DEFENCE R&D DÉFENSE

Autonomous Micro-Aerial Vehicles for Urban ISR

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Canada

Airborne Sensor for the Dismounted Soldier

Situation

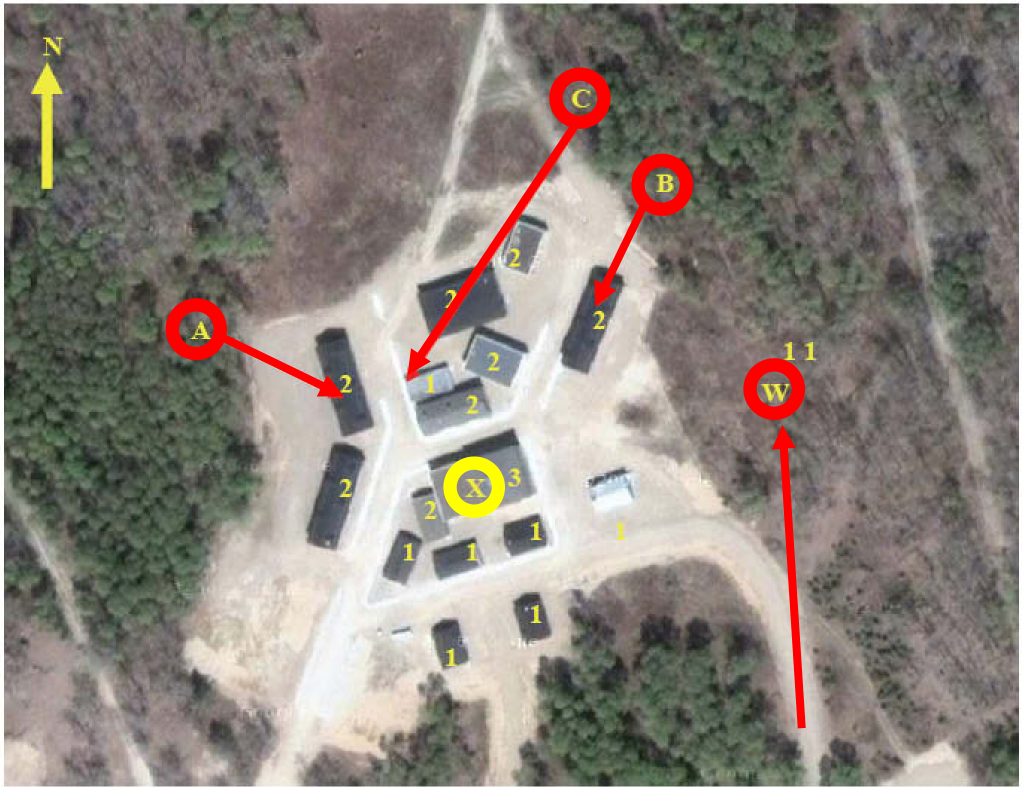
Platoon on morning patrol approaches a village and suddenly takes sniper fire.

Mission

Platoon to locate and eliminate the sniper(s) while minimizing civilian casualties.

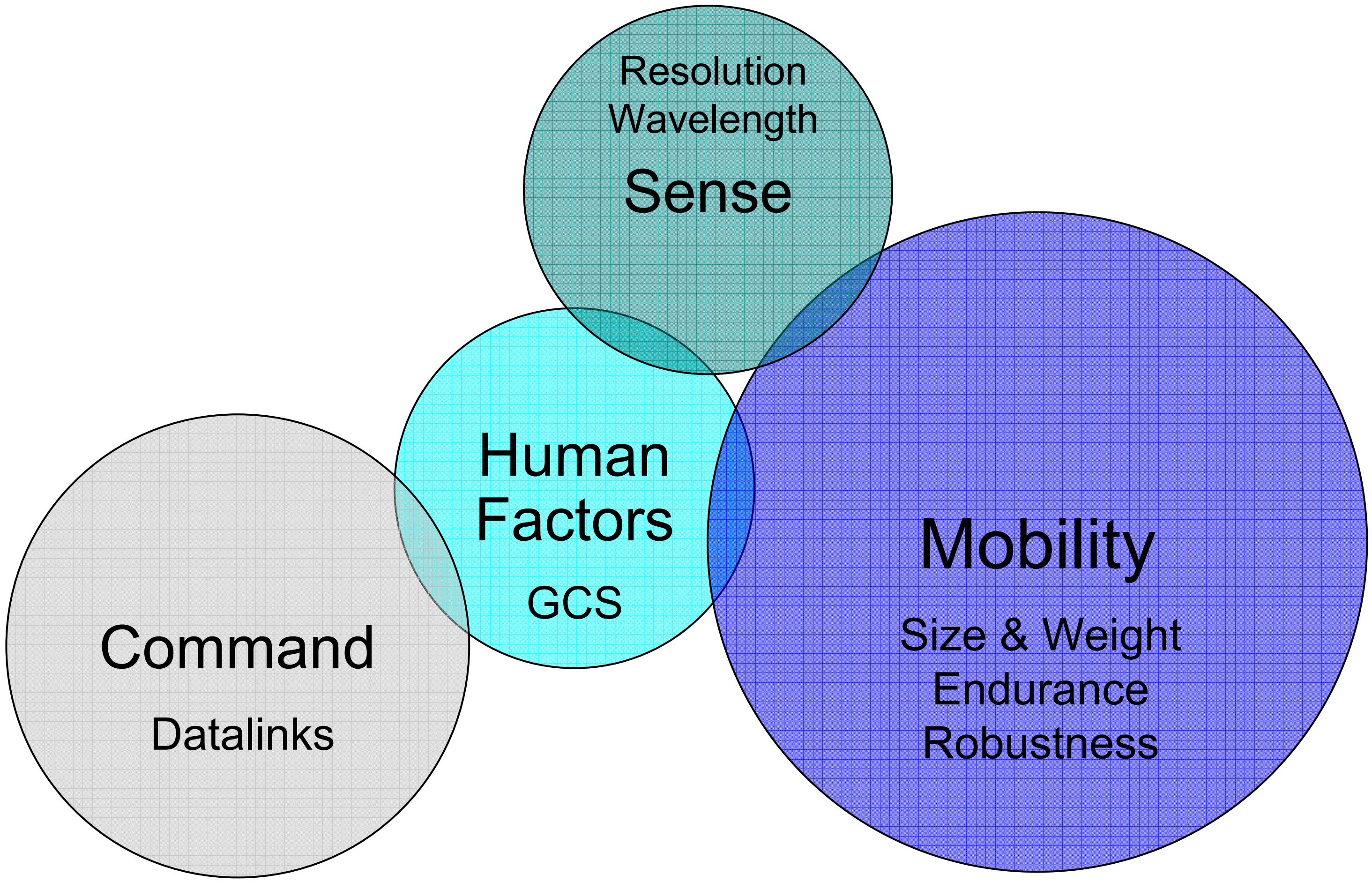
Key Questions

Would an airborne sensor contribute to successful execution of the mission?



How would TTPs change if the blue team knows the red team has equivalent ISR capabilities?

Technology Domains Relevant to the Development of a Mobile Aerial Sensor



Current Options – Fixed Wing

- Size & Weight
  - 72 cm, 430 g
- Endurance
  - 45 min.
- Sensor
  - EO or IR camera
  - forward & side
- GCS
  - IP-based, analog
  - tablet interface
  - waypoint navigation

Current Options – Ducted Fan

T-Hawk
RQ-16

- Size & Weight
  - 33 cm, 7.7 kg
- Endurance
  - 50 min.
- Sensor
  - EO or IR camera
  - forward & down
- GCS
  - analog
  - tablet PC
  - waypoint navigation

Current/Future Options - Rotorcraft

Draganflyer X6

- Size & Weight
  - 99 cm, 1.5 kg
- Endurance
  - 20 min
- Sensor
  - EO still or video
  - forward
- GCS
  - analog
  - laptop telemetry
  - manual navigation

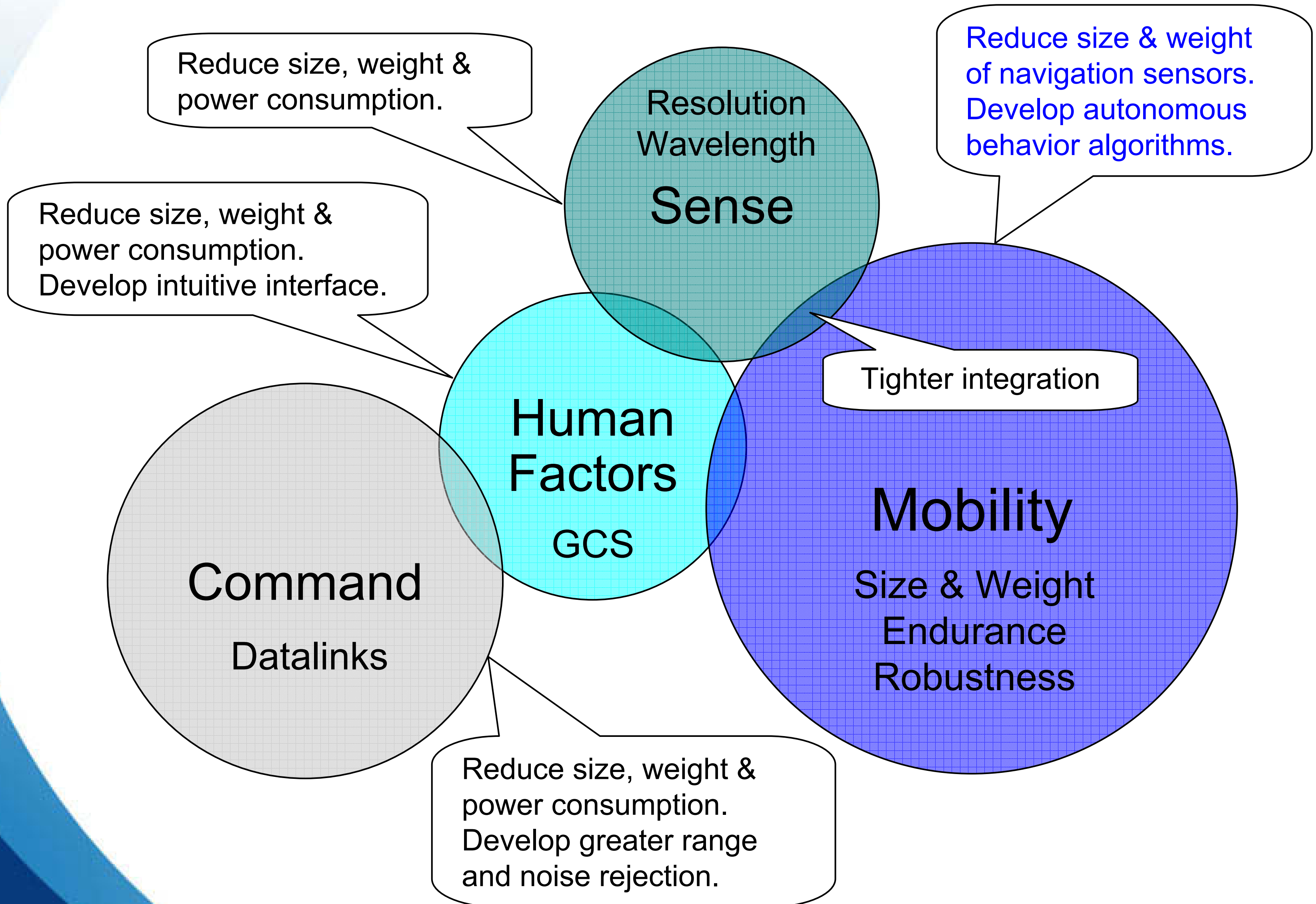
Current/Future Options – Flapping Wing

Cybird

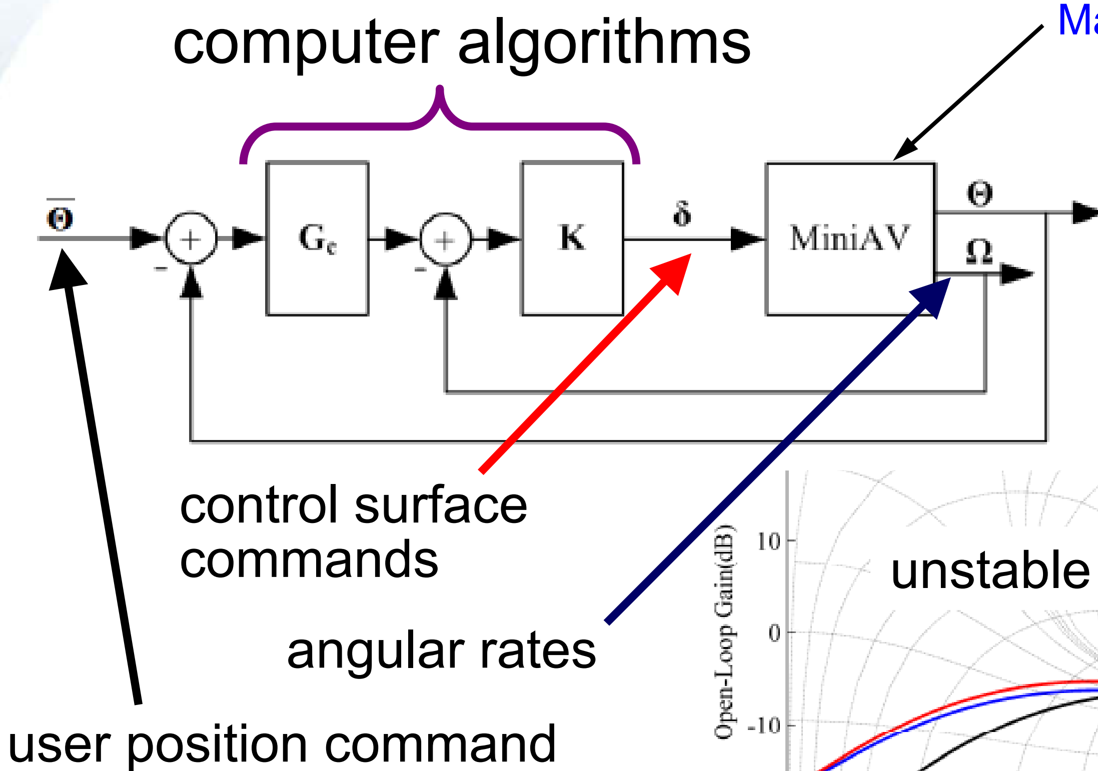
Delfly

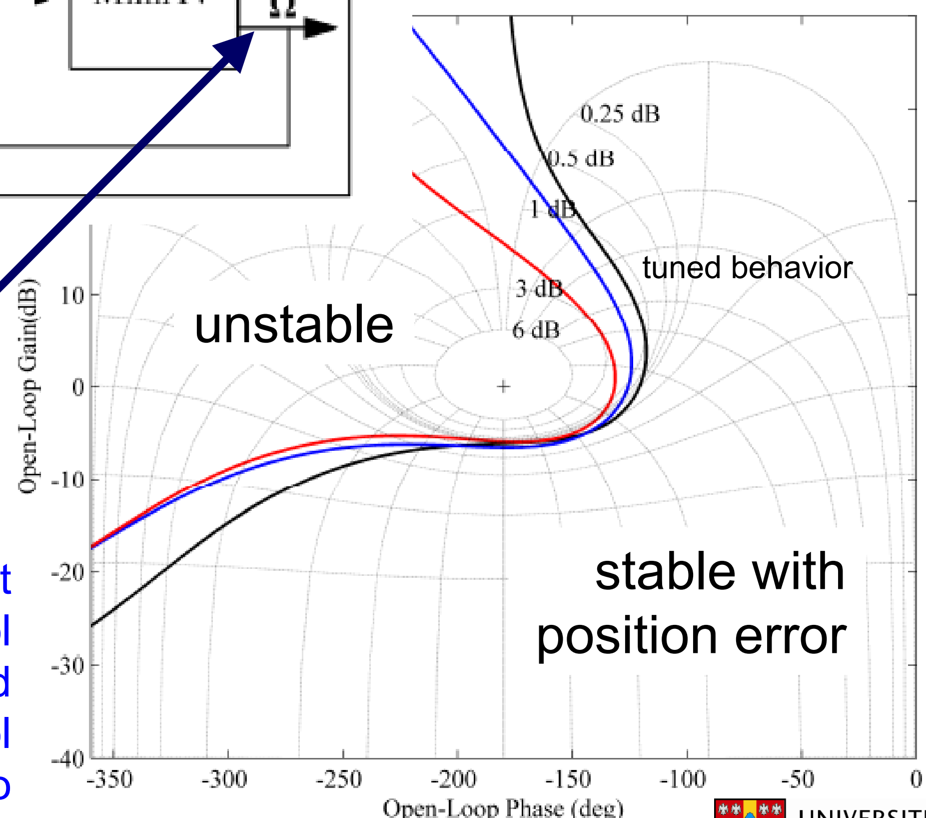
- Size & Weight
  - 74 cm, 230 g
  - 28 cm, 16 g
- Endurance
  - 15 min
- Sensor
  - EO camera
- GCS
  - none
  - manual navigation

R&D Domains for a Mobile Aerial Sensor



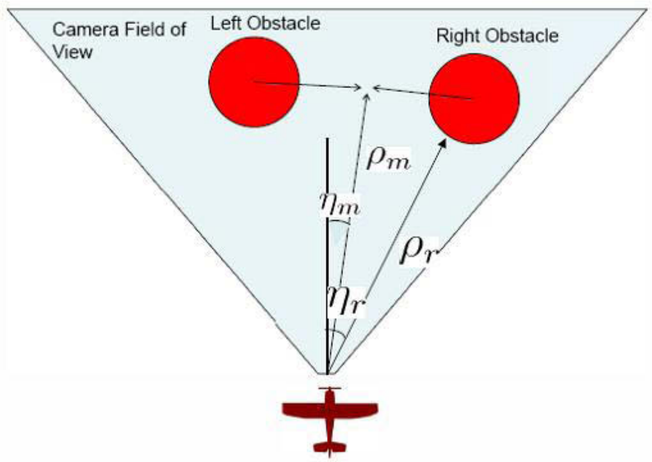
R&D Challenge – Autonomous Stabilization





Control algorithm development involves developing control algorithms to give desired dynamic behavior. Control algorithms add to user inputs to ease burden of flying MAV.

R&D Challenge – Autonomous Navigation



- Positional Sensors (Current)
  - 3-axis accelerometers
  - 3-axis rate gyros
  - 3-axis magnetometers
  - GPS
  - waypoint algorithms
- Optical Sensors (Future)
  - scanning laser
  - cameras
  - motion detection chip
  - optic flow algorithms
  - obstacle avoidance

Airborne sensor must take care of itself so soldier can concentrate on the mission.

Autonomous Airborne Sensor Availability

within 5 years

within 15 years

R&D Challenge – Miniaturization and Power

Component	Current (g) MAV	Future (g) NAV	Reduction
Airframe	180 (40%)	0.50 (17%)	360X
Propulsion	82 (18%)	0.45 (15%)	182X
Control	69 (16%)	0.70 (23%)	99X
Camera	30 (7%)	0.40 (13%)	75X
Battery	83 (19%)	1.00 (33%)	83X
Total	444 g	3.05 g	145X
Duration	20 min.	3 min.	—
GCS	3400 g	?	—

Summary

- Man-portable ISR robots are seen as a means to give the soldier a decisive advantage over the adversary.
- Current military-grade systems are based on fixed-wing and ducted fan platforms with EO/IR sensors connected to a tablet GCS. Future platforms may be based on rotorcraft and flapping wing systems.
- True usefulness of ISR robots will come when they possess autonomous technologies that allow the robot to look after itself and leave the soldier to focus entirely on the mission.
- Autonomy is a two-edged sword. If adversary is capable of creating better autonomous robots, they will have greater force multiplication capabilities.