

Artificial Intelligence for Networked Robotic Drones

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Some projections from the CF - Projecting Power: Canada's Air Force 2035, CFAWC.

Semi-Autonomy or, in certain cases, **complete autonomy** *will* be a feature of all future platforms and systems

Future robotics will become increasingly modular, reconfigurable, **self-repairing**, and self-sustaining

Micro air vehicles will be used as short-range **weapons** and ISR collectors, and will be able to use **swarming** and linking tactics

Artificial Intelligence

... the study and design of intelligent agents [1]

... an intelligent agent is a system that **perceives its environment and takes actions** that maximize its chances of success [1]

Here – AI for a collective of robotic drones

... coordination of the motion of several UAVs

... AI enables UAV group to take actions with limited human intervention

[1] Russell, Stuart J.; Norvig, Peter (2003), *Artificial Intelligence: A Modern Approach* (2nd ed.), Upper Saddle River, New Jersey: Prentice Hall

Some Envisaged Applications (CFAWC, USAF documents)

USE

Networked
Robotic
Drones

- Persistent Surveillance (24/7)
- ISTAR
- Search and Rescue
- Air Lift
- Air Refueling
- Coordinated bombing
- Protection of an area
- ...

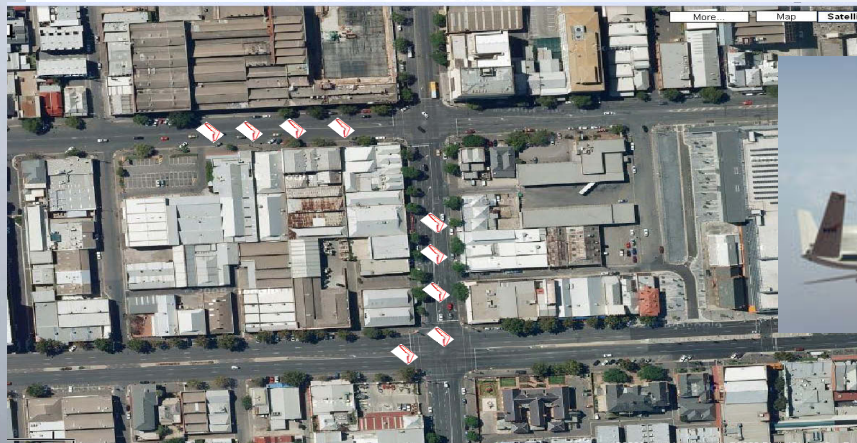
SAR



Air lift



Surveillance



Air refueling

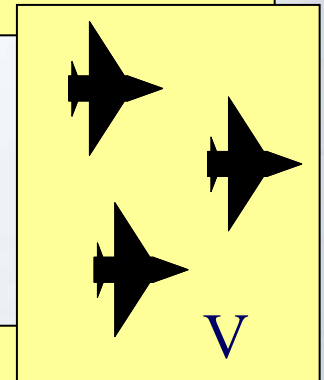
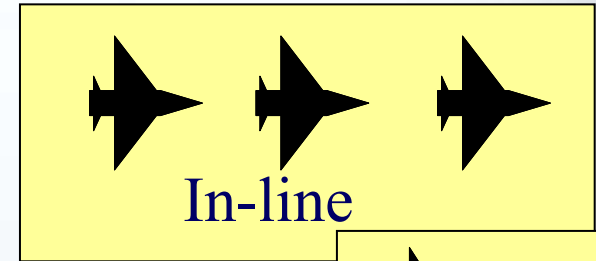


AI – Drone formation flight

- * Our AI design allows for **scalability**

From 2-vehicle squadron to 100-vehicle **SWARM**

- * Formation maintains prescribed **geometries** in flight



**AI
Software**

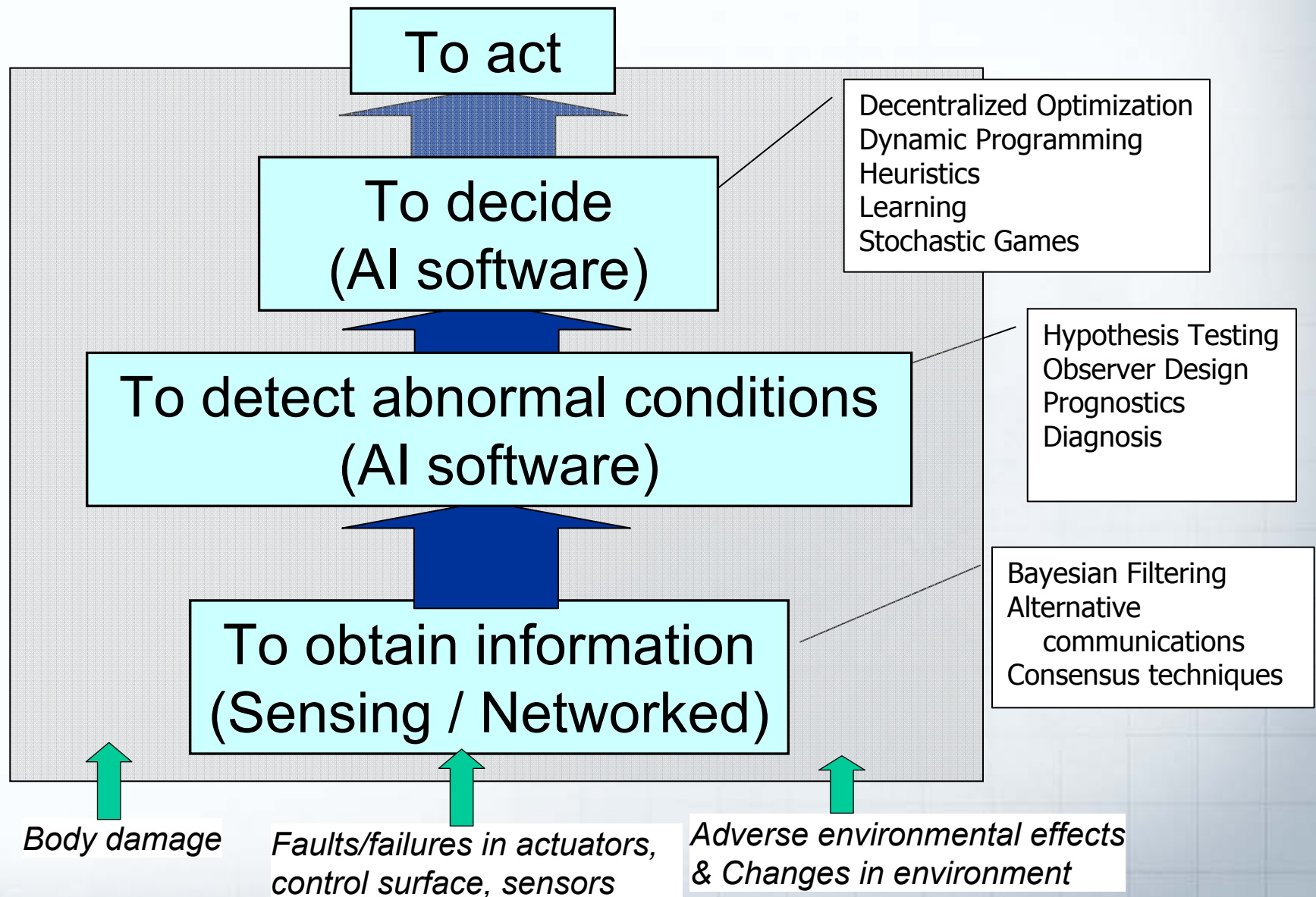
The commander **DOES NOT** pilot the UAVs

AIS adjusts to damage, motor problems, adverse weather, crash of a drone, drone takeover ...

- * Formation complies to **high-level** commander's commands without continuous human supervision

- * Formation efficiently handles **degraded** conditions and unexpected events **on its own**

Collective Artificial Intelligence



Collective Artificial Intelligence – Drone formation faced with an anomaly

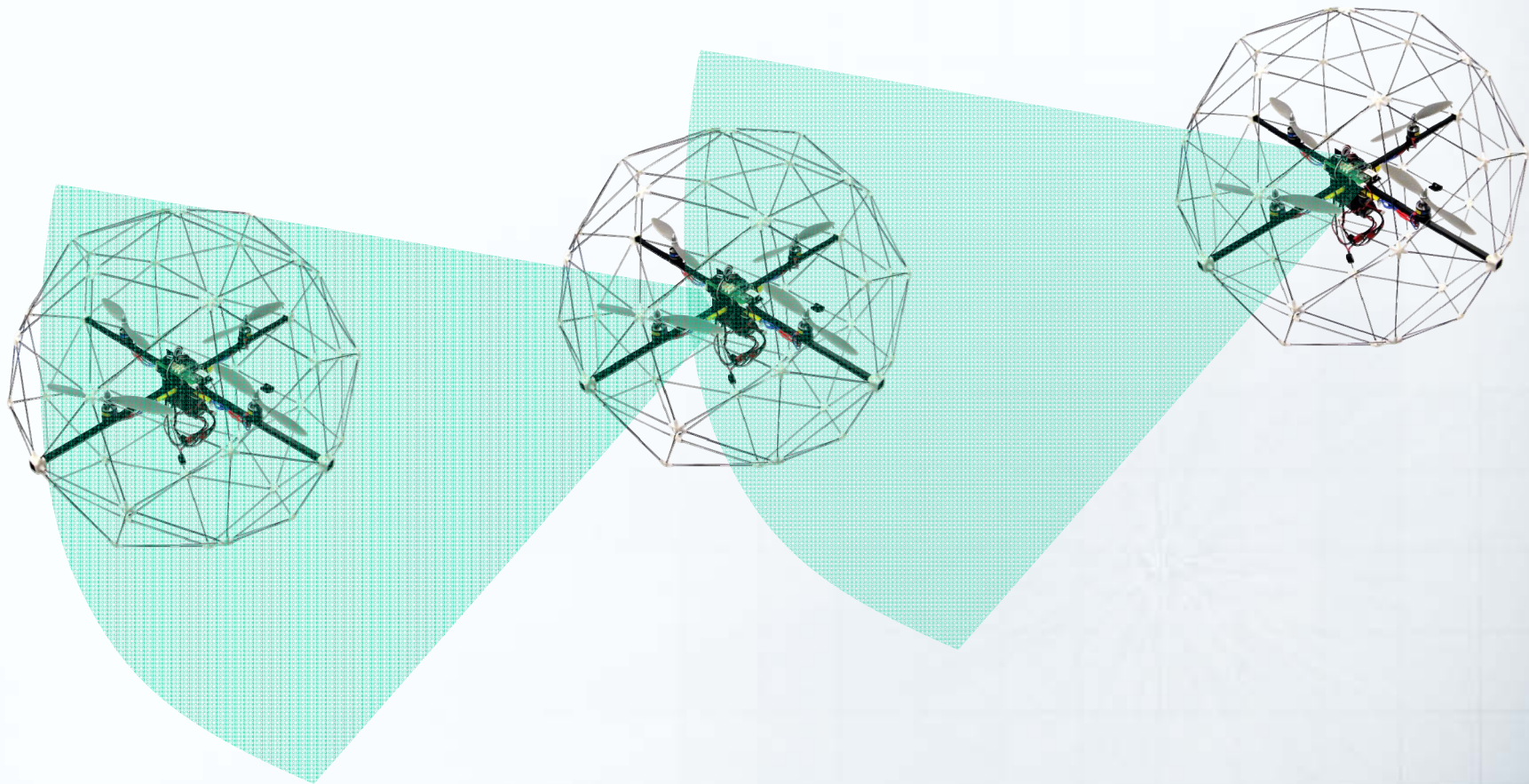


Follower 2 detects anomaly and adapts its motion/positioning (AI software)

Follower 1 goes into abnormal motion

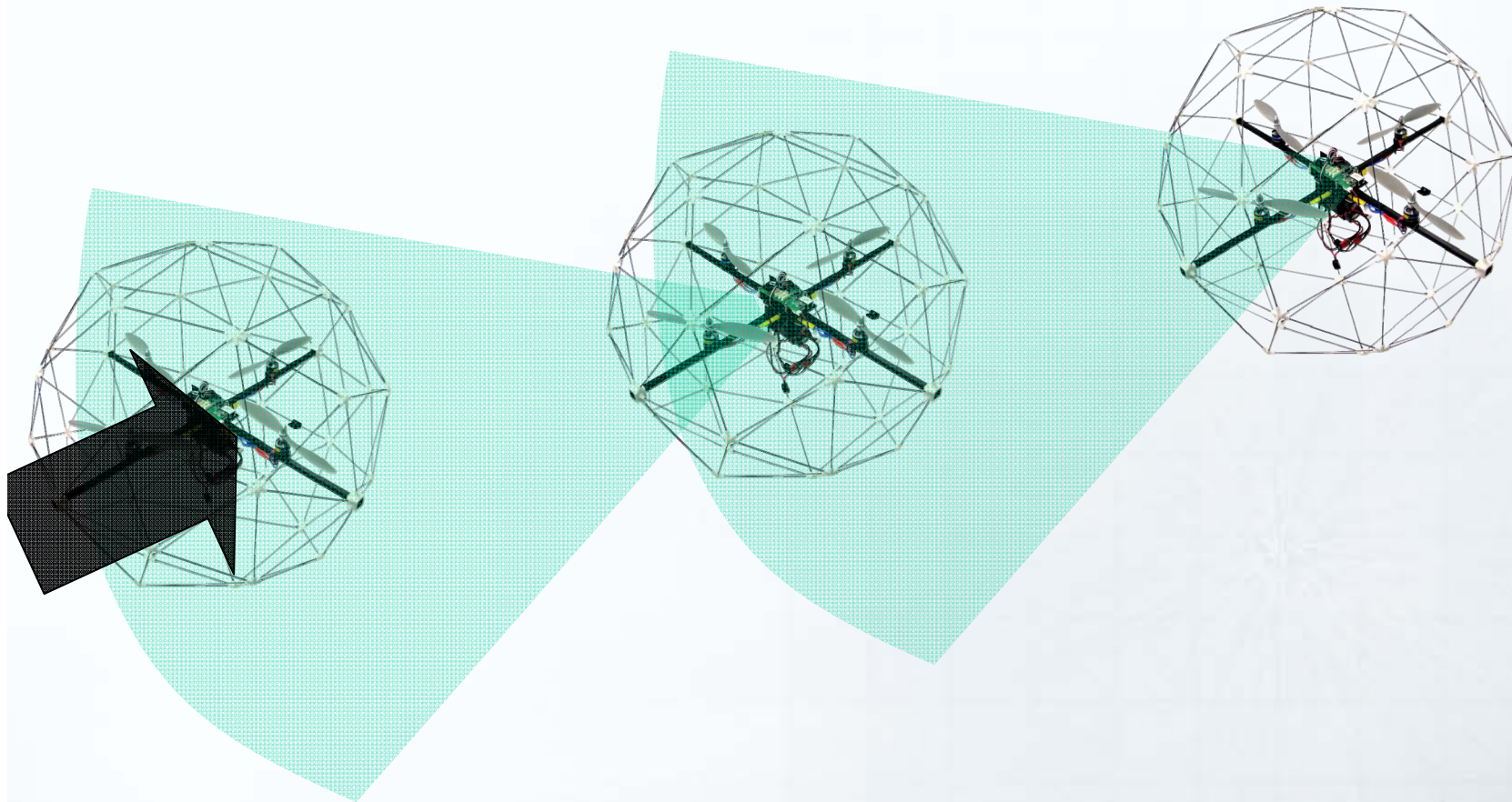
Monitoring (Sensors + AI software)

Collective Artificial Intelligence – Drone formation shape change



Team adaptation (AI software)
V-Shape request by GCS

Collective Artificial Intelligence – Robust formation of drones



Adaptation by the team (AI software)
Perturbation to leader

DEFENCE

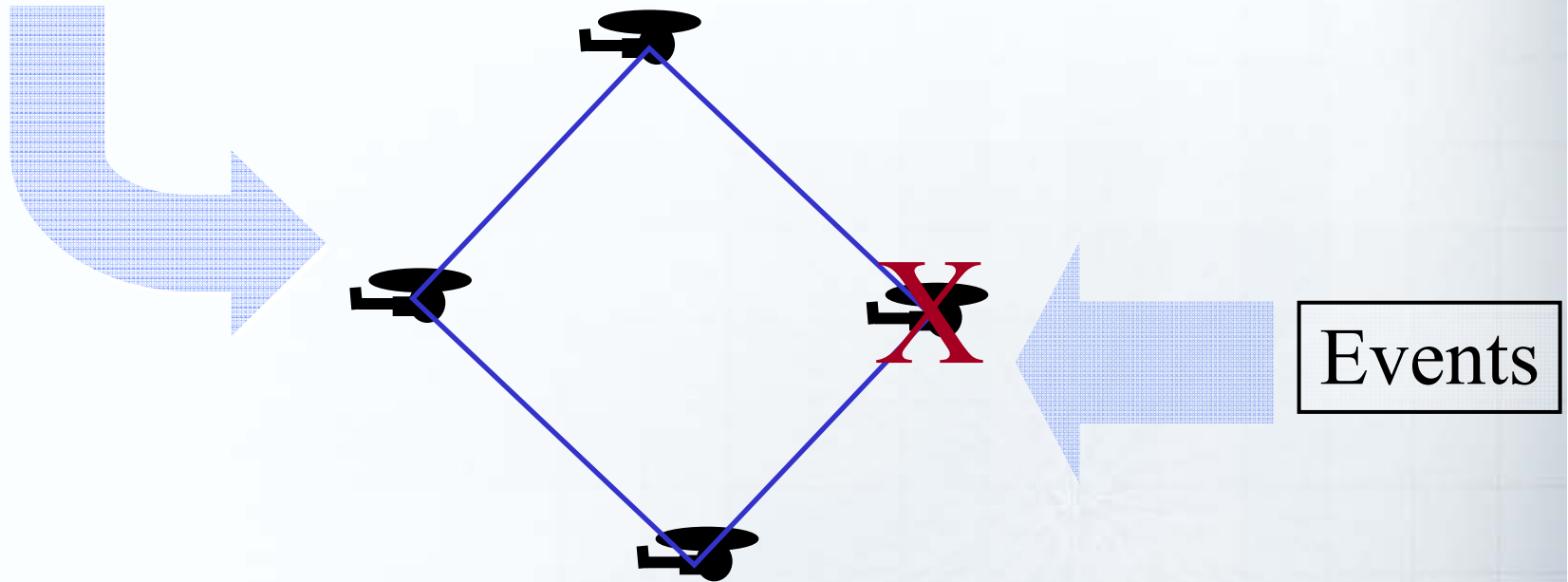


DÉFENSE

EXTRA SLIDES

Collective Artificial Intelligence – Mobile Sensor Network

* Sensor Placement Optimization



* Dynamic Reconfiguration

