Emerging Technologies

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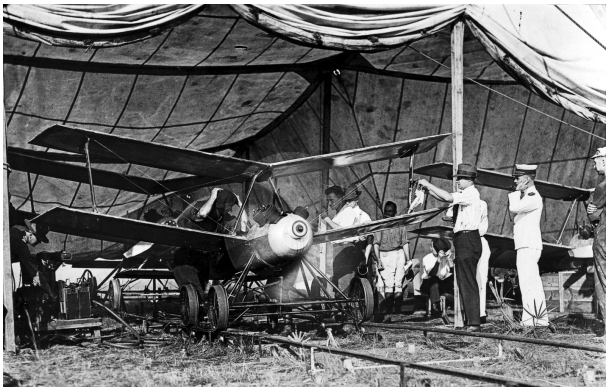
Cite as: Niklas Schoernig and Frank Sauer, "Emerging Technologies" in EUNPDC eLearning, ed. Niklas Schoernig, Peace Research Institute Frankfurt. Available at https://eunpdc-elearning.netlify.app/lu-15/, last modified 11 November 2024

0. Visible Threats: Military Robots and Hypersonic Vehicles

A Brief History of Unmanned Weapon Systems

Unmanned aerial vehicles – UAVs or "drones" – and their military use in "drone warfare" are among the most widely – and controversially – discussed developments in the realm of conventional armaments today.

While the technology for these remotely piloted military vehicles actually dates back as early as World War I, back then these systems, such as the British Kettering Bug shown here, were way too imprecise and unreliable. In fact, they ended up as targets for shooting practice.



Kettering Bug, c.a. 1918

National Museum of the U.S. Air Force (Public domain)

It was not before the Vietnam era that the ancestors of modern drones and cruise missiles eventually became useful aerial reconnaissance and surveillance assets. Toward the end of the 20th century, two key technologies – GPS and satellite communication uplinks – rendered military drones much more capable as they now could be piloted with precision from a great distance. The well-known MQ-1 Predator, for instance, was already used for reconnaissance in the Balkan wars of the 1990s. It is worth noting that commercial technology fueled this development – and so, today, we see not only military drones but countless civilian drones in all shapes and sizes, too.

But technological development alone was not what gave rise to "drone warfare". The political landscape was key. In fact, it was only after 9/11, that the Predator was armed. The goal was to be able to target specific individuals with missile strikes. A cornerstone of the so called "war on terror".

Today, remotely piloted vehicles are used in the air, on and below the sea, on land, as well as in space. Technically speaking, all these unmanned systems could be called drones. But usually the term is reserved for flying unmanned weapon platforms. The second one of the two major trends visible – next to equipping drones with weapons – is to endow them with autonomy – a development especially salient in aerial and deep-sea vehicles.

The goal is to untether them from their remote control links. Since these communication links can be severed, jammed or even hijacked, moving as much functionality as possible into the system itself makes sense. Also, the latency between the system and its pilot – which can mean up to several seconds of delay – stops being an issue with autonomous systems. Lastly, with personnel being a major cost factor, getting rid of human remote operators promises an immense saving potential.

With humans this way moving out of the loop of control and decision-making, military technology can be described as currently being on a trajectory from the era of drones into the era of robots. And while it is true that the rise of military robots is closely connected to the development of drones, it is equally important to note the differences. Drones, according to the nomenclature we just developed, are remotely piloted. Robots, on the other hand, are autonomous, able to operate without human control or even supervision.

This is where we add stuff that changed since the video above was produced.

- Apples
- Oranges
- Bananas

The current state of drone proliferation

The latency problem

When a remotely piloted unmanned military system is controlled via satellite, the problem of signal latency – that is, the time the signal needs to travel into space and back and get processed – becomes an issue.

Check out this short animation to understand the military implications of signal latency.

From Drones to Robots: Increasing Autonomy in Weapon Systems Today

The Guardium

The Guardium is an unmanned ground vehicle (UGV) developed by G-NIUS, a joint venture by Israel Aerospace Industries and Elbit Systems. It entered operational service in the Israel Defense Forces in 2008. The vehicle is remotely controlled but can be used in

'autonomous mode'. This primarily means the ability to drive along pre-programmed routes without direct human control. Guardium – currently – remains unarmed.

X-74B
The U.S. Navy's X-47B was a technology demonstrator run within the Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) system development program. The stealthy, sub-sonic, carrier-based drone demonstrated autonomous take-off and landing as well as mid-air refueling. This testbed was unarmed. Future systems might have strike capabilities.

CARACaS
CARACaS – which is short for Control Architecture for Robotic Agent Command Sensing – is a module that provides command, control and sensing capabilities to turn a regular (armed) boat into a remotely piloted sea vehicle. When deployed as a swarm, armed CARACaS-controlled boats can autonomously coordinate their behavior to patrol an area or even defend a convoy against attackers.

The Future: Lethal Autonomous Weapon Systems (LAWS)?

1. Invisible threats

Nano technology and artificial intelligence

Nanotechnology: Facts and Figures

A nanometer (nm) is defined as the millionth of a millimeter – which is approximately the size of a glucose molecule. Nanotechnology (or nanotech) deals with creating or manipulating such very small objects on the atomic or molecular scale. When experts use the term nanotech, they usually refer to systems between 0,1nm and 100nm.

Nanostructures offer the possibility of creating new materials with enhanced, novel or unique characteristics and capabilities, including even electromechanical objects on a nanoscale.

The ultimate goal is to design nanomaterial by placing individual atoms or molecules at a predesignated space in a structure.

Significant government interest in nanotech started at the advent of the new millennium. From the very beginning, the USA has been at the forefront of the nanotech revolution. In 2000, President Clinton created the National Nanotechnology Initiative (NNI), a federal research and development program. Between 2001 and 2016 the NNI received more than $22 billion from participating agencies, including – amongst others – the Department of Defense, Department of Energy or NASA. Between 2001 and 2012, the DOD's annual contribution was between 23% and 32%.

Other countries with a strong interest in nanotech includes member states of the European Union (especially Germany and the UK), Japan, China, Russia and Korea.

While many nanotech applications are civilian, there are many military usages as well.

1. Invisible threats

Nano technology and artificial intelligence

Examples of less lethal weapons

Non Lethal or Less Lethal come in a great variety. The table on the right side gives you an overview over the most important systems. Please click to enlarge.

Technology	Examples
Kinetic Energy	Impact munitions (wooden dowels, bean bags, plastic bullets, water cannons, ring airfoil projectile, foam rubber projectiles)
Barriers and entanglements	Devices to slow the progress and stop vehicles or boats (nets, chains, spikes, rigid foams)
Electrical	e.g. Taser stun guns, retractable stun sword, exoskeleton stun weapon, wireless electrical weapon (e.g Close Quarters Shock Rifle), laser-induced plasma weapon
Acoustic	Acoustic generators, acoustic cannon, long-range acoustic devices
Directed energy	High-power microwave, milimitre wave, lasers, pulsed energy, projectile weapon
Chemical	RCAs, malodrants, anti-traction materials, obscurants, sticky foam, anti-material chemicals, defoilians/herbicides
Chemical/Biochemical	Calmatives, convulsants, incapacitants
Biological	Anti-material microorganisms, anti-crop agents
Combined technologies	Flash-bang grenads, kinetic + chemical dispersal devices, optical + chemical dispersal devices
Delivery systems	Non-lethal munitions (e.g mortar shells), landmises, unmanned vehicles and vessels, encapsulation/microencapsulation

Terms

Global Positioning System (GPS)