OPTIMIZING SURVEILLANCE BY MULTIPLE INTERACTING UNMANNED AIRCRAFT SYSTEMS (UAS) USING ADAPTIVE ALBATROSS FLIGHT CONTROLS

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ABSTRACT: Increased flight endurance for unmanned aircraft systems (UAS) is useful to improve surveillance duration and reduce launch and recovery logistics. To date technological approaches have largely focused on aircraft power systems. A more recent approach involves programming an individual aircraft to use albatross flight patterns, gliding in a vertically inclined figure path taking advantage of vertical differences in the distribution of wind speed and direction, and aircraft acceleration with changes in altitude to increase time aloft without additional energy expenditure. We extend this approach by proposing multiple interacting UAS using albatross flight patterns to evaluate the challenges to performance efficiency and optimization. This capability can be useful for three scenarios: 1) searching for and tracking objects on the sea surface; 2) mapping ocean surface features (e.g. fronts, oil spills); and, 3) mapping atmospheric features (e.g. gas or particulate plumes, or turbulence features). Conditions are evaluated over ice and ocean at various wind speeds and sea states to identify critical performance factors, capabilities and limitations of this method to optimize persistent surveillance of multiple interacting UAS.

SUMMARY & CONCLUSIONS:
1) UAS wind speed and pitch & roll sensors can be combined with multi-AUV path planning algorithms for model-based field estimation modified to optimize wind field use for multi-UAS dynamic soaring.
2) A distributed network of multiple UAS with positioning sensors can provide accurate windfield measurement to optimize energy harvesting and anomaly mapping or feature tracking.
3) High bandwidth data streaming between multiple UAS and operators using Delay & Disruption Tolerant Wireless Networking (DTN) and optical stitching software abets UAS ocean studies.
4) We conclude field experiments using multiple UAS for dynamic soaring will be optimal in high wind ocean areas around icebergs or islands with steep topography. Use of multiple UAS for studies of oceanographic fronts or marginal ice zones provide other areas for further research.