Cooperative Perimeter Monitoring

Objective: Use a team of cooperatively monitor a fixed or dynamically changing border.

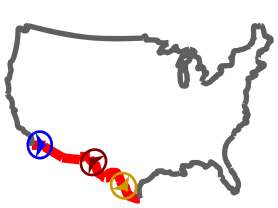
Principle Investigators: Randy Beard, Tim McLain

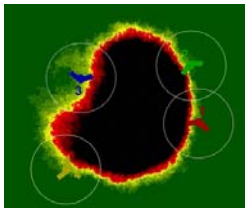
Sample Publication: David W. Casbeer, Derek B. Kingston, Randal W. Beard, Timothy W. McLain, Sai-Ming Li, Raman Mehra, "Cooperative Forest Fire Surveillance Using a Team of Small Unmanned Air Vehicles," *International Journal of Systems Science*, vol. 37, no. 6, May, 2006, p. 351-360.

Funding Source: NASA.

Problem Summary

A team of MAVs with flight durations of 1-2 hours, are tasked to cooperative monitor a perimeter. The communications range is limited and precludes constant communication. The perimeter may be changing as would be the case for a forest fire perimeter.





Possible applications include border patrol, fire surveillance, hazardous material monitoring

Approach

Simple decentralized algorithm.
Guaranteed optimal performance.

if *rendezvous with neighbor* **then**
- calculate shared border position
- travel with neighbor to shared border
- set direction to monitor own segment

else if *reached perimeter endpoint*
- reverse direction

else
- continue in current direction

Theorem

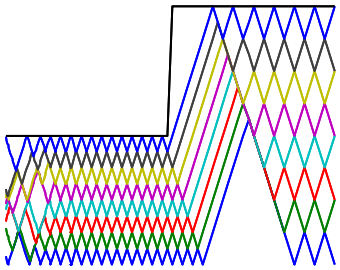
If the perimeter and number of agents are fixed, then consensus is achieved in 3T, where T is the time required for one MAV to traverse the perimeter.

Proof:

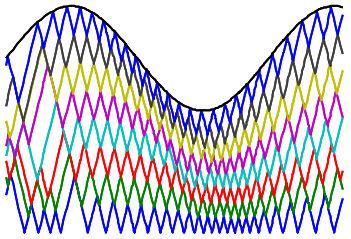
Based on consensus ideas.

Results

- Successfully flight tested in 2006-2007 using three MAVs.
- Robust with respect to wind.
- Seamlessly handles vehicle insertions and deletions.
- Works for arbitrarily small communication radius.



Step Change



Sinusoidal Change