Artificial intelligence and the modern military

Technology, Artificial Intelligence

Artificial Intelligenceand the Modern Military Wayne K Sullivan Saint Leo University MGT 327, CA01, Management Information Systems Professor Lawrence Mister November 26, 2011 Purpose: In today's military, leaders are continuously seeking ways to incorporate newtechnologyto take the place of human soldiers. It has long been an important goal to be able to remove the human element from the modern battlefield, thus enabling high risk or sensitive political operations to be conducted without the fear of capture or exploitation of US military personnel.

One such incident occurred during theCold War, on May 1, 1960, during the presidency of Dwight D. Eisenhower and during theleadershipof Soviet Premier Nikita Khrushchev, when a United States U-2 spy plane was shot down over the airspace of the Soviet Union. The United States government at first denied the plane's purpose and mission, but then was forced to admit its role as a covert surveillance aircraft when the Soviet government produced its intact remains and surviving pilot, Francis Gary Powers, as well as photos of military bases in Russia taken by Gary Powers.

Artificial Intelligence (AI) has been fully integrated within all levels within the Department of Defense (DOD), from software programs designed to efficiently data mine the vast amounts of intelligence collected to complex quantum computing design to monitor and direct operational units in real time on the modern battlefield. This paper will focus only on a few Real world Combat systems currently utilized within the Department of Defense (DOD). Within the Department of Defense (DOD), the word autonomous is equivalent to and often substituted for the term Artificial Intelligence (AI).

Autonomous is defined by Webster’s dictionary as; “ Having independent existence or laws” (Webster, 2011) , where as Artificial Intelligence (AI) is defined in the Encyclopedia Britannica as “ the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. ” (Britannica, 2011), both definitions define the overall goal of the DOD, Independent combat systems that increase soldier survivability and become a force multiplier in the combat theater of operations. And is being explored for all branches of the service for uses on land, sea, and air. Background:

In today's modern combat arenas, such as Iraq and Afghanistan, the desire for autonomous vehicles and intelligent combat systems is higher than ever. Currently within our armed forces there are numerous combat systems that are experimenting with artificial intelligence, designed to reduce or eliminate the need for combat soldiers on missions or tasks that are considered to dangerous for human operators. These missions or task include Biological or Chemical detection, Explosive Ordinance Detection and Demolition (EOD), High value target identification and covert tracking, and Treat Detection and Neutralization.

Artificial Intelligence (AI) is finally reaching the point where it is now feasible, and is starting to demonstrate its capabilities in the combatenvironment. AI techniques are becoming so ubiquitous that the computers that now bear the label " Intel inside" could well be labeled " AI inside," says Alan Meyrowitz, director of the Navy Center for Applied Research in Artificial Intelligence at the Naval Research Laboratory (NRL) in Washington (Rhea, 2000).

Now, with a combination of military-funded development programs and the availability of commercial off-the-shelf (COTS) technology, the military services are beginning real world implementation. AI methods in such new generations of weapons platforms as unmanned aerial vehicles (UAVs), autonomous submersibles to perform unmanned counterterrorismand surveillance operations in shallow water areas, and Fully Autonomous Land Vehicles designed for soldier support as well as search and destroy (Rhea, 2000).

United States Army, which is the largest arm of the military by far, in a recent report, has laid out its plans to introduce an upgrade artificial intelligence within its ranks, via a plan integration plan/roadmap from present-day through 2035. Currently the key areas the Army is looking to artificial intelligence are chemical biological detection, counter explosive hazards, security, interdiction attack, and long-range strike capabilities (US Army, 2010).

Deployed soldiers have dozens of pounds of batteries, ammo, communications equipment and other Items such asfoodand water they have to carry on their backs, on top of heavy body armor, encumbering solders with up to 100lbs of additional weight. While this large amount of technology, is useful in combat, it can greatly fatigue solders prior to engagements and can render soldiers severely limited or even ineffective during sustained engagements with the enemy (Knapik, 1989). It is this reason that the U. S. Army is experimenting with a variety of remotely controlled and even wearable machines to lighten this load.

Some are deeply quirky, designed to resemble a headless dog. The spooky Big Dog quadruped robot, which is being developed by robotics company Boston Dynamics, has some of the most advanced artificial intelligence and navigation systems in the planet. In fact, US Army officials are stunned by its programmed behaviors, which make Big Dog extremely helpful in the battlefield. Big Dog can run along soldiers, walk slowly, or lay down to be loaded or unloaded with up to 400 lbs of gear, equivalent to one full squads (6 men) backpacks, all while being aware of the terrain around it.

No matter what happens, or how hard it's hit, the robot maintains its course without falling on the ground under any circumstances. The only way to get him off its path is by a major direct hit, which could mean a rocket. U. S. Army Officials are optimistic for this beast. They see it as the most effective way to carry all kinds of material, reducing the weight that soldiers have to tug along, freeing them to move faster and be safer (Diaz, 2009). Another area the U. S.

Army is excited about is the compact surveillance platforms that are now available, such as the Skylark I, advanced mini -UAV system, a unique man-pack configuration designed for day and nightobservationand data collection up to distances of 10-15 km. The mini -UAV system is equipped with an exceptionally quiet electric motor, totally autonomous flight, and outstanding observation capabilities allowing for easy operation and orientation (Keren, 2004). Soldiers can launch the state-of-the-art AI flight system, after a brief training period, usually only one week of computer software training, no pilot skills are required.

It features a gyroscopic-stabilized gimbaled payload and a high degree of autonomous flight from take-off to precise recovery, yielding real-time intelligence, the operator simply points the camera to where he wishes to look and the Skylark flies there. The Skylark I system has proven itself in cloudy, rainy and windy weather conditions, the Skylark I has demonstrated excellent optical survey, target identification and surveillance capabilities. This configuration, equipped with algorithms derived from larger Hermes UAVs, can track fixed and moving targets, an impressive capability for a hand launched UAV.

Skylark I can be used for both defense and homeland security applications including perimeter security, border and coastal surveillance, anti-terrorism surveillance and a variety of law enforcement missions. Skylark I has already accumulated more than 3000 successful operational sorties and is currently operationally active in several theatres of the global war on terror. Skylark I set a new world record in high altitude flights, climbing to an altitude exceeding 16, 000 feet and has demonstrated outstanding performance in weather conditions ranging from arctic to equatorial weather.

Skylark I is equipped with Elbit Systems' new-generation night payload. Weighing only 700 grams, the thermal payload is the lightest in its class. The payload’s capabilities include very wide area coverage, continuous tracking of moving targets and a higher resolution rate than any of its predecessors (Keren, 2004). Lastly we will examine two of the U. S. Army’s Unmaned Vehicle programs , first the Squad Mission Support System it looks as conventional as any six wheeled hauler you’d see on an admittedly large loading dock, the size of a car with a flat back, readying it to strap up to 600 lbs. worth of equipment onboard.

It uses ladar, or laser radar, to identify the unit it needs to follow and drives off autonomously behind (Ackerman, 2011). Secondly is the Crusher, All branches of the United States military services are actively seeking new technology and programs that will limit or eliminate the need to place service personnel in harm's way. And operating and weapon systems become more advanced, it appears inevitable that someday in the not so distant future, autonomous machines will be performing a large majority of mundane and repetitive task as well as tearing out specialized operations on the battlefield of the future.

It is through organizations such as Defense Advanced Research Projects Agency (DARPA), whose mission is to maintain the technological superiority of the U. S. military and prevent technological surprise from harming our national security by sponsoring revolutionary, high-payoff research bridging the gap between fundamental discoveries and their military use (DARPA, 2011). Unlike conventional bits or transistors, which can be in one of only two states at any one time (1 or 0), a qubit can be in several states at the same time and can therefore be used to hold and process a much larger amount of information at a greater rate.

A major obstacle for realizing a quantum computer is the complexity of the quantum circuits required. As with conventional computers, quantum algorithms are constructed from a small number of elementary logic operations. Controlled operations are at the heart of the majority of important quantum algorithms. The traditional method to realize controlled operations is to decompose them into the elementary logic gate set. However, this decomposition is very complex and prohibits the realization of even small-scale quantum circuits. The researchers now show a completely new way to approach this problem. By using an extra degree of freedom of quantum particles, we can realize the control operation in a novel way. We have constructed several controlled operations using this method," said Dr Xiao-Qi Zhou, research fellow working on this project, " This will significantly reduce the complexity of the circuits for quantum computing. " The RQ-4 Global Hawk is a high-altitude, long-endurance unmanned aircraft system with an integrated sensor suite that provides intelligence, surveillance and reconnaissance, or ISR, capability worldwide.

Global Hawk's mission is to provide a broad spectrum of ISR collection capability to support joint combatant forces in worldwide peacetime, contingency and wartime operations. The Global Hawk complements manned and space reconnaissance systems by providing near-real-time coverage using imagery intelligence or IMINT, sensors. Once mission parameters are programmed into a Global Hawk, the UAS can autonomously taxi, take off, fly, remain on station capturing imagery, return and land. Ground-based operators monitor the UAS's status, and can change navigation and sensor plans during flight as necessary. (U.

S. Air Forcephoto/Master Sgt. Jason Tudor Think the U. S. military has a lot of drones now? Just you wait. The Pentagon has just released its 30-year plan for buying and developing warplanes. And in a development that should come as no surprise, the future the military anticipates for its Air Force, Army, Navy and Marine Corps air fleets — together numbering more than 5, 500 warplanes — is more robotic than ever. The congressionally mandated Aircraft Procurement Plan 2012-2041 is, of course, filled with conjecture. Any number of factors — fiscal, strategic, industrial or technological — could change nexpectedly, sending ripples through the Pentagon's carefully-laid plans, currently projected to cost around $25 billion per year. But based on current tech trends (everything always gets more expensive), anticipated (that is to say, flat) budgets and projected threats (China and terrorists, as usual), the military believes it can make do for the next three decades with air fleets roughly the same size as today's — with just one big exception. The robot air force will double in just the next nine years. The Avenger, or Predator C, is a major upgrade from the earlier versions.

With a 41-foot long fuselage and 66-foot wingp, the Avenger is capable of staying in the air for up to 20 hours, and operating at up to 60, 000 feet. Powered by a 4, 800-lb. thrust Pratt & Whitney PW545B jet engine, it can fly at over 400 knots — 50 percent faster than the turboprop-powered Reaper unmanned plane, and more than three times as quick as the Predator. The Avenger should also be much harder to spot – with wings, tails, weapons bays, and sides are all designed to reduce its radar signature. (General Atomics won't say if it used any of its specialized radar-absorbent materials in the drone, but it's a fair bet. The new plane might not just take off from land. Designed with folding wings and a tailhook, the latest killer drone could wind up launching from an aircraft carrier, before it attacks it foes. SAN DIEGO, April 12, 2011 (GLOBE NEWSWIRE) -- The Northrop Grumman Corporation (NYSE: NOC)-built MQ-8B Fire Scout vertical takeoff and landing tactical unmanned aerial vehicle marked a new single-day flight record of 18 hours. U. S. Navy operators achieved the record using a single aircraft in a series of endurance flights Feb. 25 from the USS Halyburton (FFG 40).

Fire Scout is providing intelligence, surveillance and reconnaissance data to support anti-piracy missions while deployed on the ship for the Navy's 5th Fleet. " We've continually worked with the Navy to enhance Fire Scout since its last deployment to meet these types of operational needs," said George Vardoulakis, vice president for tactical unmanned systems for Northrop Grumman's Aerospace Systems sector. " These flights not only demonstrated Fire Scout's maturity, it showed how the system provides a much-needed extension for gathering crucial information during peacekeeping or wartime missions. In April 2010, Fire Scout concluded a military utility assessment on board the USS McInerney (FFG 8), a frigate similar to the USS Halyburton. Fire Scout has flown twice as much in the first two months on board the USS Halyburton than the entire USS McInerney deployment. The system also completed initial flight tests on board the USS Freedom (LCS 1) in November. Fire Scout features a modular architecture that accommodates a variety of electro-optical/infrared and communications payloads. These payloads provide ground and ship-based commanders with high levels of situational awareness and precision targeting support.

Fire Scout's ability to operate at low ground speeds makes it particularly well suited for supporting littoral missions such as drug interdiction, search and rescue, reconnaissance and port security. Intelligent unmanned autonomous systems includes the multi-role Talismanfamilyof unmanned underwater vehicles (UUVs), which provide a flexible surveillance and protection capability for key facilities and assets, including harbours, inshore mine countermeasures and a range of oceanographic missions.

The latest generation Talisman L uses the mission system, proven on the larger Talisman M, and re-packages it into a two man portable system for port and harbor protection and inshore mine counter measures (MCM). It can be deployed from the shore, rigid hull inflatable boats (RHIB) or any platform of opportunity with either low freeboard or a small crane or davit. The system utilises the same control interface as other vehicles in the Talisman family. Talisman L can be operated using a ruggedized laptop or similar portable device.

Its open architecture command system also allows its integration with command & information systems aboard naval vessels or land-based vehicles. Data storage on the vehicle is arranged to facilitate rapid mission turnaround and analysis to maintain the tempo of operations. To fly the military's baddest, most technologically advanced planes, you once had to have what Tom Wolfe called " that righteous stuff" -- the willingness to strap yourself to a jet-fuel laden machine and push it to the very limits of its mechanical capabilities.

Nowadays, unmanned systems have taken the human danger out of some combat missions, though human pilots remain at the sticks. But not for long. The Navy's experimental X-47B combat system won't be remotely piloted, but almost completely autonomous. Human involvement won't be of the stick-and-rudder variety, but handled with simple mouse clicks. Speaking to reporters at the Sea Air Space convention near Washington, reps from both Northrop Grumman (maker of the X-47B) and the Navy said the X-47B would be piloted not by human handlers in some steel box in Nevada, but by 3. million lines of software code. The rest of its functions will be able to be handled by non-pilot personnel (or your average child), as they will only require clicks of the mouse; a click to turn on the engines, a click to taxi, a click to initiate takeoff, etc. For flyboys proudly boasting their nighttime carrier landing cred, the idea is anathema. But given the difficulty and danger of carrier takeoffs and landings, automating them is one way to ensure safety--provided the systems work the way they are supposed to.

The X-47B has already taken to the skies from Edwards AFB earlier this year, but this is a Navy plane. As such, it will begin " learning" the ins and outs of carrier operations via simulated takeoffs and landings starting in 2013. If all goes well, the X-47B could be autonomously showing Navy pilots how to put a multimillion aircraft down on a sea-tossed carrier deck by 2014. Those carrier landings, of course, take a certain kind of touch. Specifically, that of an index finger on a standard issue mouse (Dillow, 2011). On August 11, 2011, DARPA attempted to fly the fastest aircraft ever built.

The Agency’s Falcon Hypersonic Technology Vehicle 2 (HTV-2) is designed to fly anywhere in the world in less than 60 minutes. This capability requires an aircraft that can fly at 13, 000 mph, while experiencing temperatures in excess of 3500F. The second test flight began with launch at 0745 Pacific Time. The Minotaur IV vehicle successfully inserted the aircraft into the desired trajectory. Separation of the vehicle was confirmed by rocket cam and the aircraft transitioned to Mach 20 aerodynamic flight. At HTV-2 speeds, flight time between New York City and Los Angeles would be less than 12 minutes.

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