FIGHTING IN RESTRICTED AND MOUNTAINOUS TERRAIN IN THE DRONE AGE

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CENTRAL ARGUMENT

The enduring principles of war remain valid, but the methods of fighting have fundamentally changed. Mountainous and restricted terrain still favors the defender, restricts maneuver, complicates logistics, and creates natural chokepoints. However, drones, artificial intelligence (AI), autonomous systems, electronic warfare, and precision weapons are changing how military forces see, strike, survive, and maneuver in this difficult environment.

The central challenge for NATO is not simply to acquire more drones. It is to redesign how human and robotic forces fight together. We are entering the CognoRobotic Age, in which human judgment, machine intelligence, and robotic systems increasingly operate together at the speed of information. Success requires commanders to integrate these capabilities into a coherent fighting system while preserving leadership, initiative, surprise, concentration of effects, and mission command.

I. THREE FUNDAMENTAL CHANGES TO THE MOUNTAIN BATTLESPACE

1. The Mountain Battlefield Has Changed. Mountains still restrict movement, but robotic sensing and precision weapons have transformed combat. Traditional advantages provided by terrain, concealment, and restricted approaches can no longer be assumed. Control of key terrain must increasingly include control of the low-altitude airspace above it.

2. The Transparent Battlespace. Uncrewed aerial systems, thermal imagery, electronic signatures, and persistent surveillance make forces easier to detect, track, and target. Troops, command posts, artillery, and logistics concentrations are vulnerable even when concealed by terrain. Survivability demands dispersion, mobility, deception, emissions discipline, and masking—the full-spectrum, multidomain effort to deceive enemy sensors and disrupt enemy targeting.

3. Ubiquitous Precision. Low-cost drones, loitering munitions, and networked targeting threaten forces throughout the battlespace. Precision effects are no longer confined to higher echelons. Small units can deliver devastating strikes, while exposed formations may be attacked before they maneuver. Protection requires integrated electronic warfare, counter-UAS capabilities, active defense, and rapid decisions.

II. EIGHT KEY CONCEPTS FOR COMBAT IN THE ROBOTIC AGE

1. Drone Dominance. A strategic national capability built through Human Ingenuity × Artificial Intelligence × Production Scale. It is a nation's capacity to build, sustain, replace, and continuously improve large numbers of unmanned and robotic systems at scale. Drone Dominance provides the industrial, technological, and human foundation for achieving Drone Superiority.

2. Drone Superiority. That degree of control of the sense-and-strike fight within the Land-Air Littoral and/or Sea-Air-Subsurface Littoral that permits friendly forces to maneuver without prohibitive interference from enemy drone-enabled reconnaissance and strike while denying the enemy the same advantage. See first. Strike first. Maneuver freely. Deny the enemy the same.

3. Land-Air Littoral (LAL). The interconnected ground and low-altitude air battlespace in which human and robotic forces sense, strike, protect, and maneuver. In mountainous terrain, the LAL includes the low sky above valleys, ridgelines, mountain passes, routes, and fighting positions. Control of this space directly influences freedom of maneuver on the ground.

4. Ground Strike Zone (GSZ). A defined, time-bound volume within the LAL in which friendly forces synchronize detection, denial, protection, fires, and maneuver to accomplish a ground objective. The GSZ is not merely a geographic area. It provides a spatial and temporal framework for concentrating effects, creating a temporary advantage, and advancing that advantage with the maneuver force.

5. Distributed Mission Command. The exercise of mission command through dispersed, survivable, and mutually supporting command nodes. It relies on trained leaders, shared intent, delegated authority, resilient communications, and the ability to continue operations when individual command nodes or networks are disrupted or destroyed.

6. Distributed Logistics. A method of sustaining combat forces through dispersed supplies, multiple routes, small and frequent deliveries, pre-positioning, masking, deception, and autonomous resupply where feasible. It reduces lucrative targets and enables forces to continue fighting when supply routes are observed, interdicted, or disrupted.

7. Fighting in Real-Time. The conduct of combat at the speed of information, where sensing, decision, and action are fused into a continuous cycle enabled by Drone Superiority. It allows leaders at the tactical edge to maintain relevant situational awareness, receive actionable intelligence, and act inside the enemy's decision loop. Fighting in real-time is not about watching more screens. It is about understanding and acting faster than the enemy.

8. All-Arms Combat. The synchronized employment of human forces, crewed platforms, robotic and autonomous systems, sensors, fires, electronic warfare, and AI-enabled capabilities to defeat the enemy and create freedom of maneuver. It builds upon traditional combined arms warfare by integrating human and robotic combat power under one commander's intent. Its practical principle is Bots Before Boots: employ machines first for selected high-risk reconnaissance, reduction, strike, and resupply tasks.

III. IMPLICATIONS FOR NATO MOUNTAIN WARFARE

The presentation challenges NATO commanders to reconsider five elements of the mountain fighting system:

Force Structure: Integrate UAS, counter-UAS, electronic warfare, robotic support, maintenance, and trained operators at appropriate tactical echelons.

Leadership: Develop commanders capable of exercising mission command across human-robotic teams amid incomplete information and disrupted communications.

Training: Exercise against enemy drones, electronic warfare, degraded navigation, exposed signatures, casualties, and contested sustainment.

Maneuver: Plan for local Drone Superiority and establish Ground Strike Zones enabling forces to seize passes, penetrate defenses, and exploit opportunities.

Operational Design: Synchronize sensing, denial, precision strike, maneuver, sustainment, and rapid adaptation as one continuous fighting system.

Recent combat in Ukraine provides the operational evidence for these changes. The presentation uses battlefield examples, including Operation Vivaldi, to examine how robotic sensing, precision effects, and human decision-making interact. The challenge for NATO is to test these lessons under realistic mountain conditions rather than assume that methods developed on open terrain will transfer unchanged.

IV. CONCLUSION: PRINCIPLES ENDURE. METHODS MUST CHANGE.

Mountain warfare in the Robotic Age demands more than new technology. It requires new tactical methods, resilient organizations, adaptable leaders, and the integration of human and robotic capabilities into All-Arms Combat.

SEE → DENY → STRIKE → MANEUVER → SUSTAIN → ADAPT

Commanders must gain sufficient control of the Land-Air Littoral to establish local Drone Superiority, concentrate effects within a Ground Strike Zone, and create the conditions for decisive ground maneuver. Distributed Mission Command and Distributed Logistics preserve combat power when forces are dispersed, observed, or under attack.

The decisive advantage will not belong to the force with the most drones. It will belong to the force that learns, integrates, adapts, and fights more effectively with them.

"Drone warfare is not a drone revolution. It is an adaptation revolution." — John Antal