UAV swarm motion manipulation

motivatied by Boids algorithm

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Scales of organization
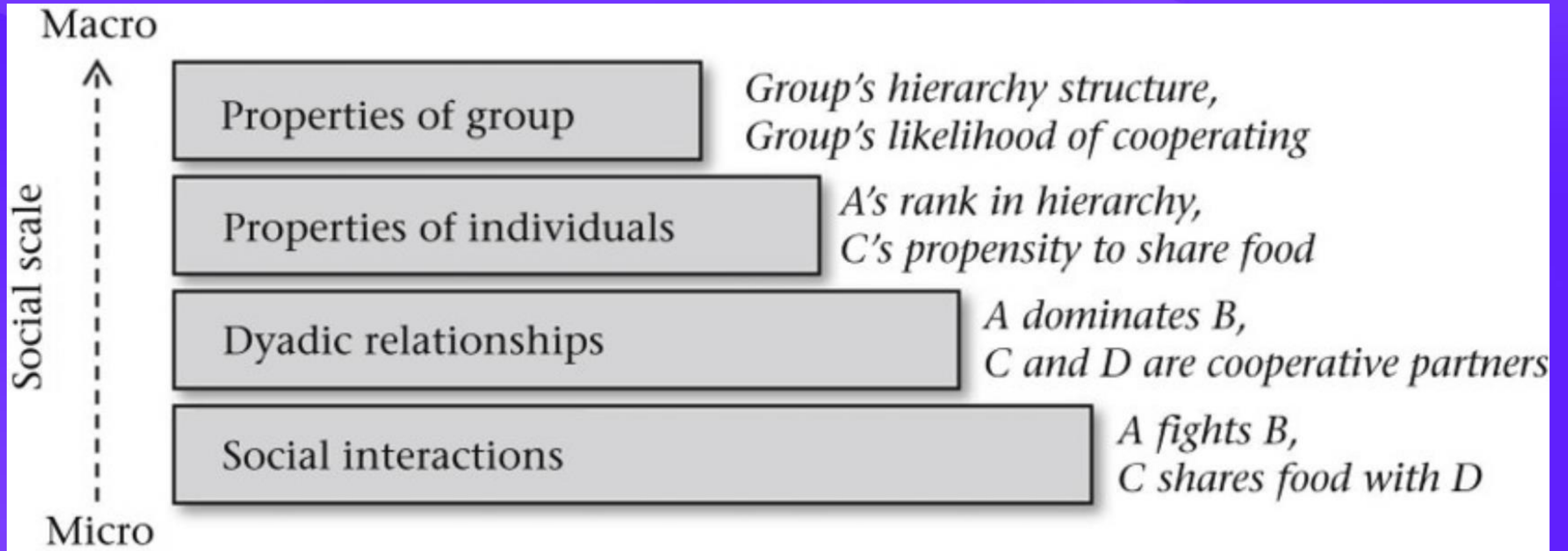
Hobson, Elizabeth A., et al. "Rethinking animal social complexity measures with the help of complex systems concepts." *Animal Behaviour* 155 (2019): 287-296.

Emergence (bird flock)

Benefits for individual :
Foraging
Protection from predators

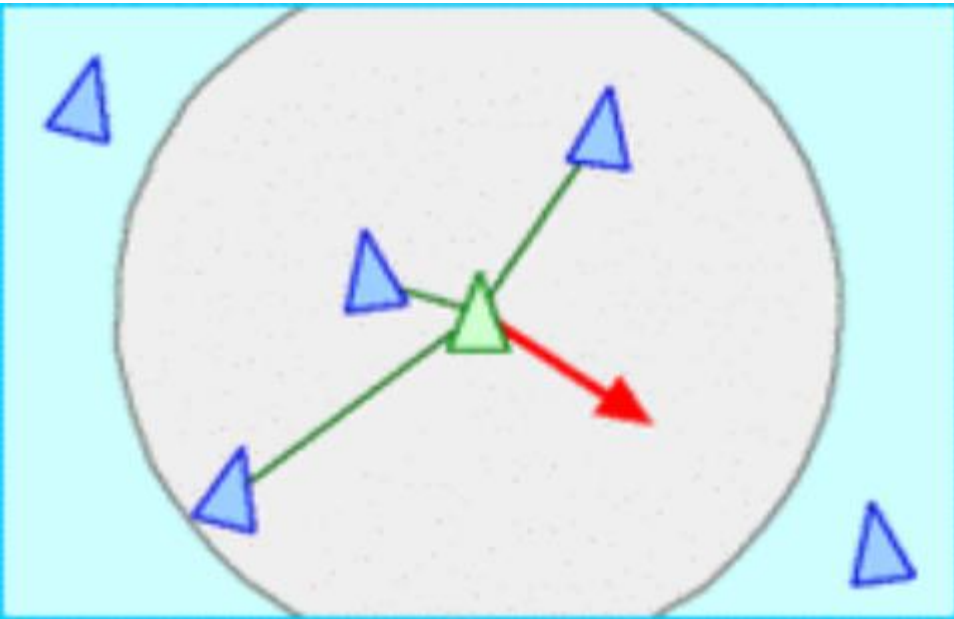**On the collective side :**
Has no collective intention
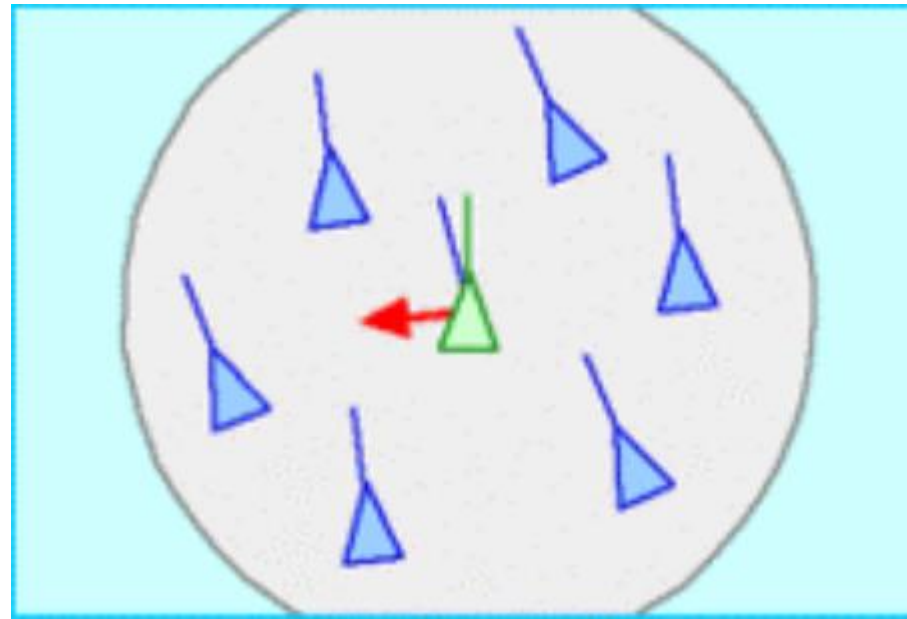
Boids

Three basic moving vectors

Separation
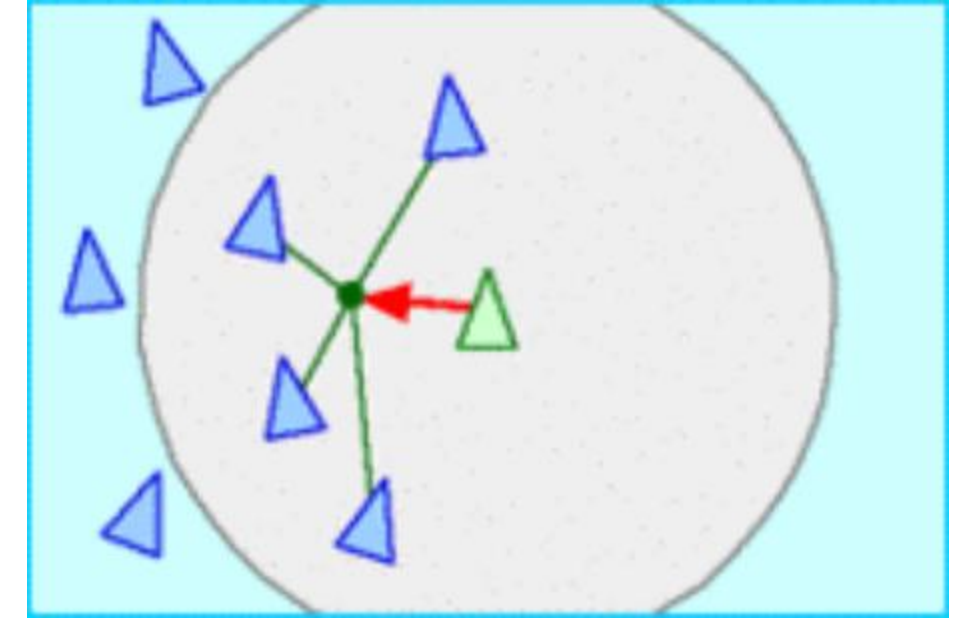

Steer to avoid
crowding local flockmates

Alignment

steer towards the average
heading of local flockmates

Cohesion

Steer to move towards
the average position
of local flockmates

Reynolds, Craig W. "Flocks, herds and schools: A distributed behavioral model." Proceedings of the 14th annual conference on Computer graphics and interactive techniques. 1987.

Drone swarm maneuver

Difficulties to maneuver drone swarm
- Low latency
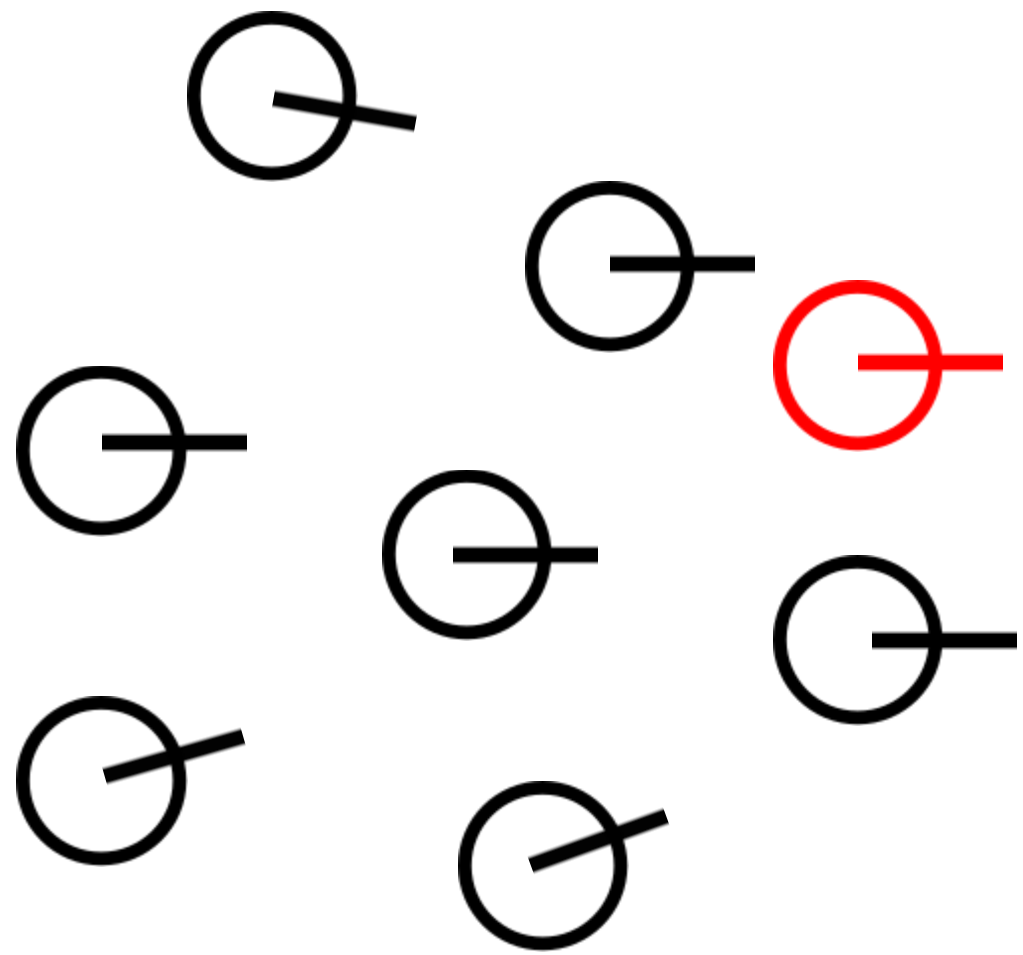- Limited bandwidth
- Interference

...

Introduce **intelligent drones**
to the boid swarm
enabling collective intelligence

Intelligent Drone

Fourth vector

Indirectly realizing
the swarm intentional moving

Swarm maneuver measurement

Methods

Quantitatively measuring the impact of a single (or a few) intelligent drones
- Measuring the group speed and intelligent drones' acceleration

  The proportion of intelligent drones
- Measuring the integrity of the group

  Swarm may be split in some situations, this can be reflected

  by the locations' deviation.

Objects

Waypoint to specific locations.
- Speed control
- Tracking
- Detouring obstacles

Expected conclusions and effects

So far we have realized some kinds of manipulation over week coupled three moving vectors (cohesion, allgnment mostly).

Next Step

Larger the weight for intelligent drone
- enable the leader drone visiable to all

Memory mechanism (moving average) to lower speed volatality
- save moving power consumption

THANK YOU

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