US, Russia and China in race to develop autonomous and intelligent guided missiles to strike targets in anti-access, area-denial environment

The new buzzword in militaries across the world today is 'artificial intelligence' (AI) – the ability for combat platforms to self-control, self-regulate and self-actuate, using inherent computing and decision-making capabilities. AI is has also enabling autonomous military missiles that can identify and strike hostile targets without human decision. The U.S., Russia and China, the world's leading military powers are all applying artificial intelligence to missiles, drones and other deadly devices.

Lockheed Martin has successfully carried out a controlled flight test of the US Navy's long-range anti-ship missile (LRASM) surface-launch variant. With a range of at least 200 nautical miles, LRASM is designed to use next-generation guidance technology to help track and eliminate targets such as enemy ships, shallow submarines, drones, aircraft and land-based targets. According to the Pentagon, this means that though targets are chosen by human soldiers, the missile uses artificial intelligence technology to avoid defenses and make final targeting decisions.

In August this year, a Chinese daily reported that China's aerospace industry was developing tactical missiles with inbuilt intelligence that would help seek out targets in combat. The new Chinese weapon typifies a strategy known as

“remote warfare,” said John Arquilla, a military strategist at the Naval Post Graduate School in Monterey, Calif. The idea is to build large fleets of small ships that deploy missiles, to attack an enemy with larger ships, like aircraft carriers. “They are making their machines more creative,” he said. “A little bit of automation gives the machines a tremendous boost.”

China has overtaken the United States to become the world leader in deep learning research, a branch of artificial intelligence (AI) inspired by the human brain, according to White House reports that aim to help prepare the US for the growing role of artificial intelligence in society.

Now Russia has claimed to be developing new missiles and drones that will use artificial intelligence to think for itself, according to weapons manufacturers and defense officials, in a bid to match military might against the United States and China.

LRASM highly autonomous missile

The LRASM is a long-range precision-guided, anti-ship standoff missile designed to meet the needs of U.S. Navy and Air Force warfighters in anti-access/area-denial threat environments. The LRASM boasts a range of well over 200 nautical miles, a payload of 1,000 pounds, and the ability to strike at nearly the speed of sound.

What really makes LRASM stand out is that all of this is completely autonomous. Human beings tell the missile where the enemy fleet is, which ship to strike, and provide it with a continuous stream of data—the missile takes care of everything else. Using artificial intelligence, the missile takes data and makes decisions all on its own. Using AI and datalinks, multiple LRASMs can launch a coordinated attack on an enemy fleet, writes Kyle.

LRASM is first guided by the ship that launched it, then by satellite. The missile is jam-resistant and can carry on even if it loses contact with the Global Positioning System. As part of the targeting system, the missile can be set to fly to a series of waypoints, flying around static threats, land features, and commercial shipping. LRASM can detect threats between waypoints and navigate around them. If it decides it would be entering the engagement range of an enemy ship not on the target list, LRASM will fly around the ship, even skipping waypoints that might lie within enemy range and going on to the next one.

After locating the enemy fleet, it dives to sea-skimming altitude to avoid close-in defenses. LRASM then sizes up the enemy fleet, locates its target, and calculates the desired "mean point of impact"—the exact spot the missile should aim for, taking into account the accuracy of the missile—to ensure the missile does not miss. In most instances that is the exact center of the ship, with the angle of the ship in relation to the missile taken into consideration, reported Kyle Mizokami in PM.

China's next-gen cruise missiles shall have high-level of artificial intelligence

China is looking to create a new generation of cruise missiles, which will have a high level of artificial intelligence, will be multifunctional and reconfigurable based on modular design according to a senior designer from China's Aerospace and Industry Corp. The Chinese military is looking to adapt its technology with the belief that future combat missions will require weapons to be both cost-efficient and flexible.

“We plan to adopt a ‘plug and play’ approach in the development of new cruise missiles, which will enable our military commanders to tailor-make missiles in accordance with combat conditions and their specific requirements,” Wang Changqing of the China Aerospace and Industry Corp told China Daily newspaper. Meanwhile Wang Ya’nan, the editor in chief of the Aerospace Knowledge magazine, said that missiles will be multi-functional. He mentioned that their payload can be changed, while they will also be suitable for striking targets both on land and at sea.

“Moreover, our future cruise missiles will have a very high level of artificial intelligence and automation,” he told China Daily. “They will allow commanders to control them in a real-time manner, or to use a fire-and-forget mode, or even to add more tasks to in-flight missiles.”

Russia’s Military developing highly autonomous missile for its stealth fighter

Tactical Missiles Corporation CEO Boris Obnosov said Thursday that the new weapon, which he did not name, would be released within the next few years and would take inspiration from Russia’s greatest military rival, the U.S. Speaking at the annual Zhukovsky-based MosAeroShow (MAKS-2017), Obnosov told attendees that he studied the U.S.’s use of the Raytheon Block IV Tomahawk cruise missile against Russia’s allies in Syria and sought to emulate its advanced technology, such as the ability to switch targets mid-flight, in an upcoming weapon

Earlier this year, General Viktor Bondarev, commander-in-chief of Russia’s air force, discussed equipping such smart missiles to the proposed next-generation Russian stealth fighter, the Tupolev PAK DA. What the PAK DA lacks in supersonic speed, it

would reportedly make up for in stealth, electronic innovations and the artificial intelligence-capable missile, which Bondarev said was already in the works as of February.

“It is impossible to build a missile-carrying bomber invisible to radars and supersonic at the same time. This is why focus is placed on stealth capabilities. The PAK DA will carry AI-guided missiles with a range of up to 7,000 kilometers (about 4,350 miles) Such a missile can analyze the aerial and radio-radar situation and determine its direction, altitude and speed. We’re already working on such missiles,” Bondarev told Russia’s official Rossiyskaya Gazeta newspaper in comments translated and analyzed by The Aviationist.

Intelligent Guided Missile

With escalating cost of a missile and the potential damage that an intruding aircraft can cause, there is a need to improve the single shot kill probability of a missile to hundred percent. Present Guided missiles using conventional algorithms like proportional navigation algorithm and its variants are optimal when the speed of missile is very high and the maneuvering capability of the target is low.

However the efficiency of missile may be degraded in battlefield due to many reasons like in case of highly maneuverable fifth generation aircrafts with speeds between Mach-2 and Mach-3. The radars data link is also vulnerable to jamming by the adversary therefore autonomous missile is highly effective in such scenarios.

Recent advances in distributed Artificial Intelligence such as deploying intelligent agents (lA) hold promise of improving the performance and decreasing the misdistance (distance between the target and the closest point of approach of the missile to a small value). Intelligent agents are software

entities that come under the category of distributed Artificial Intelligence, and are associated with problem solving functions. They are characterized by some general attributes like autonomy, social ability etc.

M.S Vinoth and others from Department of Computer Sciences Vellore Institute of Technology Tamilnadu , India have proposed incorporating an IA system on-board a missile that will enhance the kill probability or even achieve the most coveted fire and forget capability.

The on-board radar based sensors on the missile will detect any hostile ground or air activity the missile will directly break from the wireless ground based link and then the control is shifted to the intelligent agent and the series of counter moves will be affected to shoot down the enemy intruder. By this modification the already airborne missile will have much lesser reaction time compared to the traditional radar based and ground stationed SAM(surface to air missile entities) , there by effectively saving the time and increasing the kill probability of the missile. The missile needs to have a much higher speed advantage or to use a combination of artificial intelligence and modern control algorithms, authors say.

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