



Low Altitude Collision Avoidance

HSAC May 2022 Meeting



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IRIS AUTOMATION™



Collision Avoidance - 14 CFR 91.113



- Pilot is responsible
- Visual means
- Well Clear
- Right of Way based on Maneuverability

(b) General. *When weather conditions permit, regardless of whether an operation is conducted under **instrument** flight rules or visual flight rules, vigilance shall be maintained by each **person** operating an **aircraft** so as to **see** and avoid other **aircraft**. When a rule of this section gives another **aircraft** the right-of-way, the pilot shall give way to that **aircraft** and may not pass over, under, or ahead of it unless **well clear**.*

Current Approach - “See and Avoid”



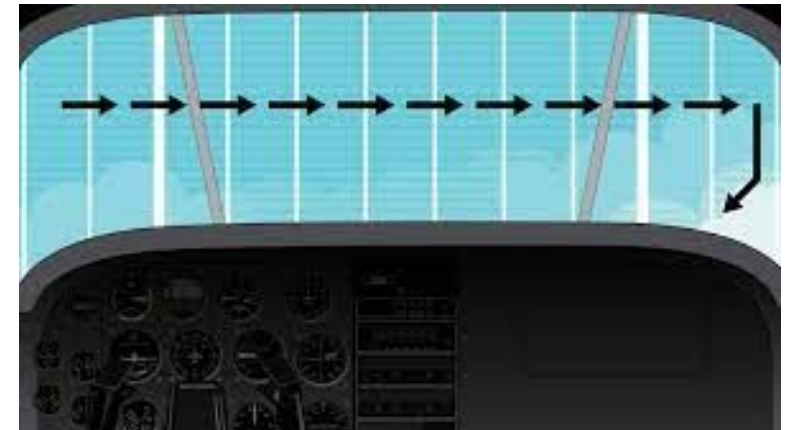
Recommended Method: Block system scanning

of Blocks in FoV: 9-12

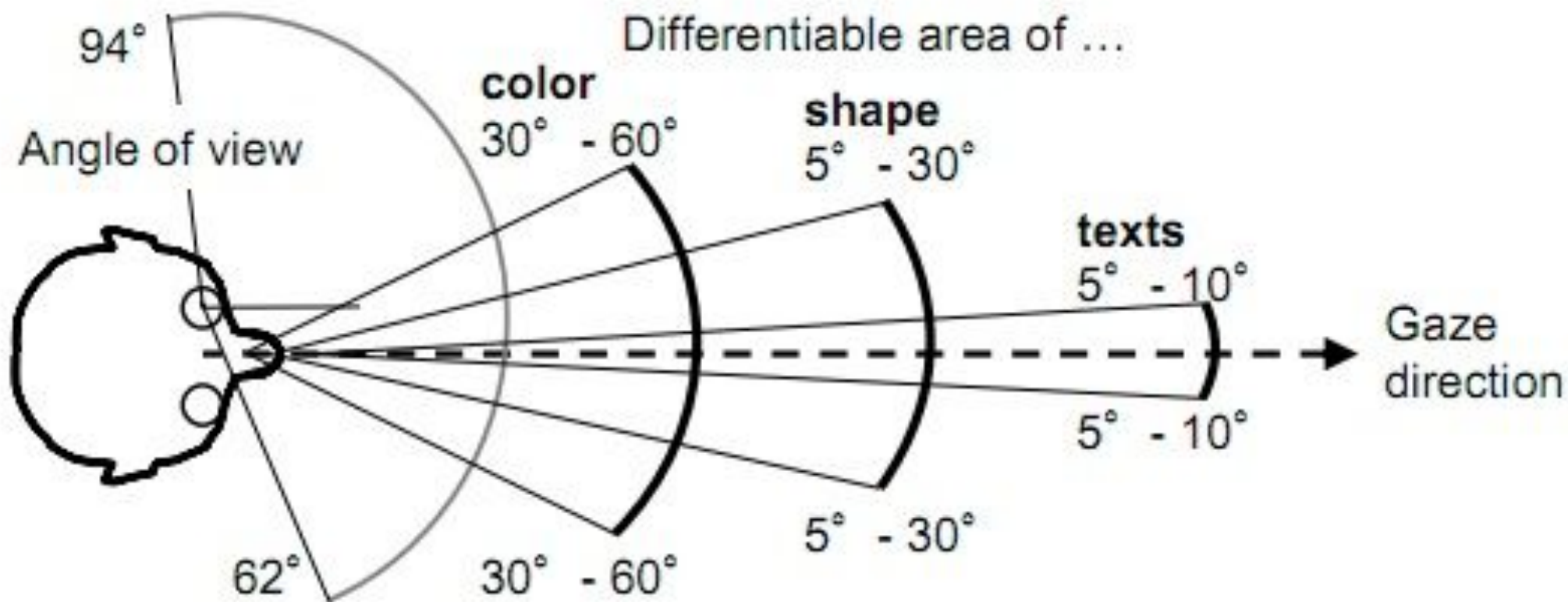
Size For Each Block: 10-15° horizontally
10° vertically

Minimum Area To Scan: 60° side-to-side
10° up/down

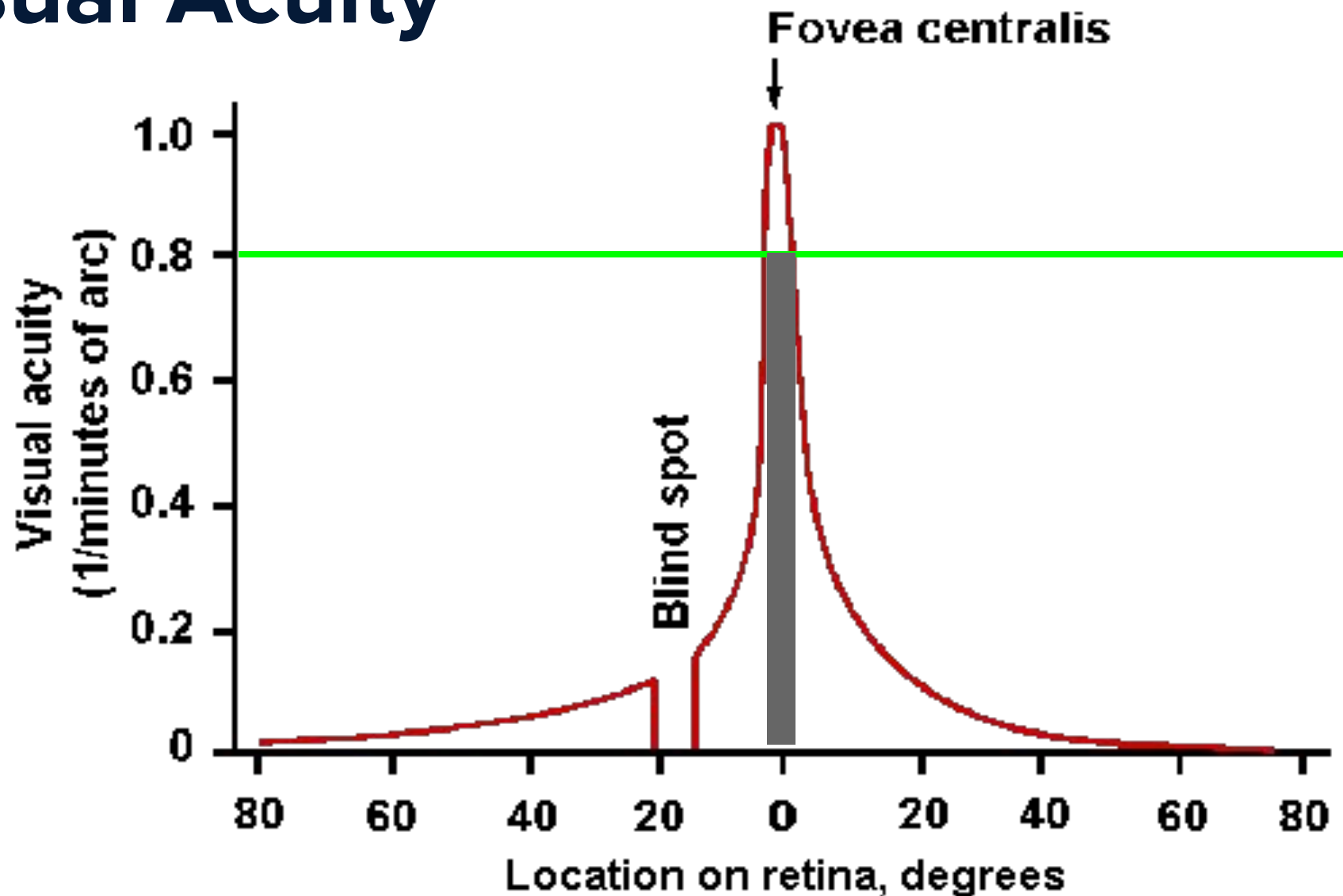
Time Needed To Scan: 20 seconds



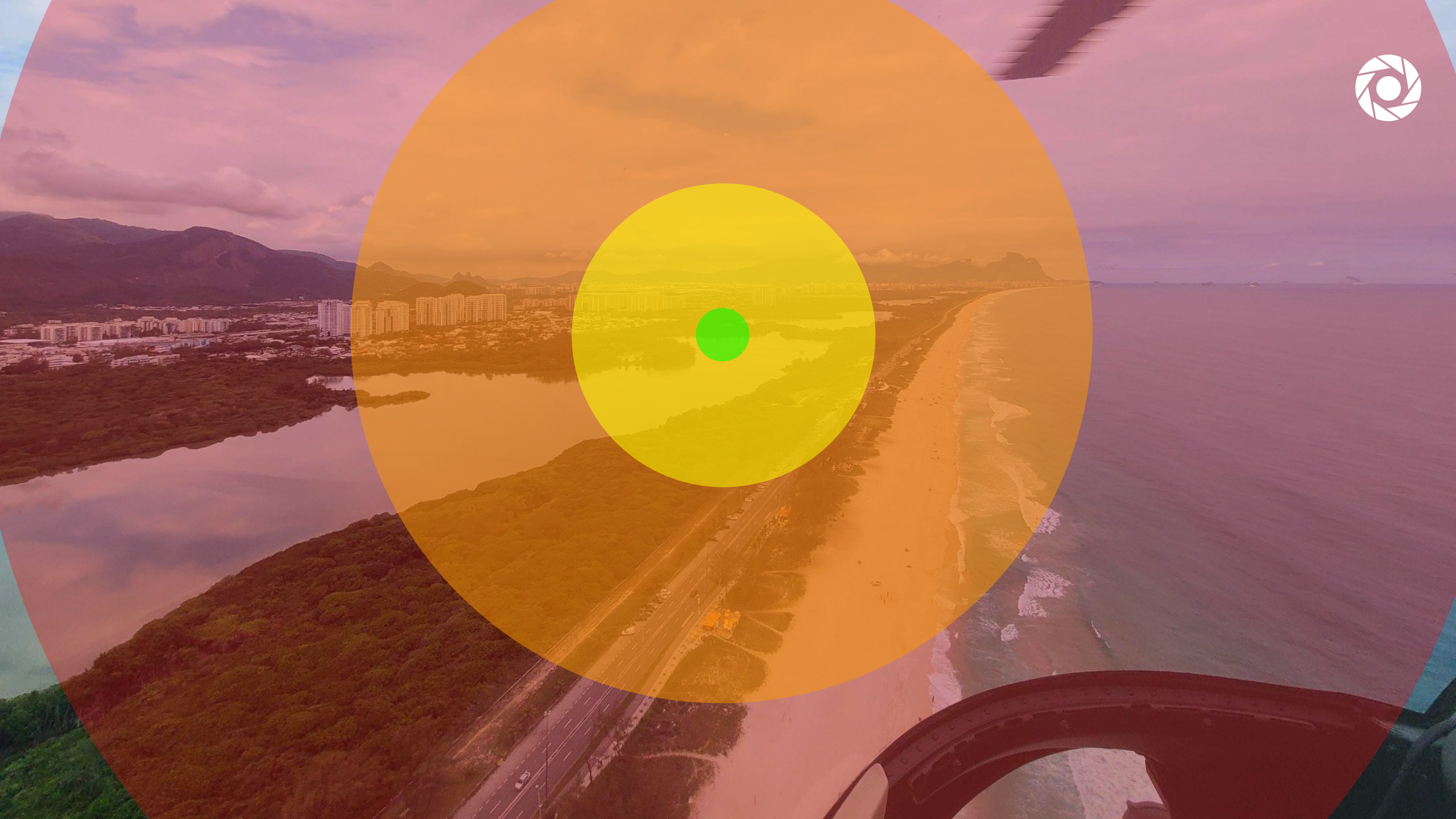
Visual Acuity



Visual Acuity



Visual Acuity required to detect crewed aircraft at 2km.





Other factors



This isn't the pilot's only job

- 1 **Structural Occlusion**
- 2 **Division of Attention**
- 3 **Navigation**
- 4 **Mission Tasks**

How are we doing?

Public acceptance != good enough



NMAC Reported Each Year:

Approximately **200**

Actual Collisions:

15 to 25 **70%** Fatal

Most **Within 5 miles** of an Airport

About **half** within traffic pattern

Less than **1,000 feet**

Average Altitude:

Typical Meteorological Conditions:

VFC

Most Common Time:

10 a.m.-5 p.m., weekends

Average Experience Of Pilots Involved: 5,000 flight hours





Insights from the FAA BVLOS ARC

- FAA expects > 2,000,000 registered commercial use drones by end of decade
- eVtols and air taxis WILL be flying by the end of the decade
- First Responders, Emergency Response, Medical Deliveries
- Initial focus on Class G airspace, smaller aircraft (< LSA), no ATC services

BVLOS ARC Final Recommendations



SHIELDED OPERATIONS

- Only Drones should be here
- No DAA required on drones
- All other aircraft must yield RoW



BELOW 500' AGL (EQUIPPED)

- Shared airspace
- No DAA required on drones
- Drones must yield RoW
- ADS-B or TABS



BELOW 500' AGL (NOT EQUIPPED)

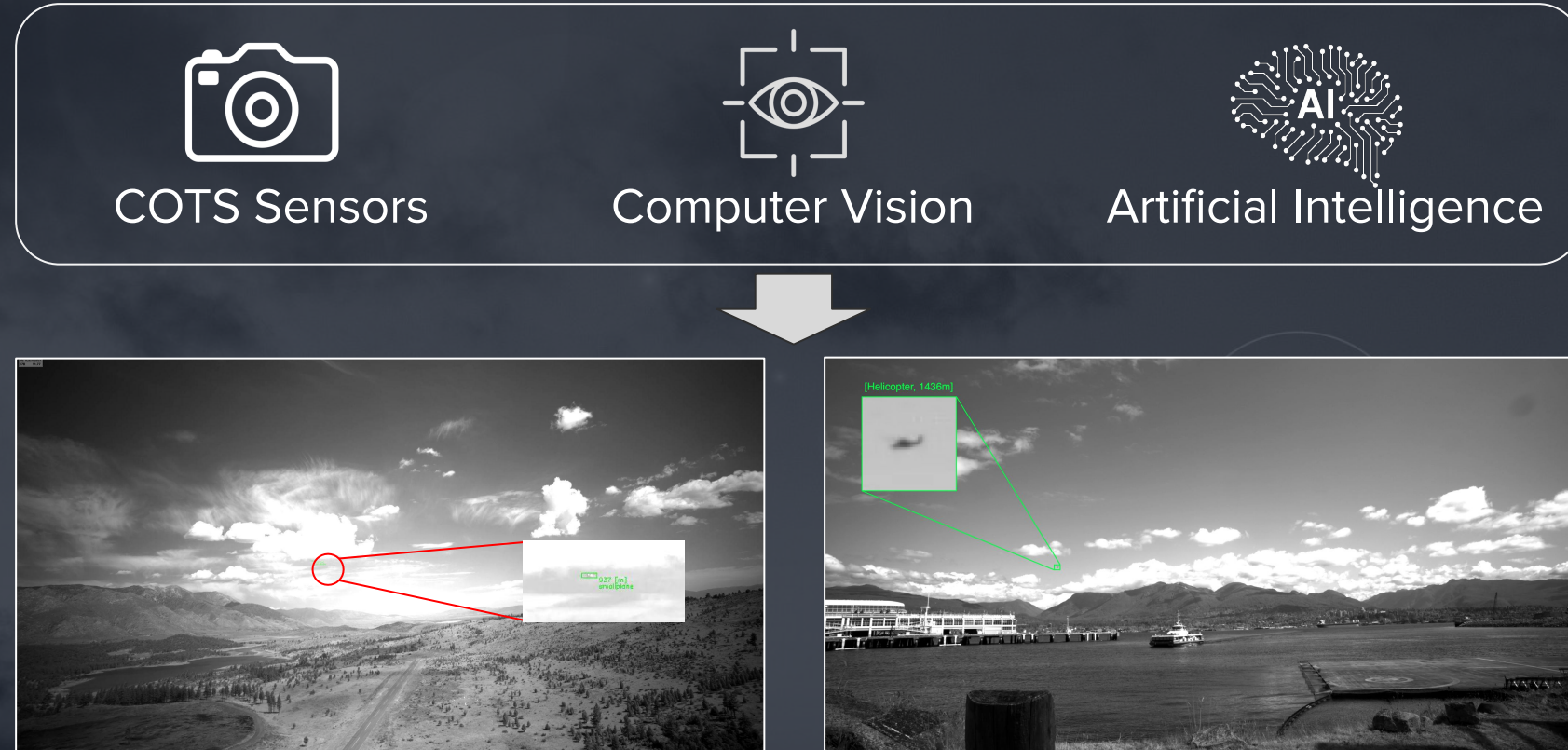
- Shared Airspace
- No DAA required on drones
- Non-equipped, Crewed aircraft must yield RoW

Iris' View





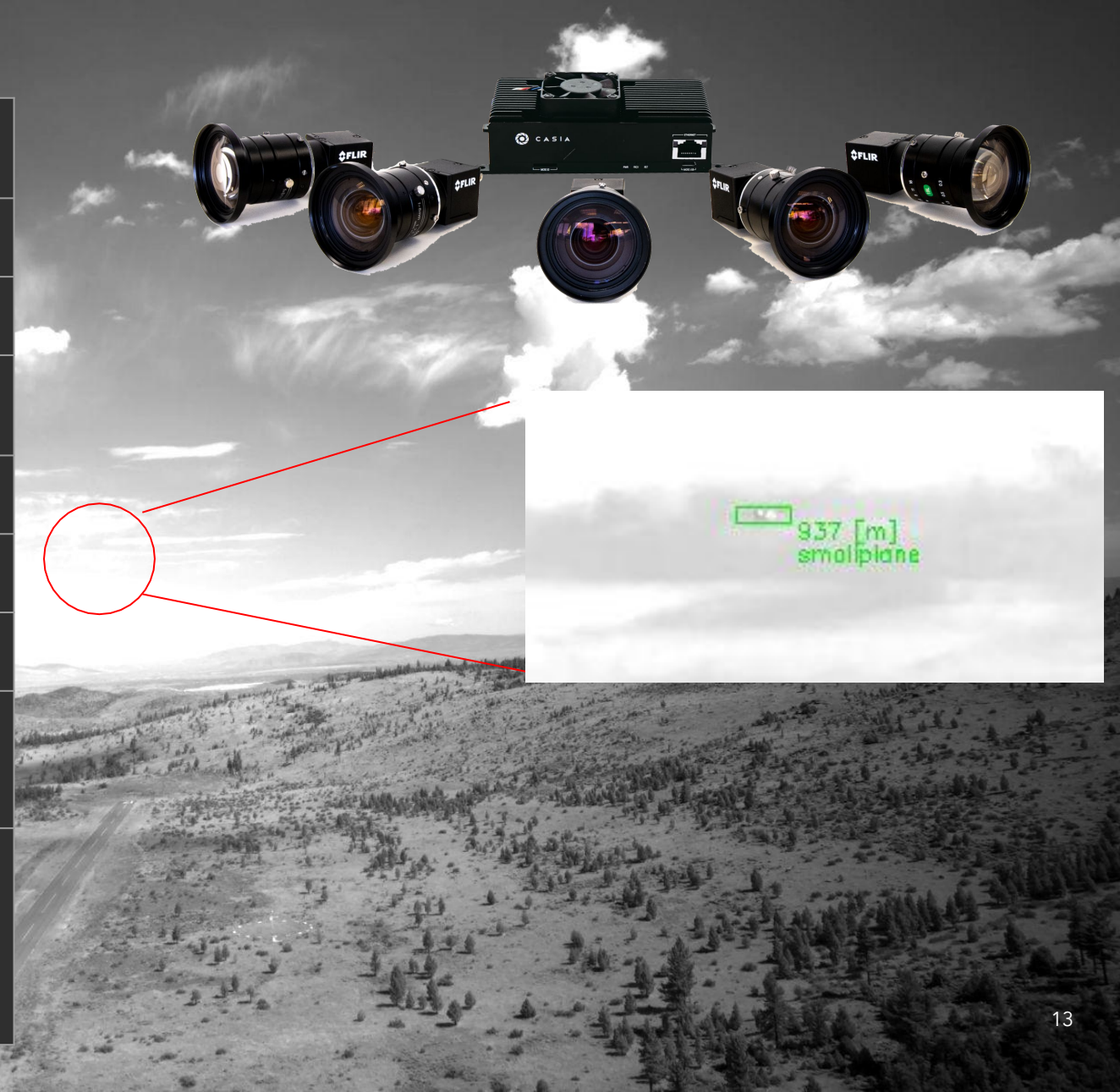
Iris combines three building blocks

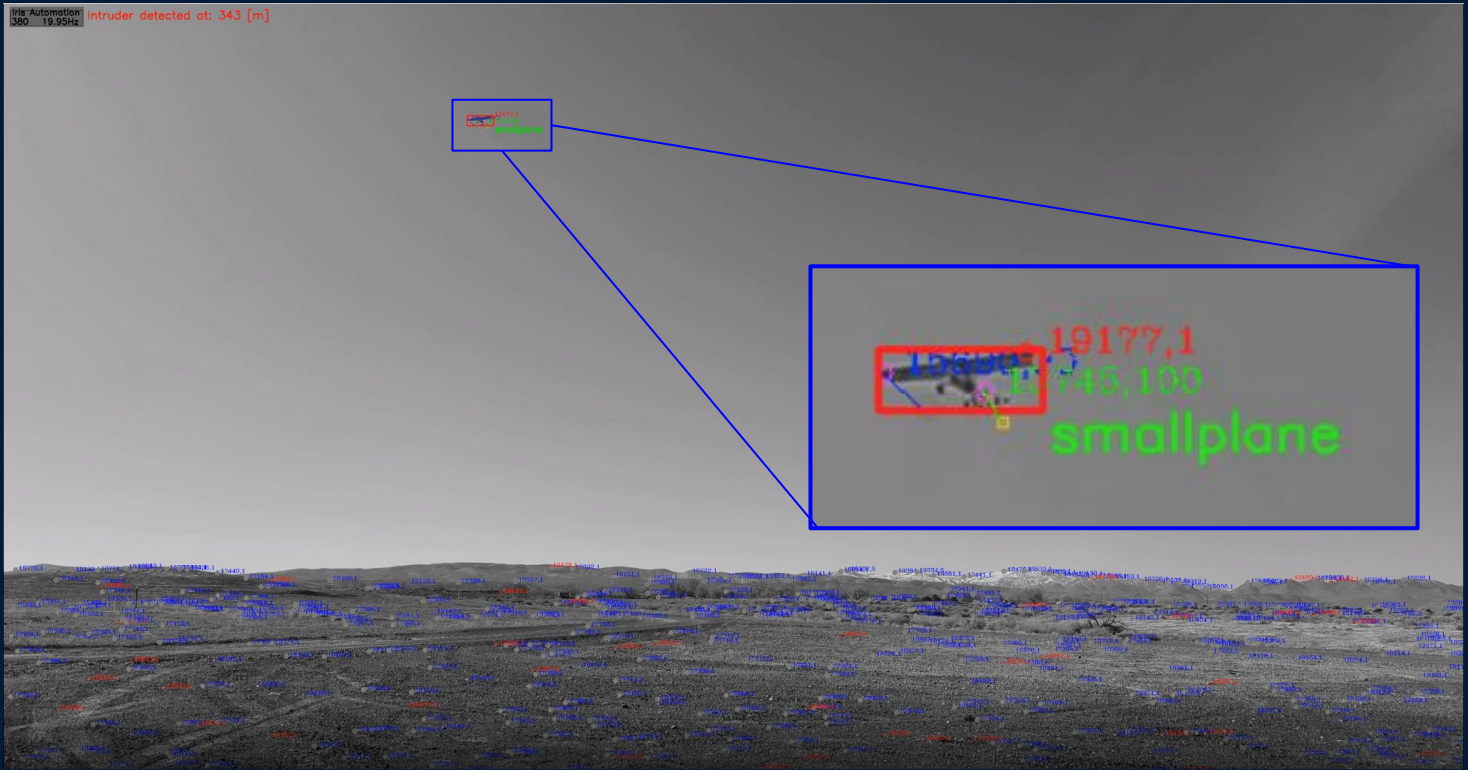
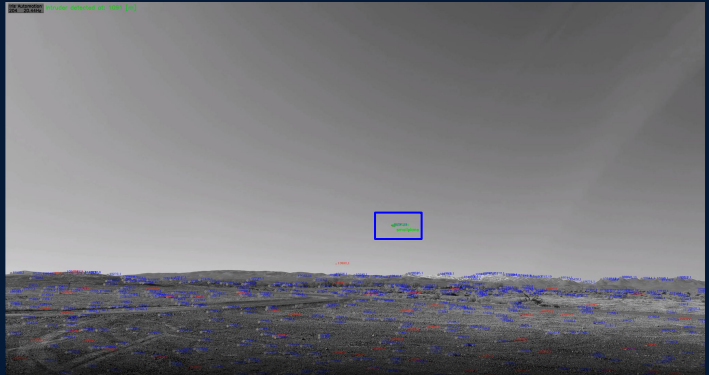
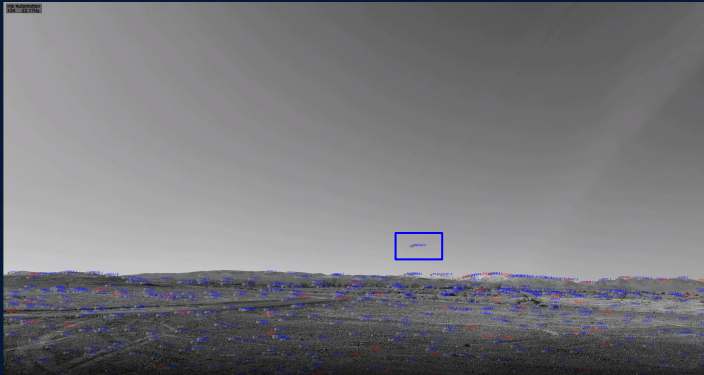
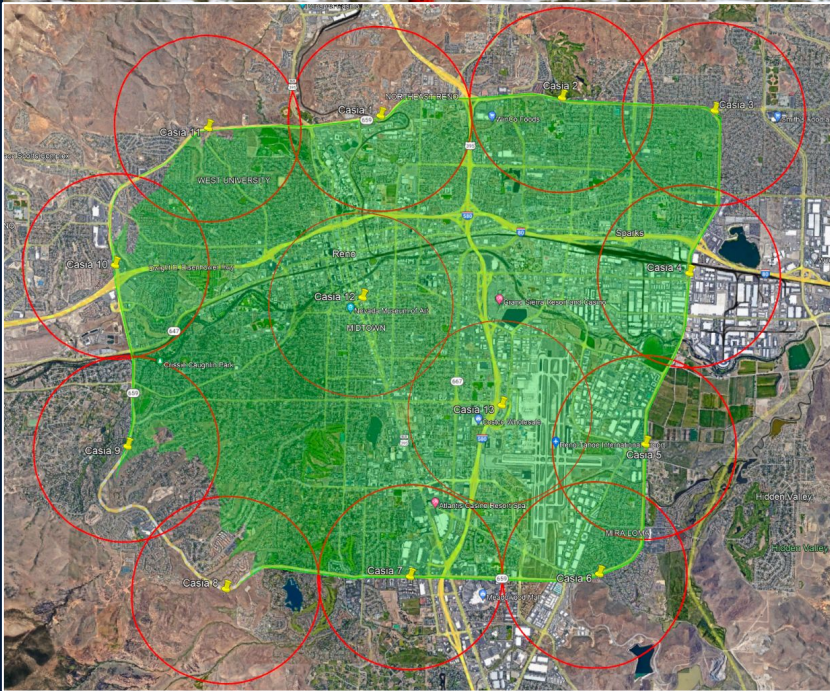


'better-than-human' situational awareness for autonomous systems

Casia X

Field of Regard	360 degrees x 50 degrees
Refresh Rate	10 frames per second
Resolution	45 megapixels per frame
Detection Rate	95% $P_{\text{detection}}$ @ 1.6km (1 mi)
Maximum Range	2.2km (1.36 mi)
Input Voltage	11V-40V
Power	56W Nominal
Mass	Module: 1345g (with enclosure) Cameras x5: 955g
Dimensions	Module: 110mm (W) x 110mm (L) x 80mm (D) Cameras: 60mm (W) x 60mm (L) x 105mm (D)





Additional approaches

Optical is best combination of cost vs. performance. Complementary to other modalities.



	Casia (Optical)	RADAR	Acoustic	LiDAR
Operating Conditions	Clear of Clouds	All	Low Noise	Clear of Clouds
On-board or On-ground	Both	Both	On-Ground	On-board
Range	0-3 km	1-5 km	0-5 km	< 0.3 km
Field of View (per unit)	0-120 degrees	110 degrees	360 degrees	< 40 degrees
Bearing / Distance Accuracy	+/- 2 degrees +/- 20%	+/- 10 degrees +/- 5%	+/- 20 degrees no range ability	+/- < 1 degree +/- 10 cm
Size & Weight	< 1 kg	1 - 5 kg	< 1 kg	1 - 5 kg
Power (per unit / 360)	15W / 40W	35-60W / 140-240W	7W / 7W	34W / 96W
Cost for Single Unit	\$ 9k	\$ 20-30k	\$ 50k	\$ 15k
Cost for 360 Coverage	\$ 20k	\$ 80-120k	\$ 50k	\$ 60-100k
Complexity	Low	High	Low	Medium
Simultaneous Targets	Scores	< 5	1	No Limit
Additional Approvals Required	No	Yes - FCC	No	Yes - FCC

Examples - BVLOS UAS



No box = Initial Detection > 1200m

GREEN = Successful Classification @ 1200m

RED = Inside Well Clear Volume

[Link to video on YouTube](#)

Examples - Embraer Testing



Intruder # 21



Frame taken at 00:34:58 (video time), 2022-02-14, 14:14:2 UTC (flight time)

Intruder Area Image



Zoomed In Intruder Image



Intruder # 28



Frame taken at 00:36:49 (video time), 2022-02-14, 14:16:1 UTC (flight time)

Intruder Area Image



Zoomed In Intruder Image



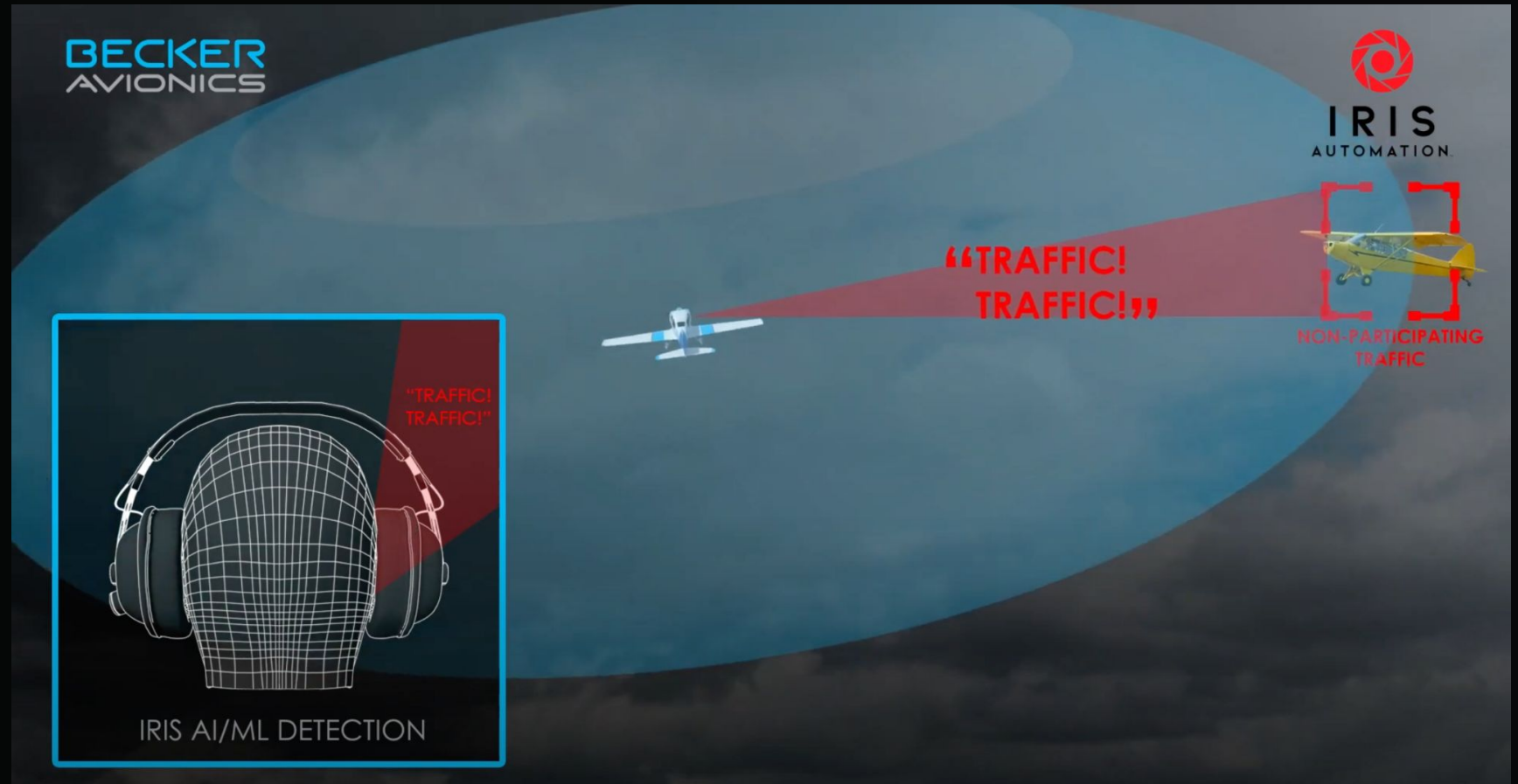
Examples - Becker Avionics



AMU6500



CASIA X System





Questions and Discussion



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