CONTROL OF THE ATMOSPHERIC LITTORAL

A FUTURE DOCTRINAL FRAMEWORK FOR UNMANNED SYSTEMS IN GROUND COMBAT

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THE STRUGGLE FOR MILITARY-TECHNOLOGICAL ADVANTAGE

QUOTES FROM THE SUMMARY OF THE 2018 NATIONAL DEFENSE STRATEGY

- The security environment is affected by rapid technological advancements and the changing character of war. The drive to develop new technologies is relentless, expanding to more actors with lower barriers of entry, and moving at accelerating speed.
- Modernization is not defined solely by hardware; it requires change in the ways we organize and employ forces. We must anticipate the implications of new technologies on the battlefield, rigorously define the military problems anticipated in future conflict, and foster a culture of experimentation and calculated risk-taking.
- The Department will invest broadly in military application of autonomy, artificial intelligence, and machine learning, including rapid application of commercial breakthroughs, to gain competitive military advantages.

CLOSE COMBAT IN THE GROUND DOMAIN IS A KEY CHALLENGE

Urban operations in the 21st century are not just another type of operation; they will become this century's signature form of warfare.

- Atlantic Council, *The Future of the Army: Today, Tomorrow, and the Day After Tomorrow,* 2016.

THE USE OF ROBOTICS AND AUTONOMY OFFERS UNDEFINED POTENTIAL

THE APPLICATION OF NEW TECHNOLOGY IS OFTEN INITIALLY CONSTRAINED BY FAMILIAR PARADIGMS

Horse-drawn carriage

Horseless carriage

Horse-drawn tiller

Horseless tiller (tractor)

THE IMPORTANCE OF INNOVATIVE DOCTRINE

WW1 Mk I Tank

Armored Maneuver Warfare

Wright Military Flyer

Combat Aviation

KEY PROBLEM FOR ROBOTIC GROUND VEHICLES: COMPLEXITY OF THE PHYSICAL ENVIRONMENT

THE ATMOSPHERIC LITTORAL

The portion of the atmosphere adjacent to the Earth, i.e. “the air between the buildings” and extending to an altitude of a few hundred feet.

ATMOSPHERIC LITTORAL OPERATIONS ARE CONDUCTED:

- In the air, high enough that most ground obstacles are of no consequence and forces can move, concentrate, and disperse without hindrance, like aircraft but on a local scale.
- Low enough that the forces are in close and intimate contact with ground forces, able to attack enemy ground forces and support friendly ones (i.e. engage in ground combat).
- Low enough that forces can use large features such as buildings, hills, or large trees as cover and concealment.

MILITARY ADVANTAGES OF ATMOSPHERIC LITTORAL OPERATIONS

The atmospheric littoral can provide a new dimension of tactical overmatch in ground combat, combining many of the fundamental strengths of airpower and ground forces.

- Speed
- Flexibility
- Persistence
- Mass / Concentration
- Integration

ATMOSPHERIC LITTORAL PLATFORMS

- Operations in the atmospheric littoral have not been possible in the past because no suitable platforms have been technically possible until recently.
- Large quadrotor / hexrotor drones are the first platforms with the basic characteristics required for atmospheric littoral combat.

- 3-axis maneuverability
- Small size
- Tactically useful payload
- Control
- Autonomy
- Endurance

JTARV prototype

THE BASIC UNIT OF ATMOSPHERIC LITTORAL COMBAT OPERATIONS: THE DRONE ARRAY


Firefly drone shows


UPenn GRASP lab

- A drone array is an ordered and controlled swarm capable of assuming tactical formations and acting as a cohesive unit.
- The array unit provides survivability and lethality.

TACTICAL EMPLOYMENT

Drone arrays may be attached to company- or battalion-sized units, such as Marine infantry battalions or Army Stryker infantry rifle companies.

They will operate at the direction of the ground unit commander.

They could be utilized in high- and low-intensity conflict, and with a range of combat forces from special operations forces to heavier maneuver forces.

Tactical employment can greatly enhance ground combat actions including:

- Movement to contact
- Shaping engagements
- Envelopment and flanking/turning movements
- Infiltration and interdiction
- Decisive engagements
- Area defense and retrograde

TECHNICAL CHALLENGES

COMMAND, CONTROL AND COMMUNICATIONS

- Human meaningful control and situational awareness / telepresence
- Autonomous navigation and array behavior
- Acceptance and interpretation of intuitive high-level commands
- Info sharing and data fusion across the array
- Communications security and redundancy

COMBAT AI

- Target acceptance
- Target keeping
- Target assessment
- Incoming fire awareness
- Drone vs. drone engagements

LOGISTICS

- Autonomous Replenishment
- Damage tolerance

QUESTIONS

WILL THEY SHOOT THE WRONG THINGS OR RUN AMOK?

- For the foreseeable future the context of modern ground combat will be too complex for fully autonomous combat systems to be effective. Limited autonomy under meaningful human control will be essential.

WILL THEY BE A BURDEN TO OPERATE IN COMBAT?

- Autonomous logistics and intuitive array control by a single operator are key aspects of the atmospheric littoral operations concept. Burden must be similar to, or less than, that of conventional manned forces.

CAN OTHER SYSTEMS DO THE SAME THINGS?

- Littoral drone arrays provide capabilities that are fundamentally unobtainable through existing means such as ground vehicles, manned aircraft, or large fixed-wing drones.

WILL THEIR COMMUNICATIONS BE JAMMED?

- Relative proximity to friendly forces and to each other provides excellent fallback options for redundant low-probability-of-intercept communications.

CONCLUSION AND NEXT STEPS

- Realizing the military potential of robotics and AI will involve more than just plugging unmanned systems into existing operational doctrine.
- Atmospheric littoral operations are an example of how the inherent capabilities of unmanned systems and autonomy could provide disruptive new capability and sustainable military advantage.
- The necessary hardware technology is almost available and software / AI capabilities are increasing rapidly.

- As in earlier eras of rapid technological change, small numbers of prototypes should be procured for experimentation and field exercises.
- Key military questions such as how best to coordinate with other small unit actions and what degree of autonomy is optimal should be worked out on the proving ground.

Based on Dougherty, George M. "Ground Combat Overmatch Through Control of the Atmospheric Littoral," *Joint Force Quarterly* 94, 3rd Quarter 2019, 64-73.