Air Defense with an Attitude: Helicopter v. Helicopter Combat

Ka-50 HOKUM illustration by John E. Richards

Lieutenant Colonel Lester W. Grau, U.S. Army, Retired, and Major James H. Adams III, U.S. Marine Corps

Helicopters are proliferating among the world's armies. This growing inventory includes armed helicopters equipped with weapons systems suitable for engaging other helicopters in aerial combat. In a major regional conflict, armed helicopters might pose a threat that neither the U.S. Air Force nor U.S. Army is prepared to counter.

IN THE 1990s, the coalition air forces enjoyed unquestioned air superiority during Operation Desert Storm over the skies of the Persian Gulf, during the NATO air operation over Bosnia, and during the NATO operation against Kosovo. Despite this overarching air superiority, some Iraqi and Serbian military aircraft continued to fly practically unhindered. Such aircraft included helicopters and prop-driven, fixed-wing aircraft that flew low and slow for short hops.

Although Airborne Early Warning and Control System (AWACS) airborne radar can detect practically any moving object, aircraft radar operators routinely screen out objects moving slower than 85 miles per hour to avoid tracking motor vehicles. Doing this also screens out most slow-flying aircraft. Even when slow-flying aircraft were detected, fast-moving jets were uninterested or were too stressed to be able to engage the slower aircraft before they had landed and moved under shelter. Even in ideal circumstances, fast-moving jets are hard pressed to engage slow-moving aircraft because they fly low, employ elementary electronic countermeasures, or take evasive action.

In future conflicts, U.S. ground forces might face a new air threat for which U.S. Air Force (USAF) and U.S. Army air defenses are not fully prepared. Helicopter gunships or utility helicopters (UHs) armed with antitank guided missiles and chain guns can pop up to engage U.S. ground forces, then disappear. Accompanying ground-based air defense (AD) forces usually require line-of-sight (LOS) to engage aircraft. The best LOS is normally found on open ground or at the top of commanding heights, but it is often difficult to get AD elements to these positions, particularly when the unit is moving. Ground-based AD assets are challenged to provide adequate coverage in difficult terrain.

The ideal air defense against enemy rotary-wing and slow-moving, fixed-wing aircraft is an AD system situated in the same environment as the attacking helicopters. The system would then enjoy rapid target acquisition, identification, and unimpeded fields of fire. An armed helicopter or slow-moving close air support (CAS) aircraft (such as the A-10) is the ideal counter to a low-altitude, low-air-speed threat. Such aircraft can readily engage threat systems with rockets, guided missiles, and automatic cannon, and

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can quickly offset the threat to the ground force since the opposing aircraft must contend with the ground force and the attacking aircraft simultaneously. The A-10's future is uncertain, so in the next decade, the Army might need to train and equip heliborne assets to assume the anti-helicopter mission.

A major problem with the Army's assuming the rotary-wing air-superiority role is that Army aviation and Air Force assets will have to be synchronized. Army aviation must integrate into the USAF's planning process and configure its command and control (C2) systems to receive reports and warnings from USAF systems such as the Joint Surveillance and Target Attack Radar System (JSTARS). Army aviation and the Air Force have a history of not talking to each other — a bad habit that has resulted in such unfortunate incidents as the fatal USAF attack on Army helicopters during Operation Provide Comfort in 1994. During the Kosovo crisis, Army aviation and the Air Force again proved they were not "talking" to each other during the ponderous deployment of Task Force Hawk. The door swings both ways, but the fact remains that Army aviation has derived few lessons about working with the Air Force and vice versa.[1]

Currently, Army helicopters are not specially equipped for aerial combat. The Army had mounted short-range Stingers on some observation helicopters (OH-58s) to protect Apaches while in battle positions, but the OH-58s were phased out of the inventory because they were too slow to keep up with the Apaches and because they lacked the optics for aerial combat.[2] The on-again-off-again Comanche, which is an impressive aircraft that might be able to conduct aerial combat, is supposed to take the OH-58's reconnaissance role. Some provisions and tactics, techniques, and procedures (TTP) to mount short-range Stinger missiles on Army Apaches have been made, but there is no developed Army doctrine, partly because the Army has no current peer competitor and does not expect to meet quantities of opposing helicopter gunships in future conflicts. However, as the Army's mission changes from forward deployment to force projection, the probability of this happening increases. Helicopter gunships and armed utility helicopters are increasingly common worldwide. In undeveloped theaters where there are no nearby hard-surfaced airfields, USAF assets will be hard pressed to provide continual close-air and air-defense support. The rapid deployment forces the Army is developing are limited in AD weapons. There might well be a need for Army helicopter aviation to develop an aerial combat capability against enemy helicopters and CAS aircraft.

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Helicopter v. helicopter combat began in much the same fashion as fixed-wing aerial combat began in World War I—in chance encounters between opposing aircraft. These encounters led to individual aerial duels using individual sidearms, then on-board ordnance, or whatever else was available. In the late 1960s, a U.S. utility helicopter (a UH1-C) shot down a North Vietnamese AN-2 Colt biplane. During the Falkland Islands war, British helicopters dueled with Argentinean fixed-wing aircraft, and Argentinean helicopters fired at British Harrier jets. According to Russian sources, at least 53 helicopter v. helicopter fights were recorded during the Iran-Iraq War (1980-1988). The bulk of the helicopters shot down during these fights were unarmed combat support helicopters downed by helicopter gunships. Also Iranian AH-1 Cobra helicopters successfully attacked fixed-wing jet aircraft.[3]

New helicopter gunship designs include specific aerial combat capabilities, and European and South African aviation firms are developing such aircraft. Russia, despite economic and social problems, is actively involved in developing helicopters optimized for aerial combat.

Enter the Black Shark and the Alligator

The Russians developed the Mi-28 (NATO designation HAVOC) during the 1970s; it made its first appearance in the early 1980s. The Mi-28, which is a conventional two-rotor attack helicopter with a maximum flying speed of 300 kilometers per hour (kmph), can fly rearward and sideways at speeds up to 100 kmph, hover turn at 45 degrees per second, and perform aerial stunts such as loops and snap-rolls.[4] The Mi-29 carries 16 Vikhr [Whirlwind] laser-guided antitank missiles, which can fly 420 meters per second (mps) to a maximum guided range of 8 kilometers (km). The Vikhr has an impact fuze and a proximity fuze; the pilot chooses one or the

McDonnell Douglas

Ambush or abeam attacks should work particularly well against helicopter forces whose antiarmor attack doctrine calls for on-line-abreast attack formations, which individual helicopters have little maneuver room to escape the ambush.

The optimal time to attack is when antiarmor attack gunships have missiles in the air (either on-the-wire or squirting lasers). Most crews lose situational awareness at this point because they are concentrating solely on their target. Diminished situational awareness allows the ambush force to turn the flank, engage, then egress, all the time remaining at maximum missile range. Aerial /ambushes cause a great deal of confusion and further loss of situational awareness as wingmen suddenly explode for no apparent reason.

other before firing. The impact fuze is used against armored vehicles; the proximity fuze is used against airborne targets. The Mi-28 also carries a stabilized 2A42 30-millimeter (mm) cannon attached to the right side of the fuselage that provides a fast point-and-shoot capability. The 30-mm cannon has an initial projectile velocity of 980 mps for its 1,000-grain bullet, and it has a selective fire rate of 300 or 900 rounds per minute.[5] The nose turret allows a vertical cannon displacement of +13 degrees to –40 degrees and a horizontal displacement of ±110 degrees. The cannon has an effective range out to 4,000 meters (m) depending on the ammunition used. The ammunition types include an armor-piercing round and an exploding fragmentary round with a proximity fuze, both of which are carried in the Mi-28's chin-pods.[6]

On 27 July 1982, the Ka-50 Black Shark (NATO designation HOKUM) made its first flight. The Ka-50, a dual-coaxial, main-rotor attack helicopter with a one-man crew, has a maximum flying speed of 350 kmph and a hover ceiling of 4,000 m. Since the Ka-50 has no tail rotor, it is extremely maneuverable and can make abrupt 180-degree changes in course and sharp lateral moves at speeds of over 100 kmph.[7] Like the Mi-28, the Ka-50 carries the Vikhr and the stabilized 2A42 30-mm cannon in a nose turret.

During the early 1980s, the Soviet Ministry of Defense conducted a competition to determine which

US Army

An armed helicopter or slow-moving close air support aircraft (such as a Warthog) is the ideal counter to a low-altitude, low-air-speed threat.

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design bureau would manufacture the new ground forces gunship. Specifications required that the helicopter be capable of ground and air attack. The Kamov design bureau won the competition because its dual-coaxial, main-rotor design was so much more maneuverable than the Mi-28 with the conventional tail rotor. Also, the Kamov is structurally impervious to 23-mm rounds. During the fly-off, a ZSU 23-4 AD gun shot off the Kamov's tail, and the Kamov was still able to complete its mission. In a 1998 Swedish Army fly-off, the Kamov outscored the U.S. Apache and the French/German Tiger gunships.[8]

The Ka-52 Alligator (NATO designation HOKUM B), a modification of the Ka-50, was introduced in November 1996. It seats two and can also serve as a C2 craft, a training craft, or as a platform for additional equipment that requires a dedicated operator. Although some Ka-52 specifications differ from Ka-50 specifications, the Ka-52 carries the same ordnance of 12 Vikhr laser-guided missiles; 480 30-mm rounds; and 80 80-mm free-flight rockets. The Vikhr can also carry 20 122-mm free-flight rockets in place of the 80-mm rockets. These Russian attack helicopters have been shown with weapon loads that include AA-8 APHID and AA-11 ARCHER air-to-air missiles. The APHID has a 10-km range, while the ARCHER has a 40-km range.[9] Because the Russian military is experiencing severe budgetary problems and an ongoing conflict in the Caucasus, it has bought little new equipment. Instead, the cash-strapped Russian defense industry is trying to sell its own equipment. Turkey, India, China, and Poland are seriously considering

US Army photos

Close-up views of Mi-28 Havoc systems at a Paris International Air and Space Show, Le Bourget Airfield. (*Left*) Rockets and missiles include the laser-guided Vikhr with a proximity fuse for use against helicopters. (*Below left*) The Havoc's laser target indicator allows for rapid engagement and disengagement.

(*Above*) The Mi-28's stabilized 2A42 cannon can effectively fire an exploding 30-mm fragmentary round with proximity fuse out to 4,000 meters. The 30-mm cannon and Vikhr missile system are well suited to helicopter v. helicopter operations.

***B**ecause the Russian military is experiencing severe budgetary problems and an ongoing conflict in the Caucasus, it has bought little new equipment [including the Mi-28, the Ka-50 and Ka-52]. Instead, the cash-strapped Russian defense industry is trying to sell its own equipment.*

buying the Ka-50 or KA-52 along with SA-16 and AA-11 air-to-air missiles.[10]

Russian military theorists look to future war and continue to develop the theory and tactics for helicopter aerial combat. Other countries are also studying the issue, but so far, unclassified discussion in their professional journals is not as developed as the Russians'.

Not the Only Threat

While advanced systems such as the Black Shark and the Alligator pose a significant threat on the future battlefield, a more significant threat already exists—the armed utility helicopter. In an age of decreasing defense budgets, the cost of replacing existing inventories of heliborne assets with dedicated attack helicopters is beyond most nations' financial capacities. Equipping utility helicopters with offensive anti-air weapons is a less costly route that many nations are taking to create forces to be reckoned with.

Helicopter-mounted machineguns and chain guns are universally common and are quite effective in air-to-ground and air-to-air missions. China originally mounted the old Soviet SA-7 Grail air-to-air missile on helicopters for tail engagements and is upgrading those with the Chinese QW-1 Vanguard air-to-air missile with a 5-km range. Pakistan is building a similar air-to-air helicopter missile—the ANZA MK2.[11]

In 1986, France mounted the Mistral air-to-air missile on the Gazelle helicopter. Since then, this 5-km-range air-superiority weapon has also been mounted on the Dauphin Panther, the A129 Mangusta, the Ecureuil Fennec, the AH-64, the CSH-2 Rooivalk, and the Eurocopter Tiger. France has exported the Mistral to at least 17 countries. Of these, South Korea is known to be mounting the Mistral on its helicopters. South Africa has built 5- and 8-km-range Darter V3C and U-Darter air-to-air missiles and mounted them on Puma and Rooivalk helicopters. South Africa also has built the longer range (20-km) Kukri V3A/B and mounted it on the Rooivalk.

The old air-to-air SA-7, which is built by Russia, Egypt, China, Bugaria, the Czech Republic, Poland, and Yugoslavia, has been mounted on helicopters belonging to Afghanistan, Angola, Belarus, Bulgaria, China, Cuba, Georgia, India, North Korea, Libya, Mongolia, Poland, Russia, Sudan, Syria, Ukraine, Vietnam, and Yugoslavia. Russia has replaced the

US Army

An Mi-28 Havoc being towed on a flight line.

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SA-7 with SA-16 and SA-18 air-to-air missiles on the Mi-24 Hind E, Mi-28 Havoc, and KA-50 Hokum.[12] That future battles will be fought against utility helicopters armed for air-to-air battle is highly likely.

Helicopter Aerial Combat

Army aviation has limited aerial combat doctrine and limited pilot training for air-to-air combat. Preparing pilots for air-to-air combat takes time to develop the required skills. Furthermore, Army aviation plans to fight future engagements mostly at night. U.S. helicopters are far better equipped than those of most countries for night flying. Will future helicopter v. helicopter combat be primarily a daytime action, or will it be conducted around the clock?[13]

Helicopter AD combat air patrols (CAPs) would stress maintenance capabilities and should be mounted only when the threat is high or the ground force is especially vulnerable to hostile helicopter attack. The ground force is most vulnerable when it is moving through difficult terrain or when it is deployed in the attack. Helicopter aerial combat will seldom be a one-on-one duel. Rather it will most often involve groups of helicopters attacking other helicopters and might include attacks on groups of attack helicopters, air assault formations, electronic warfare (EW) helicopters, radio relay helicopters, or transport helicopters. Helicopter aerial combat might also include attacks on other low-flying, slow-moving, fixed-wing aircraft used for liaison, reconnaissance, CAS, or artillery fire adjustment, or for attacks on unmanned aerial vehicles and, according to the Russians, cruise missiles. Helicopter aerial combat might be used to defeat enemy reconnaissance and penetration attempts or to screen friendly forces.[14]

While the helicopter lacks the jet fighter's ability to climb and turn rapidly, helicopter aerial combat has much in common with jet fighter aerial combat. Like jet fighter crews, helicopter crews attempt to be the first to detect and identify enemy aircraft, gain the altitude and speed advantage, and open fire. Figure 1 is an example of a Russian defending helicopter force fighting an enemy air assault. The air assault force is flying in three groups: a support group of EW, C2, and scout helicopters; an attack group of helicopter gunships; and a transportation group of transportation helicopters. The defending screening force provides early warning to helicopters on strip alert. The helicopter force commander

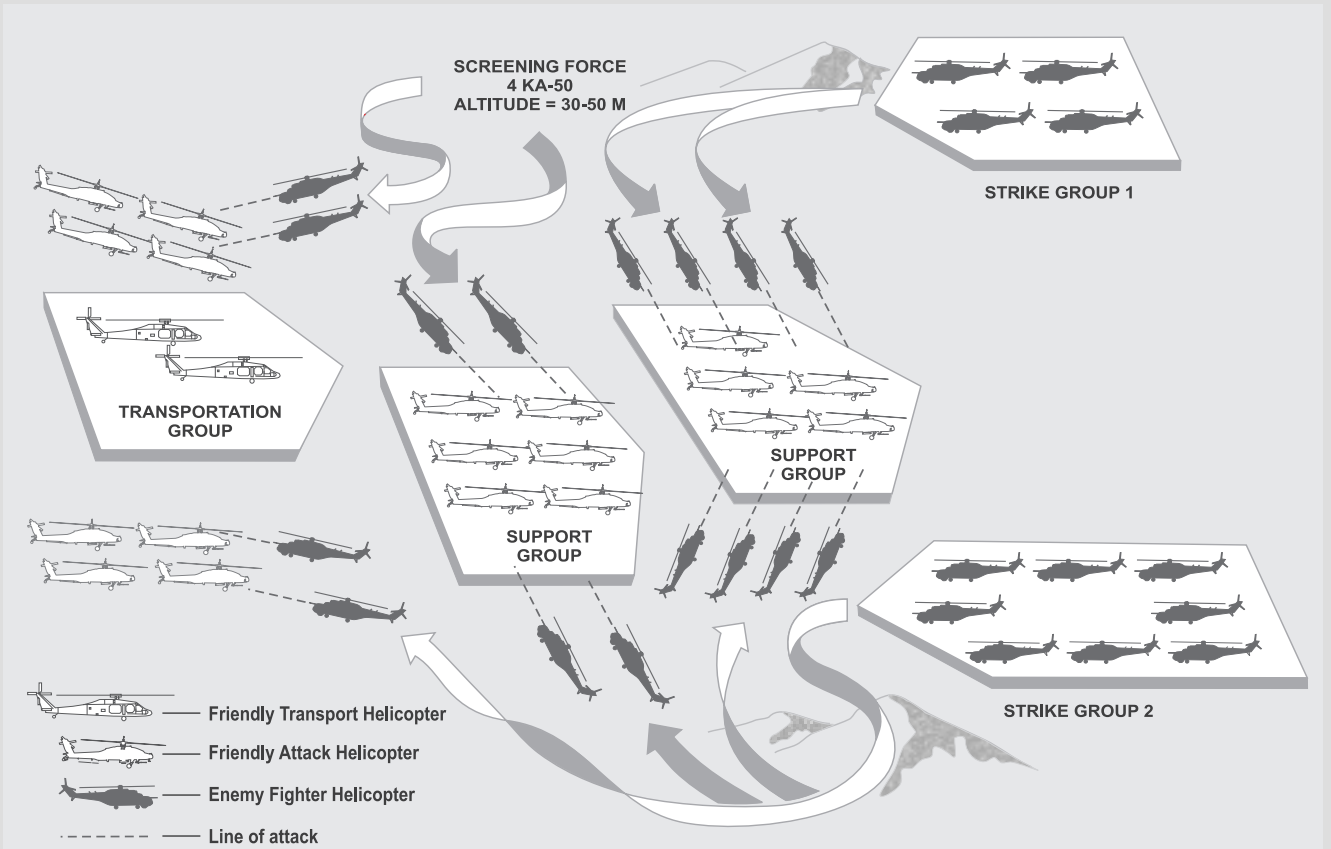

Figure 1. Russian defending helicopter force fighting an enemy air assault.

Command and control of a helicopter aerial attack force is probably a question of national style. The Russian military prefers centralized C2 . . . [while] the U.S. Army would probably control from the air. In the Russian examples, it would not be hard to control the merge of the number of helicopters involved in the engagement with the enemy. It would be difficult, however, to affect the success of tactical engagements directly in an air-to-air battle using a centralized command structure.

uses strip-alert helicopters to reinforce the screening force to the extent he believes is needed during the time it takes to alert the rest of his force. The commander will covertly deploy his main force to the flanks and rear of the attacking force using terrain folds, forests, and masking terrain to get close to the air assault force. He will try to hit the air assault group from the rear with long-range air-to-air missiles. Should he lose surprise or exhaust his supply of missiles, the commander will quickly press forward for the close battle with automatic cannon. The air assault force will try to shake off the attacker and leave the area. High tempo and movement, G-force turns approaching 3.5, and limited time characterize close aerial combat. Therefore, it is always best to gain time and position by hitting the other force while it is hovering to attack a ground target or inserting an air assault force.

During the approach and battle, it is essential that helicopter pilots receive accurate, up-to-date information on enemy actions or the approach of other helicopters.[15] This information can come from visual spotting, acoustical signatures, infrared characteristics, ground-force reconnaissance, or radar.

Radar is particularly important in determining the presence and activity of aircraft. During the Persian Gulf war and the war over Kosovo, the United States used cruise missiles, helicopter strikes, and other systems to take out stationary AD radar early. Aircraft-mounted radar, whether on helicopters or AWACS aircraft, are often more survivable than ground-based radar, but they are key targets. The Russian KA-31 radar helicopter can detect low-flying objects out to 120 km at a height from 5 to 3,500 m off the ground, and its radar can accurately determine a target's speed, identity, and location.[16]

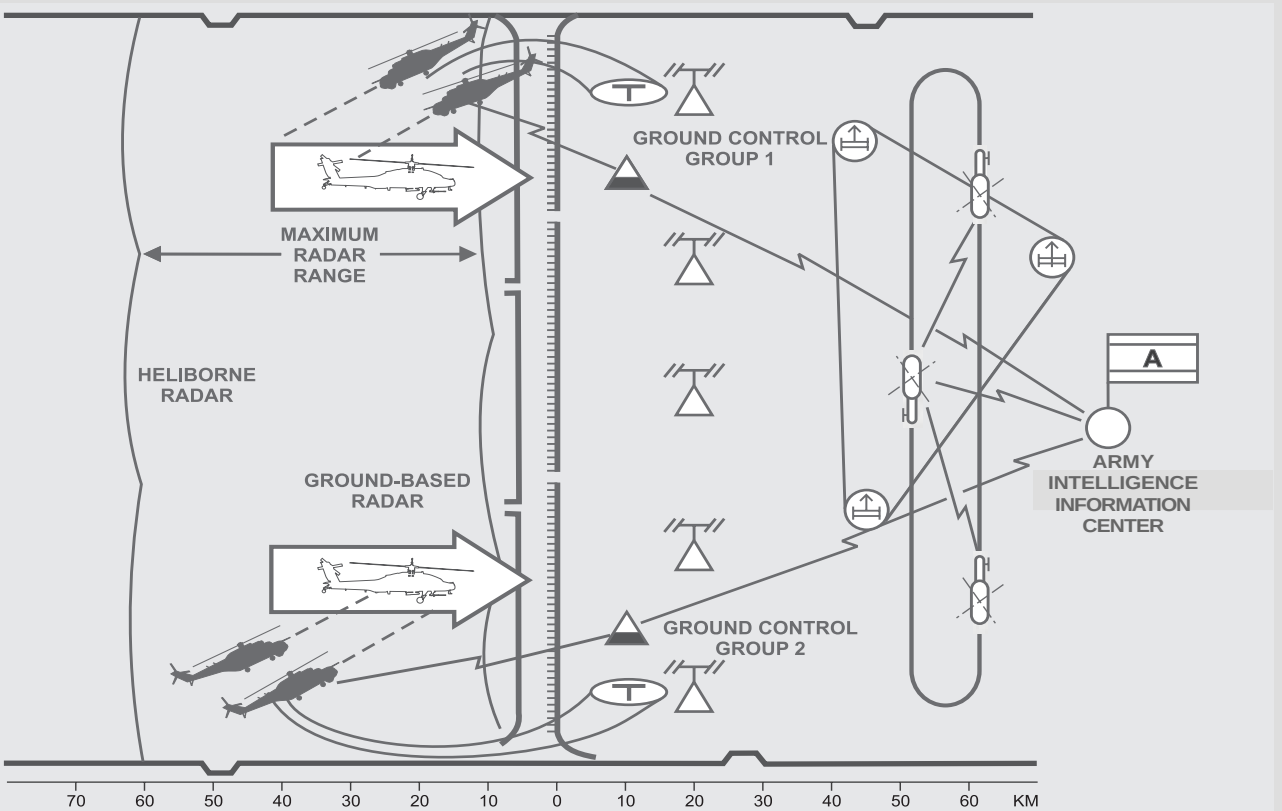

Figure 2. Russian use of heliborne and ground radar to defeat approaching helicopters.

***MAWTS-1** currently conducts two weapons and tactics instructor courses per year, during which USMC aircrews learn the additional skill of aerial combat. The 6-week course stresses aerial combat terminology that saves time and avoids ambiguous orders. The course also spends considerable time teaching aircraft identification, range estimation, and battle drills. Most training scenarios are run in the context of a meeting engagement as part of a two-helicopter team.*

Figure 2 is an example of the Russian use of heliborne and ground radar to defeat approaching helicopters. A combined arms army has established a low-altitude radar field using three orbiting radar helicopters. To remain protected from enemy air activity, they orbit over the major concentration of the army's air defenses. They can detect low-flying objects 50 to 60 km from the front-line trace. This is a much greater detection distance than mobile ground-based radar can achieve. Radar reports are passed to the army's intelligence information center, which retransmits the information to forward combat control groups and helicopter landing fields. Helicopters sortie to meet and defeat the enemy.

Command and control of a helicopter aerial attack force is probably a question of national style. The Russian military prefers centralized C2, which limits the flexibility of airborne assets because of the requirement to receive guidance from ground commanders. The U.S. Army would probably control from the air. In the Russian examples, it would not be hard to control the merge of the number of helicopters involved in the engagement with the enemy. It would be difficult, however, to affect the success of tactical engagements directly in an air-to-air battle using a centralized command structure.

To facilitate successful engagements, tactics for aerial combat must be simple and decentralized. A frontal attack, where a friendly helicopter engages an adversary from the forward quarter, has some advantages over ambush or abeam attacks. The increased closing velocity (Vc) reduces the adversary's firing time for either guns or missiles; masks the heat signature of the attacking aircraft from first-generation heat-seeking missiles; and presents a smaller target to the enemy. Also, most

Although the Army does not currently train for helicopter aerial combat, one sister service does. The U.S. Marine Corps, which has its own organic fixed-wing CAS, is not content with leaving the destruction of opposing helicopters to fixed-wing fliers. It realizes that the best counter to an attack helicopter is another attack helicopter. Using fixed-wing aerial combat tactics as a start point, the USMC has developed doctrine, armaments, and TTP, and procedures for helicopter aerial combat.

helicopter-launched weapons are forward-firing and can be used more readily from this position.

While the frontal attack has some definite advantages, the preferred tactic is the unobserved attack. The optimal time to attack is when antiarmor attack gunships have missiles in the air (either on-the-wire or squirting lasers). Most crews lose situational awareness at this point because they are concentrating solely on their target. Diminished situational awareness allows the ambush force to turn the flank, engage, then egress, all the time remaining at maximum missile range. Aerial ambushes cause a great deal of confusion and further loss of situational awareness as wingmen suddenly explode for no apparent reason. This technique should work particularly well against helicopter forces whose antiarmor attack doctrine calls for on-line-abreast attack formations, in which individual helicopters have little maneuver room to escape the ambush. Many of the world's helicopters look alike at longer ranges (the AH-64 Apache and the Mi-28 Havoc, for example), which could also add to the confusion and leave helicopters' flanks and rears exposed to additional long-range missile shots.

Limited radio coordination can control simple tactics and battle drills. Once an attack begins, coordination becomes a matter of protecting friendly flanks and countering any counterattacks.[17]

Training for Helicopter Combat

Although the Army does not currently train for helicopter aerial combat, one sister service does. The U.S. Marine Corps (USMC), which has its own organic fixed-wing CAS, is not content with leaving the destruction of opposing helicopters to fixed-wing fliers. It realizes that the best counter to an attack helicopter is another attack helicopter. Using fixed-wing aerial combat tactics as a start point, the USMC has developed doctrine, armaments, and TTP for helicopter aerial combat. USMC Cobra helicopters rise to the challenge over the desert floor at the Marine Aviation Weapons and Tactics Squadron-One (MAWTS-1) near Yuma, Arizona. The USMC AH-1W Bell Super Cobra, which is the primary aerial combat helicopter, can carry two AIM-9 missiles or use Hellfire and TOW missiles for aerial combat along with the Cobra's 20-mm cannon and flechette-tipped 2.75-inch rockets.

MAWTS-1 currently conducts two weapons and tactics instructor courses per year, during which USMC aircrews learn the additional skill of aerial combat. The 6-week course stresses aerial combat terminology that saves time and avoids ambiguous orders. The course also spends considerable time teaching aircraft identification, range estimation, and battle drills. Most training scenarios are run in the context of a meeting engagement as part of a two-helicopter team. The course teaches helicopter v. helicopter and helicopter v. fixed-wing battle and survival.

An intimate knowledge of aerodynamics is essential for the survivor in an aerial duel. The thinking, well-armed opponent can counter every move. The aircrew must understand intimately its own aircraft and armament capabilities as well as those of the enemy. Head-on attacks are dangerous, but maybe less so if the opponent's helicopter has less power, weapons range, tactical training, or maneuverability. During aerial combat training, the aircrew plans initially against a specific threat, then it does a hanger-floor walkthrough of the plan using 1:72-scale, stick-mounted aircraft models. The walkthrough tests the plan against the three-dimensional geometry of the engagement. The aircrew rehearses the tactical radio calls necessary to coordinate the fight. The walkthrough also helps identify and solve problems in the plan. The aircrew then flies the rehearsed plan against an MAWTS-1 aggressor force. After the exercise, the stick walkthrough is repeated to identify what worked and what did not.

Aircrew search techniques are an important part of the course. Since the Super Cobra lacks on-board radar, the aircrew must actually see the threat. The aircrew has to learn how to do a 360-degree search, looking for exhaust smoke, canopy glint, shadows, contrasting shapes, and so on. Avoiding detection is another imperative. Route selection, varying airspeeds, limiting electronic signals, shadow reduction, avoiding wing flash, and applying camouflage help hide the helicopter.

Once the helicopter meets the air threat, the pilot must decide to engage or avoid it. USMC training

presents the aircrew a variety of scenarios (rear hemisphere attack, forward hemisphere attack, abeam attack) and allows it to practice various standard battle drills. Each sortie also has a portion devoted to a mission-oriented attack, which tests the aircrew's ability to conduct aerial combat in conjunction with its assigned mission.

The USMC does not see the helicopter as a dedicated anti-air platform; rather, the aerial combat capability is an implied or embedded mission that might arise while performing or conducting a primary mission and should be part of an experienced pilot's capabilities. Therefore, the USMC provides doctrine, training, and weapons systems that allow Super Cobras to meet and match hostile aviation.

So What?

The world is not static, and the United States might not always hold the preeminent position in military affairs. The Army certainly will not always fight in prepared theaters, so it must anticipate changes. At the end of World War I, fixed-wing aerial combat was in its infancy, but it developed rapidly. Now, rotary-wing combat is in its infancy, but the impetus for it to develop is close at hand. Force projection over vast distances will mean traditional relationships between the Army and Air Force might change. The Army might have to do more to keep enemy aviation off its own neck. One way to do this is to prepare to defeat enemy helicopters with our own.

The Army will not take over the air superiority battle from the Air Force, but it can supplement the effort through conventional ground-based and helicopter air defense. Army helicopters could protect themselves and the ground force. Experienced helicopter pilots would fly AD missions as a supplemental mission to their normal missions. Helicopter air defense CAPS might be necessary during an advance or during close combat, but doing so would not be a full-time effort that would require dedicated AD helicopters.

The cost of replacing existing inventories of heliborne assets with dedicated attack helicopters is beyond most nations' financial capacities. Equipping utility helicopters with offensive anti-air weapons is a less costly route that many nations are taking to create forces to be reckoned with. . . . Future battles will be fought against utility helicopters armed for air-to-air battle is highly likely.

Developing the Army's capability for aerial combat will take time and effort. Doctrine should lead the effort followed by adapting and acquiring necessary hardware. Future helicopter design should consider the demands of aerial combat, cockpit ergonomics and armor, special maintenance needs, and perhaps, G suits. A good place to start would be Yuma, where the Marine Corps has been working on the capability for years. ***MR***

NOTES

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13. Calhoun.
14. Krasnov and Mel'nichuk, 36-37.
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16. Ibid., 38-39.
17. These three paragraphs are courtesy of Barnes and Adams.

Lieutenant Colonel Lester W. Grau, U.S. Army, Retired, is a military analyst in the Foreign Military Studies Office, Fort Leavenworth. He received a B.A. from the University of Texas at El Paso and an M.A. from Kent State University. He is a graduate of the U.S. Army Command and General Staff College, the U.S. Army Russian Institute, the Defense Language Institute, and the U.S. Air Force War College. He has held a variety of command and staff positions in the continental United States, Europe, and Vietnam.

Major James H. Adams, U.S. Marine Corps, is an AH-1W pilot at the Marine Corps Air Station, New River, North Carolina. He received a B.S. from the U.S. Naval Academy. He has held various operational assignments, including three overseas deployments, and he was recently an instructor pilot at the Marine Aviation Weapons and Tactics Squadron-One (MAWTS-1) where he was responsible for rotary-wing air-to-air tactics.