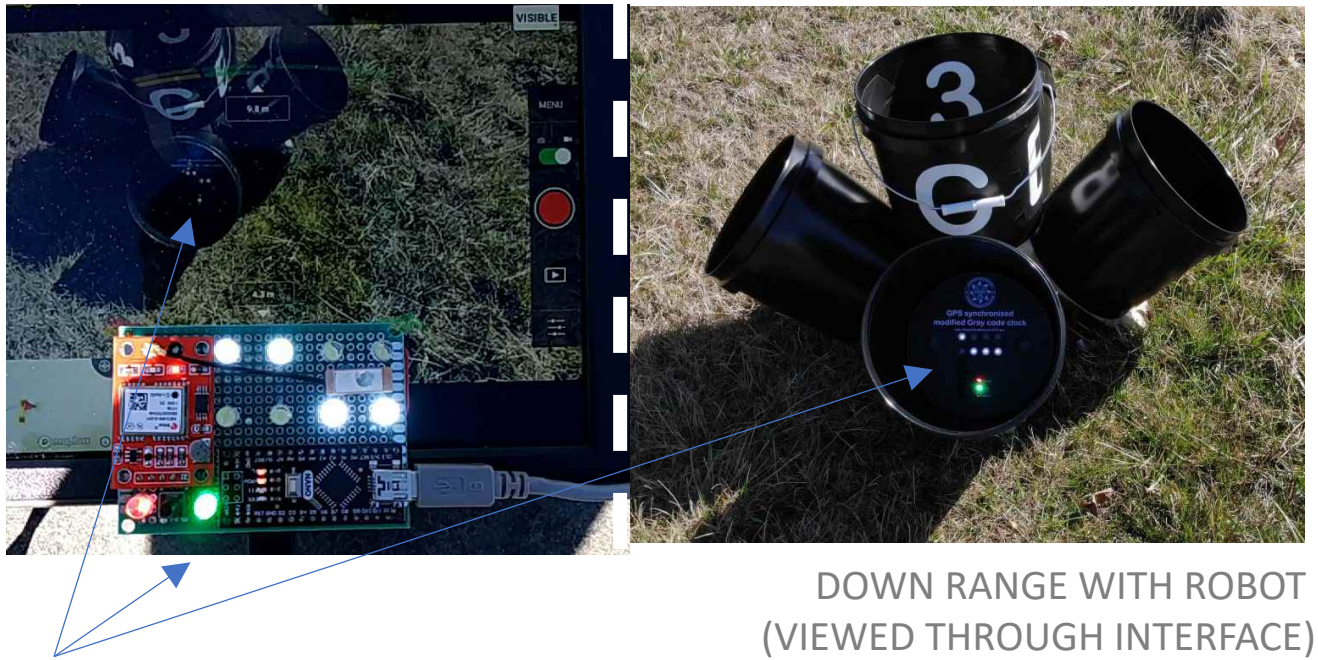


Sensing: Remote Latency and Packet Loss

ASTM WK46478

COMPUTER READABLE CODES SYNCRONIZED AT BOTH ENDS

UP RANGE WITH OCU
(VIDEO CAPTURE WITH INTERFACE)



DOWN RANGE WITH ROBOT
(VIEWED THROUGH INTERFACE)

HUMAN READABLE CLOCKS SYNCRONIZED AT BOTH ENDS

UP RANGE WITH OCU
(VIDEO CAPTURE WITH INTERFACE)

DOWN RANGE WITH ROBOT
(VIEWED THROUGH INTERFACE)

Sensing: Audio Acuity (2-Way)

ASTM WK60783

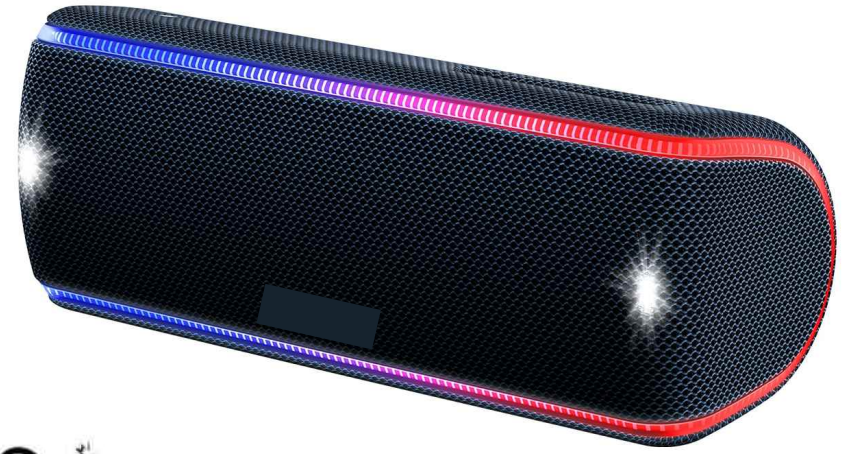
Alpha-numeric list read by a computer voice

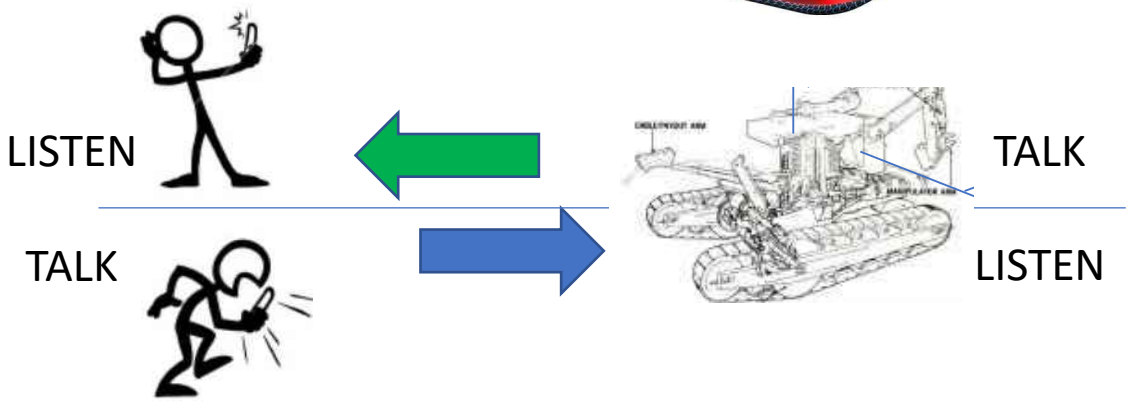
Loudness set to 75-80 dB

AUDIO ACUITY TEST1.

0 MISSES IN 2 LINES ALLOWED. 0 IN 10 NUMBERS.
1 MISS IN 3 LINES ALLOWED. 1 IN 15 NUMBERS.
2 MISSES IN 5 LINES ALLOWED. 2 IN 25 NUMBERS.
3 MISSES IN 6 LINES ALLOWED. 3 IN 30 NUMBERS.

A!	1.	2.	3.	4.	5.	1	2	3	4	5
B!	6.	2.	3.	5.	4.	6	2	3	5	4
C!	2.	5.	9.	8.	7.	2	5	9	8	7
D!	7.	2.	8.	9.	5.	7	2	8	~~8~~	5
E!	3.	4.	9.	1.	0.	3	4	9	1	0
F!	5.	8.	0.	2.	9.	5	8	0	2	9
G!	6.	9.	7.	3.	8.	6	9	7	3	8
H!	2.	0.	5.	2.	7.	2	0	5	2	7
I!	3.	5.	2.	8.	9.					
J!	7.	2.	6.	1.	6.					
K!	8.	3.	3.	4.	5.					

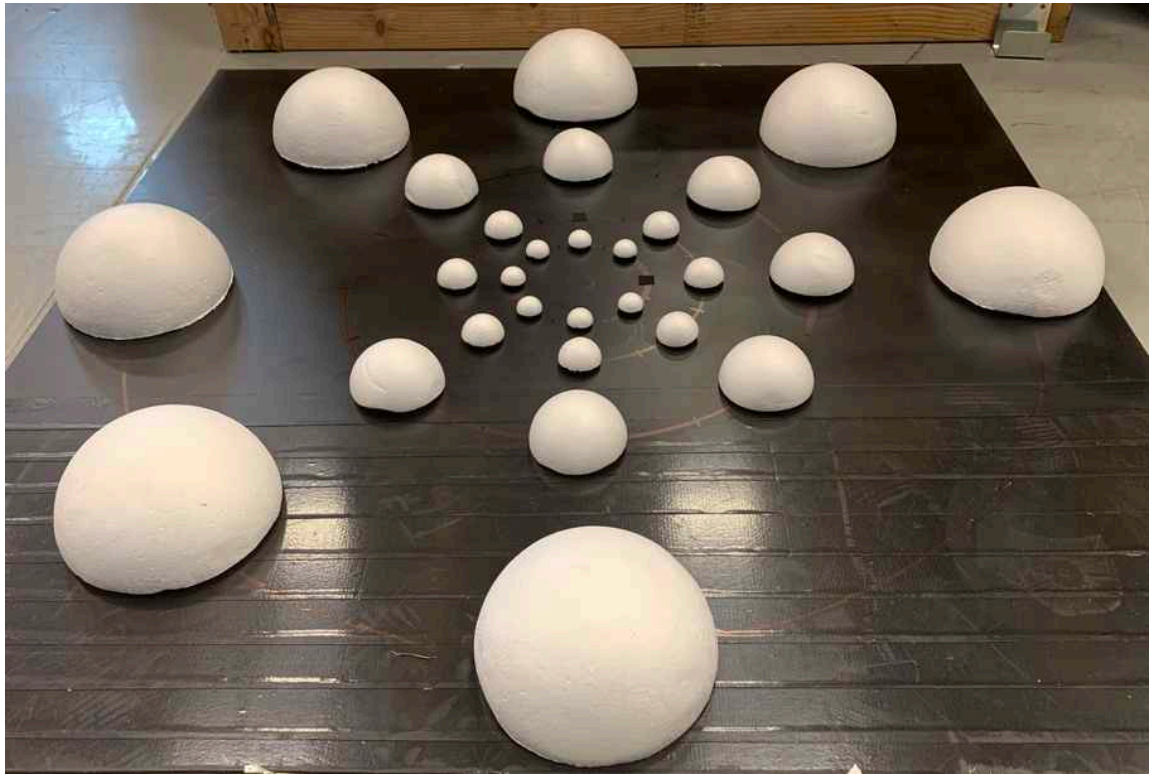




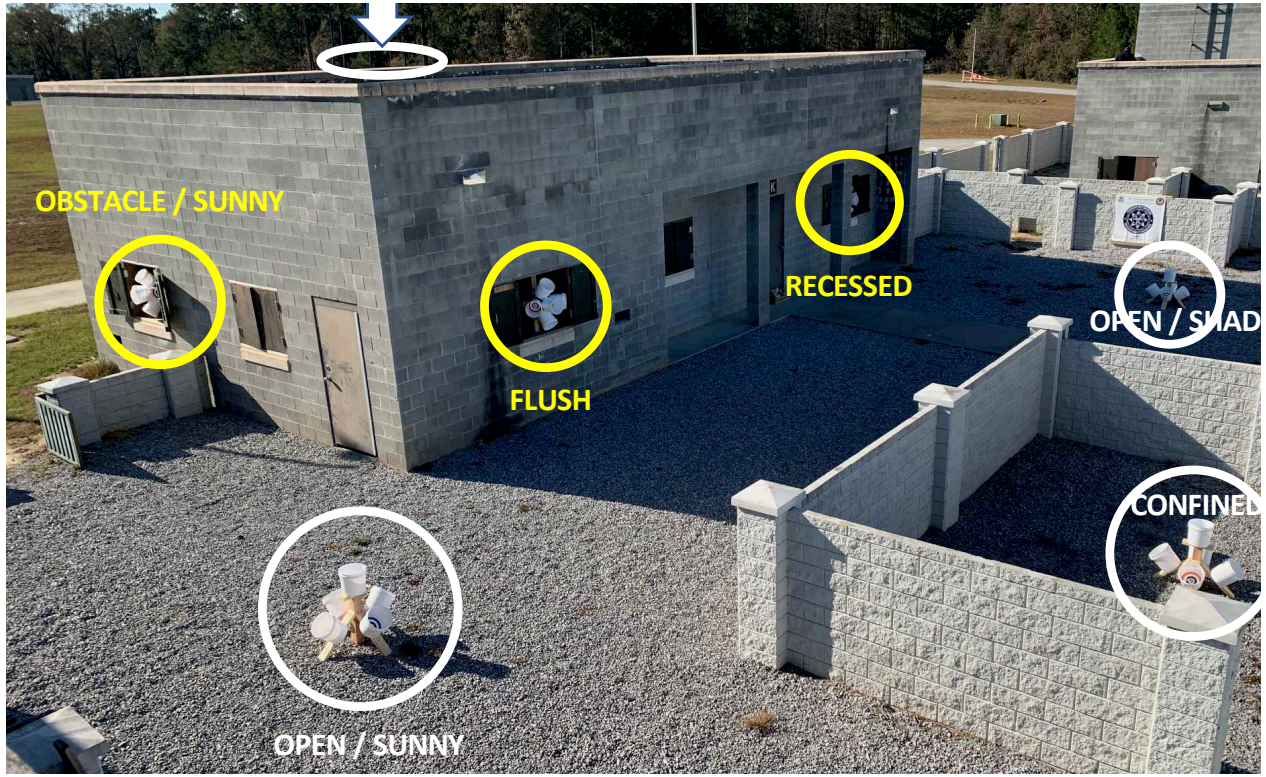
Sensing: 3D Range Imagers and Scanners

ASTM WK____

Resolution



Mapping

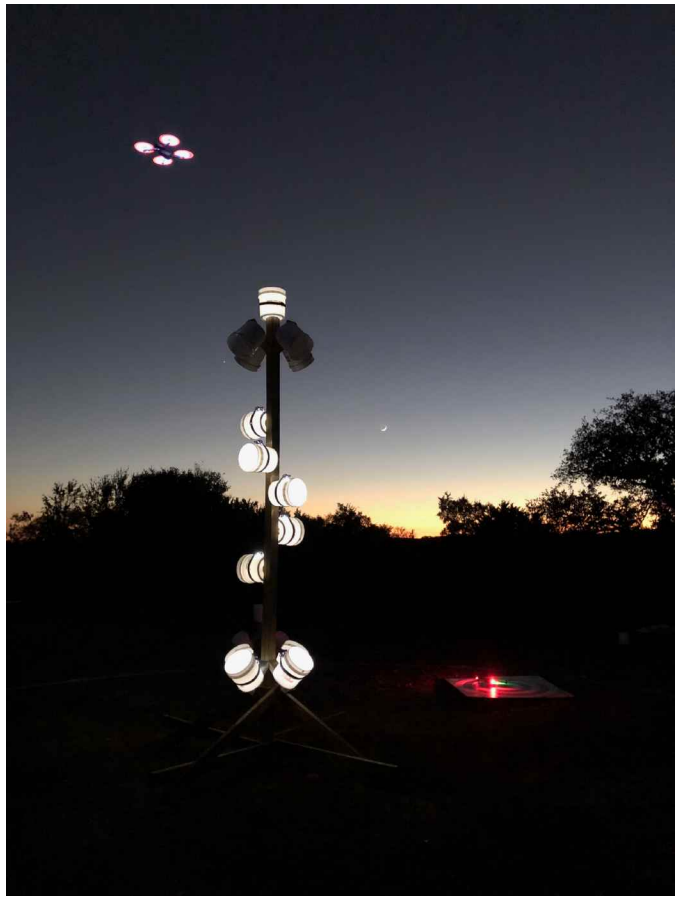


Sensing: Light Emissions

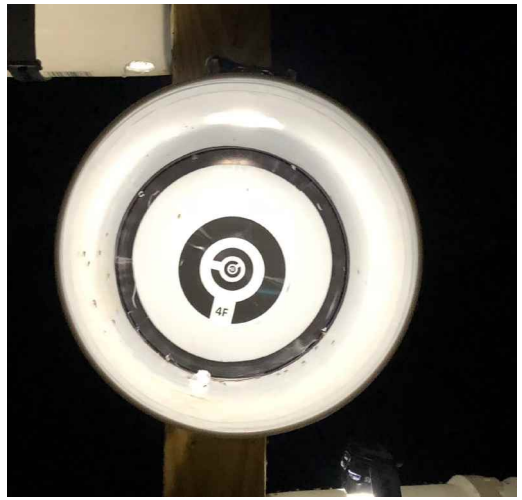
ASTM WK_____

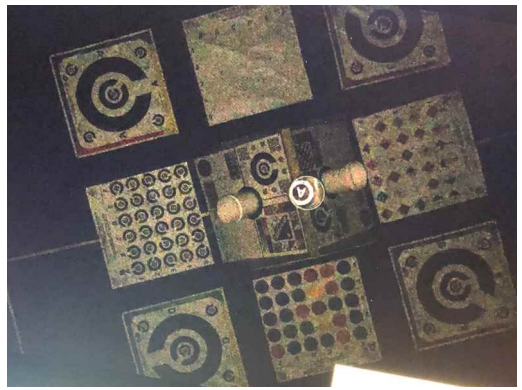
WHITE OR RED HEADLAMPS
WRAPPED AROUND BUCKETS POINTED INWARD

Position accuracy for range to target using lighted buckets (red or white)

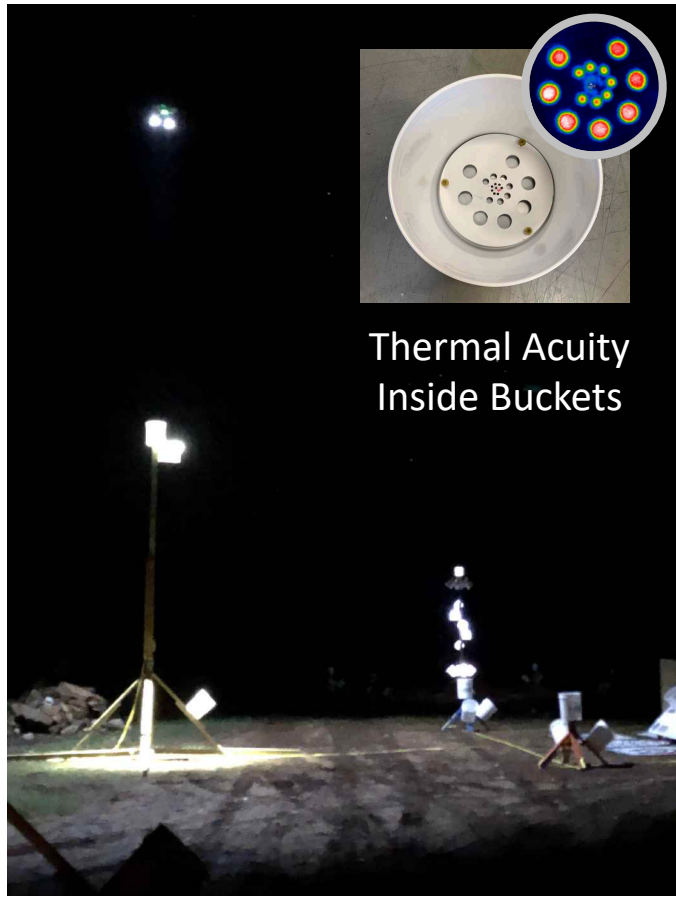


Inspect objects of interest using lighted buckets (red or white)





Identify objects lighted from the aircraft



Measure additional sensor capabilities

Sensing: Combined Sensor/Dexterity Crates (aka “Victim” Crates)

WK _____

LIGHTED CRATES

CENTER DEXTERITY PIPE TASKS
(BLOCKS VIEWS WHEN NOT CENTERED. BUT IS USED ONLY TO DETERMINE ROBOT DEXTERITY CONFIGURATION MULTIPLIERS)

DARK CRATES

15cm (6in) Diameter Hole

HAZMAT LABEL IDENTIFICATION (x2)

VISUAL/COLOR ACUITY (x2)

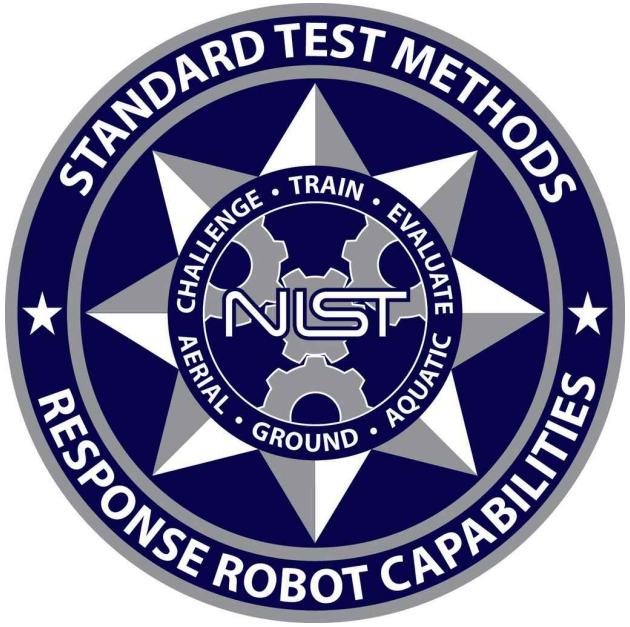
MOTION DETECTION (x2)

THERMAL IMAGE RESOLUTION (x2)

PROXIMITY SAMPLING MAGNETS IN CORNERS AND CENTER (x5)

Radio Comms Range Tests

Ground Robots



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Internet
RobotTestMethods.nist.gov

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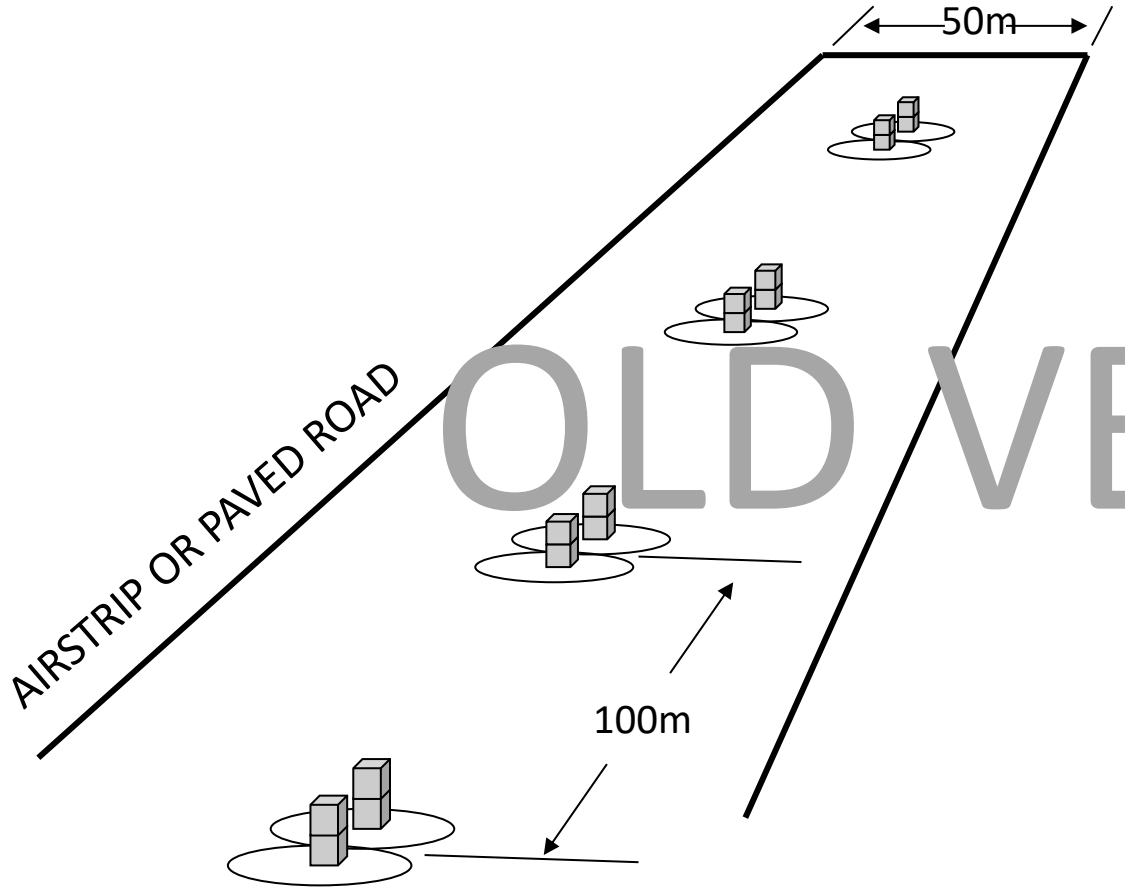
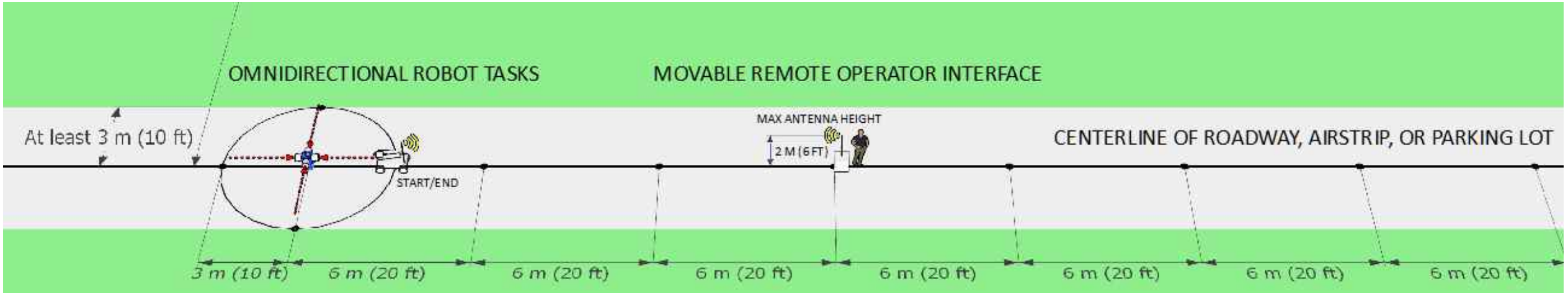
Radio Comms: Line-of-Sight Range

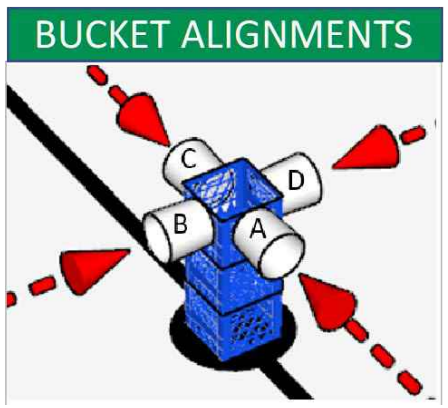
ASTM E2854-2013

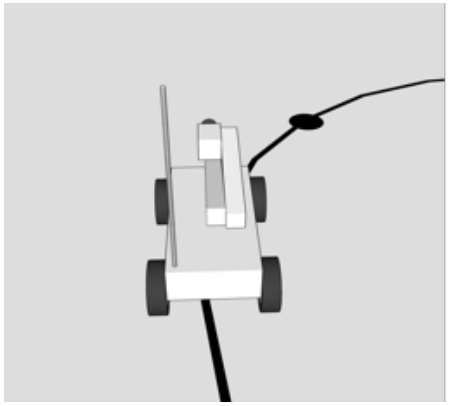


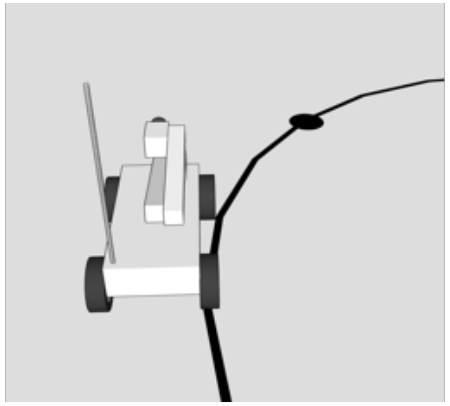
Radio Comms: Line-of-Sight Range

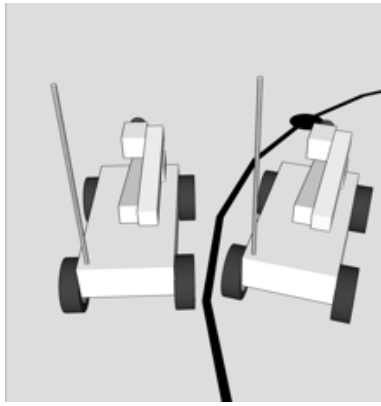
ASTM E2854-2020





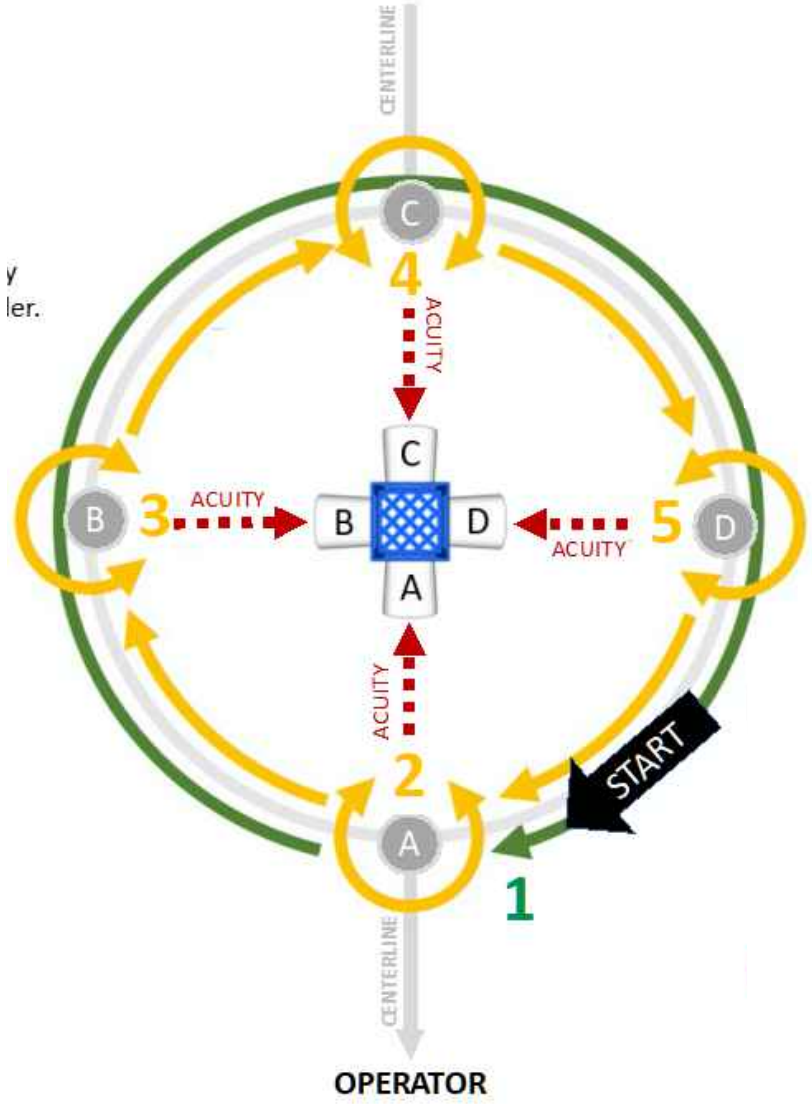




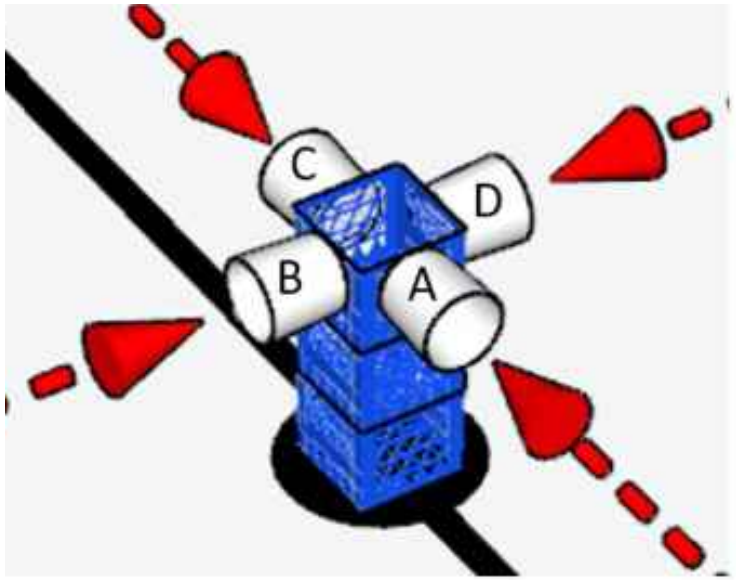


Radio Comms: Line-of-Sight Range

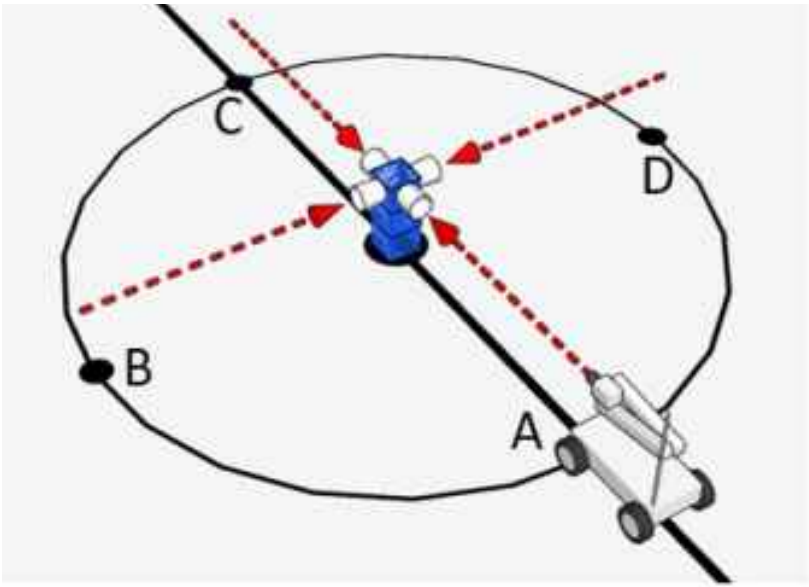
ASTM E2854-2020



PERPENDICULAR BUCKETS



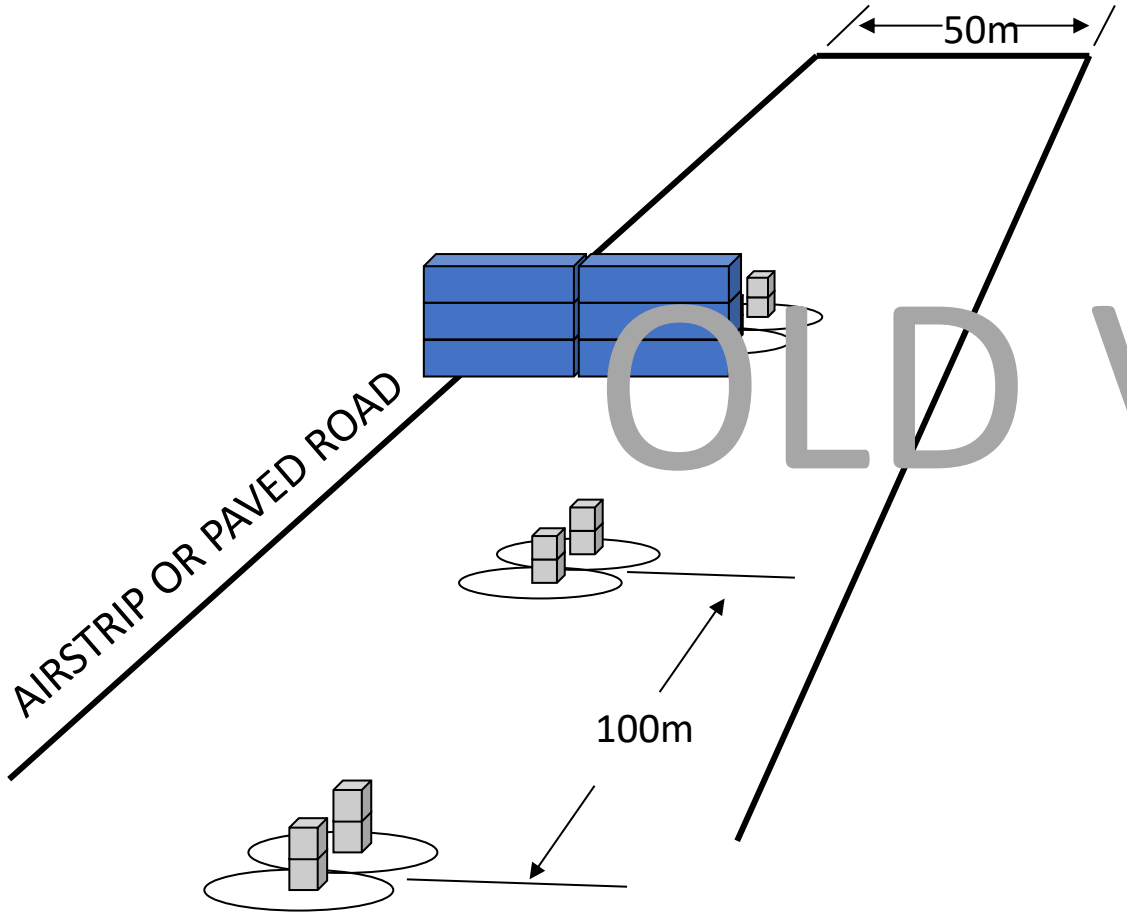
BUCKET IDENTIFICATION POSITION



Maneuvering Tasks (5 points) and Visual Acuity Tasks (20 Points)

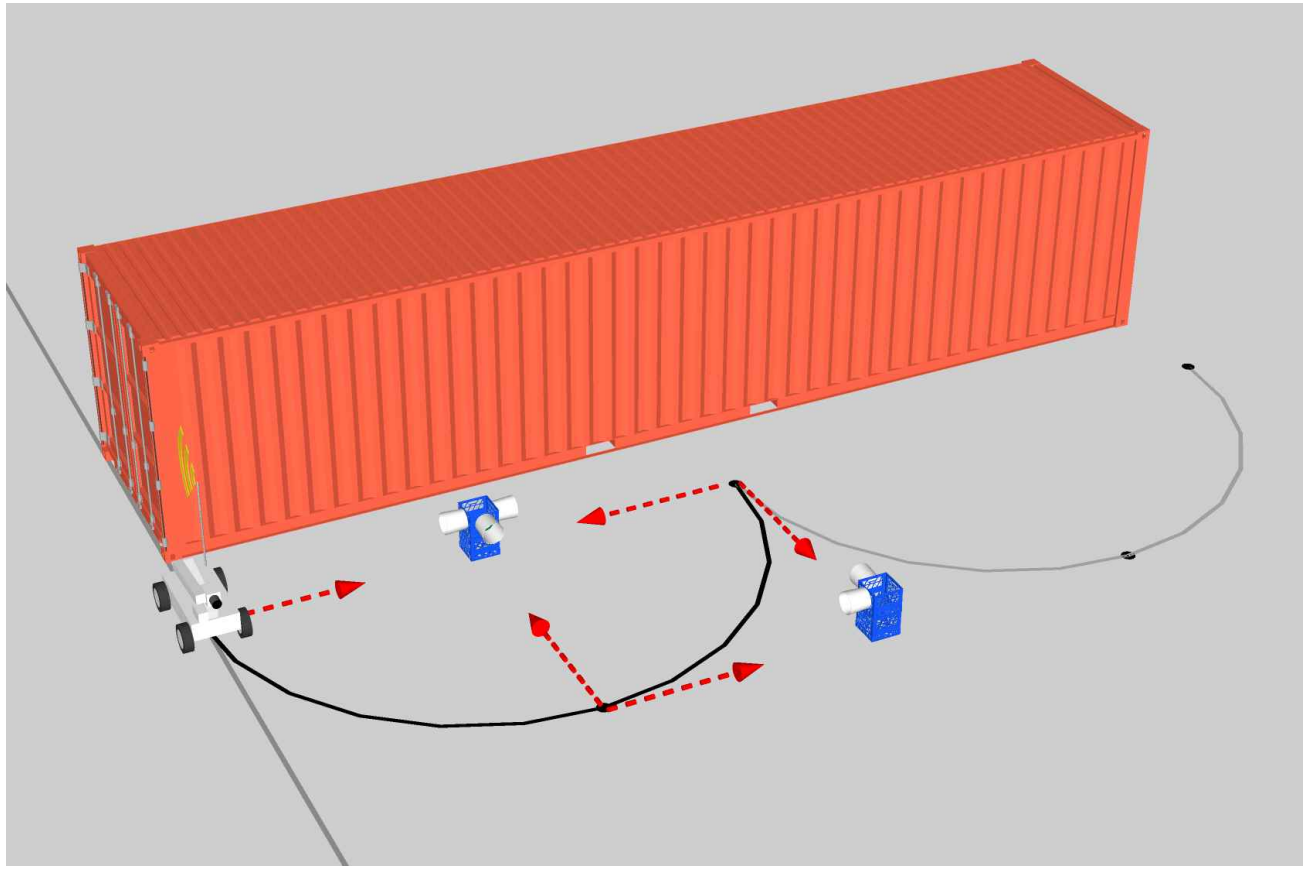
Radio Comms: Non-Line-of-Sight Range

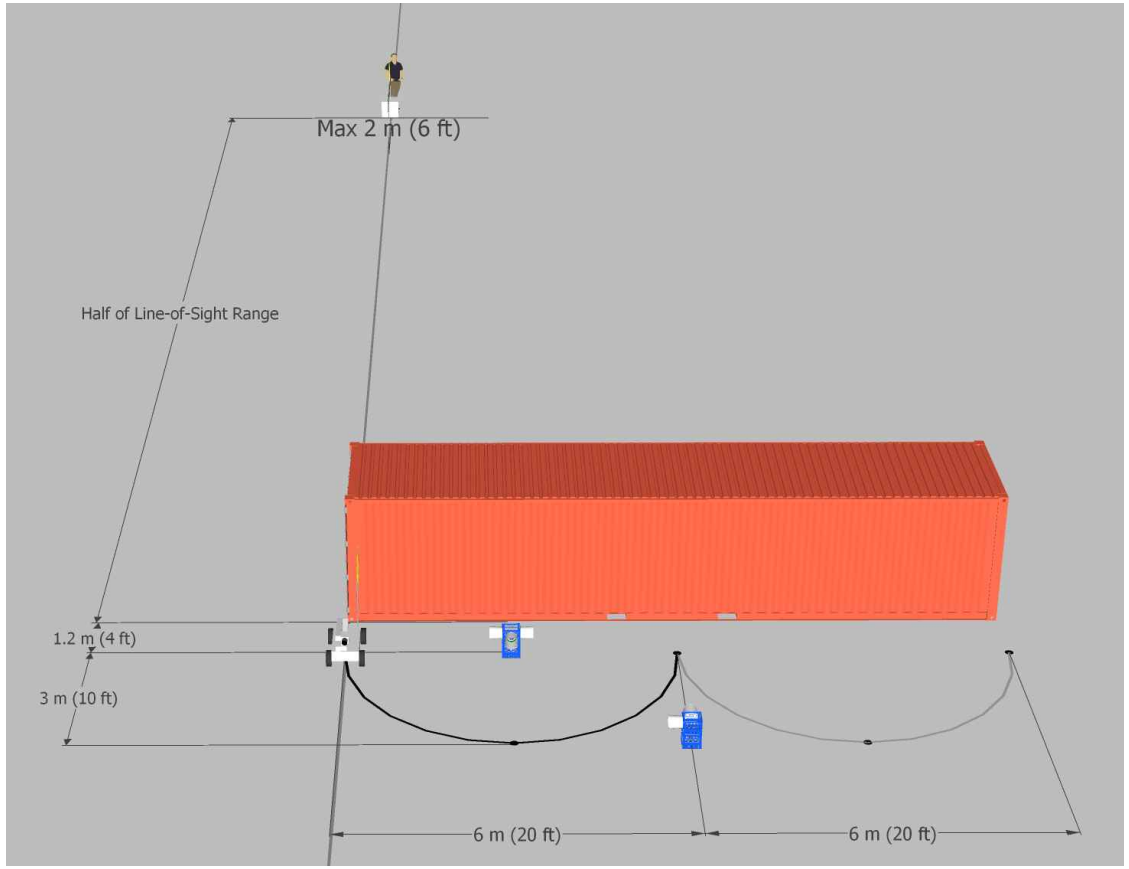
ASTM E2855-2013



Radio Comms: Non-Line-of-Sight Range

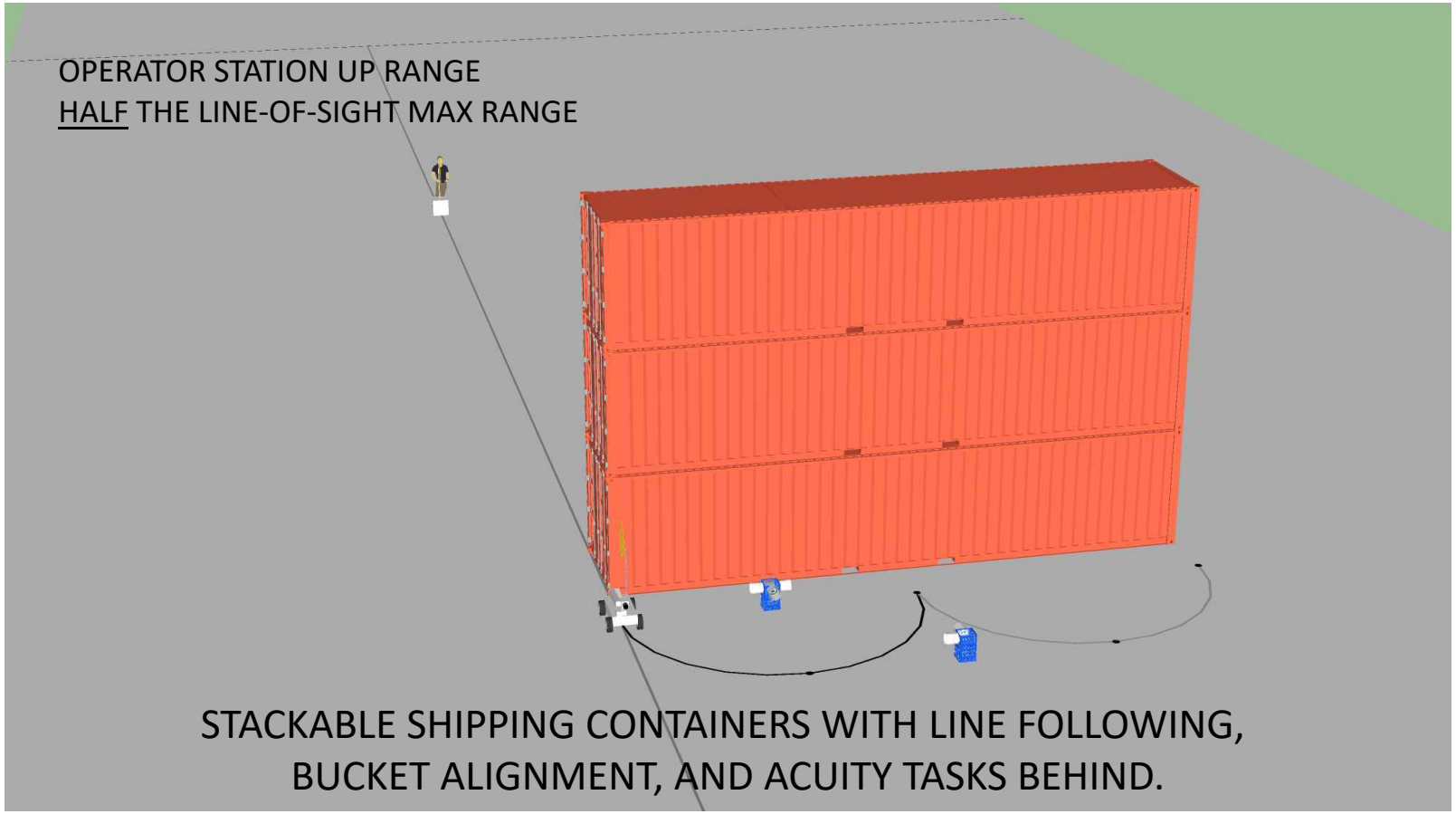
ASTM E2855-2021

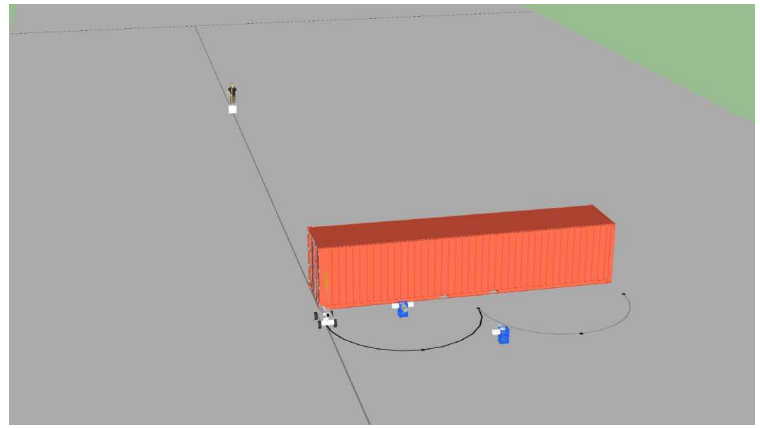


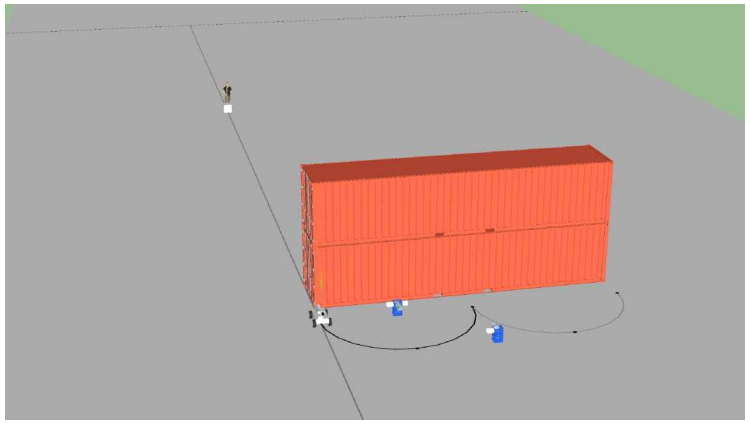


Radio Comms: Non-Line-of-Sight Range

ASTM E2855-2021

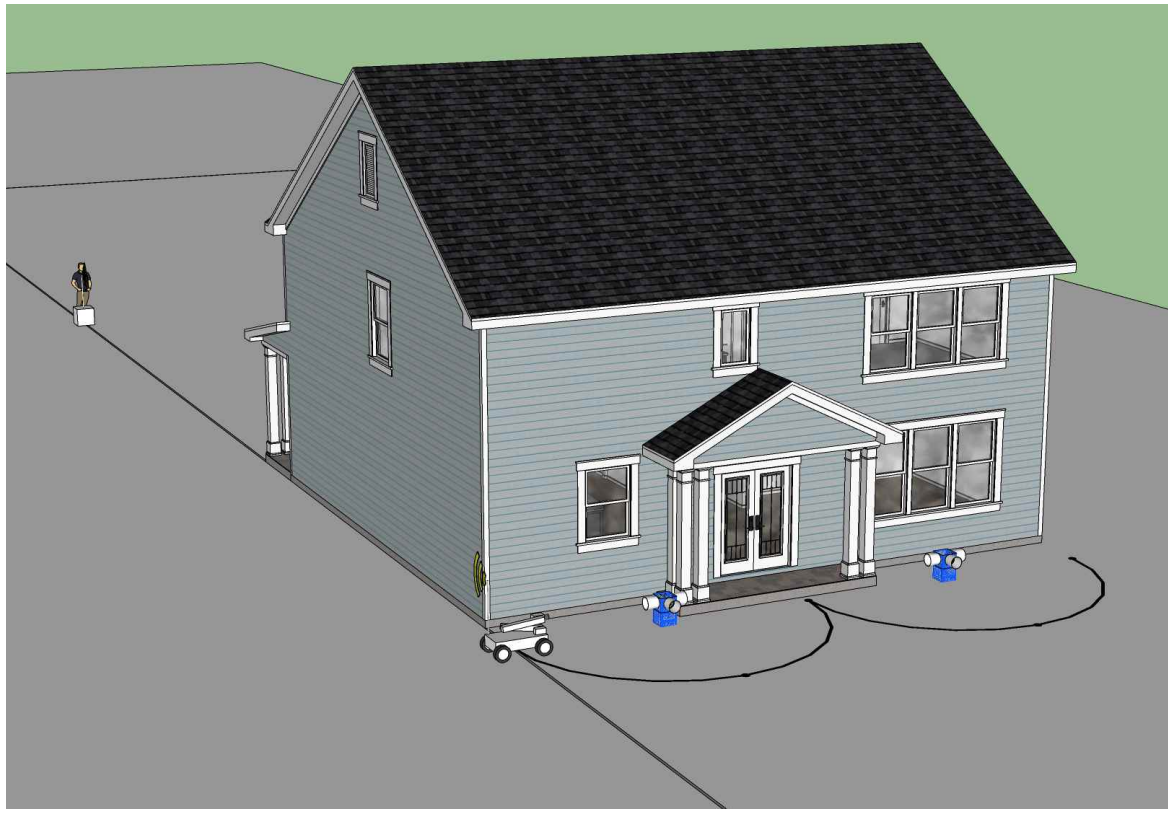


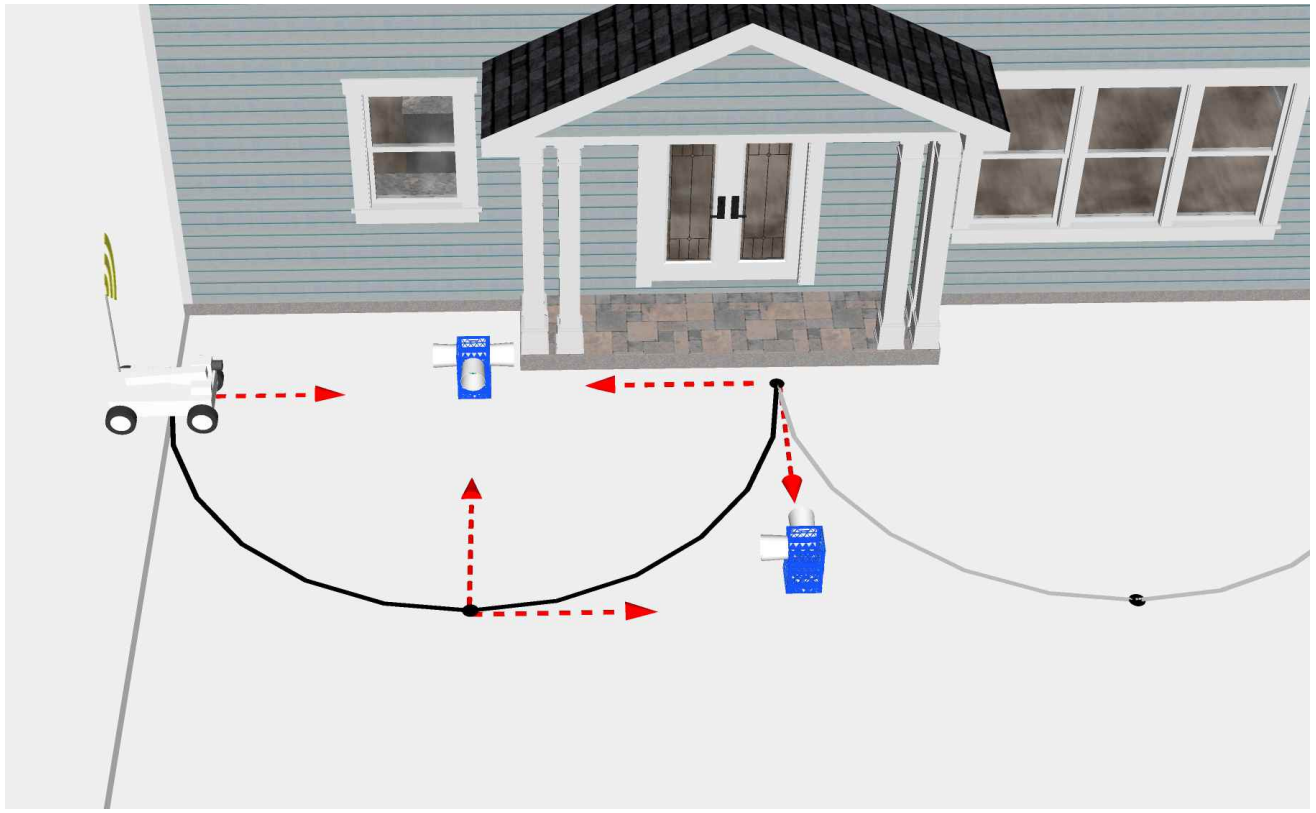




Radio Comms: Non-Line-of-Sight Range

ASTM E2855-2021





Sub Committee Chair:
Adam Jacoff
Intelligent Systems Division
National Institute of Standards and Technology
U.S. Department of Commerce

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Phil Mattson
Science and Technology Directorate
U.S. Department of Homeland Security

Internet
RobotTestMethods.nist.gov

Email
RobotTestMethods@nist.gov