Autonomous machines, towards the end of the war as a human enterprise?

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Robots coupled with artificial intelligence (autonomous machines) could represent the next strategic breakthrough in the military field because their symbiosis would allow the machine to decide autonomously on a battlefield deserted by man.

The **alert** launched in 2015 by Elon Musk, famous founder of innovative companies such as Space X or Tesla: "Killer robots must be banned", provoked a lot of articles in newspapers and some scientific journals, but without really succeeding in moving public opinion or decision-makers.

Yet this crucial subject deserves the world's attention, for when weak signals converge, it becomes possible to imagine a new threat with as yet unknown effects. It is therefore time to consider the arrival of autonomous machines on the land battlefield, because the question is no longer whether they will appear, but when and how. The term autonomous machine, or autonomous lethal weapon systems (ALWS), will be preferred to robot. It is also the term used by the Army Staff or the DoD[1] to designate machines that move on the battlefield and perform their mission by adapting to their environment. The focus here will be on the progress of autonomous land-based machines[2], with air or sea-based UAVs having already been the subject of numerous publications; however, the latter may be cited as examples. Furthermore, the concept of artificial intelligence (AI), whose fame is largely linked to science fiction, must be supplemented by that of machine learning or deep learning, which better reflects the reality of this technology and which has made exponential progress in recent months. Robotics and AI have reached varying degrees of maturity in recent years, but has the question been raised as to the nature of the progress that would result from pooling them? In the same way, in terms of the application of these technologies, can it be asserted conclusively that in the future man will always be indispensable in the decision-making loop?

Thus, the symbiosis of robotics and artificial intelligence could lead to a singular upheaval in man's relationship to war. The machine, endowed with self-learning capabilities, could decide alone how to carry out its mission, but also how to destroy a target. This is where the paradigm shift lies: the exclusion of man from the decision-making loop.

The technologies are already available or on the way to reaching sufficient maturity. They raise major political and strategic issues in the art of warfare. The decisions to be taken will commit France to the path of robotics or will carry the risk of a strategic downgrading of our country.

Mature technologies or technologies about to become so in the near future...

The technologies necessary for the development of autonomous machines are already available and their use in the military field is proven. Indeed, autonomous machines are benefiting from spectacular advances linked to the exponential increase in computing power and the development of AI, to the point that thoughts on their use are beginning to emerge.

- Machines with a certain degree of autonomy are already a reality. First of all, military robotics is finding areas of application in the very rapid development of civilian technologies. This is an area where the duality of technologies is obvious. Up to the assembly of lethal means, which ultimately distinguish them, nothing differentiates a civilian robot from a military one. The current machines are not Terminator-type humanoid robots, taken from anticipation films, but autonomous platforms based on wheeled, tracked, legged or crawling machines. At present, the United States, Russia, Japan and South Korea are launching into a race to equip and build sophisticated machines.

The United States, which already seems to be at the forefront in this field, is keen to keep its lead. On December 14, U.S. Assistant Secretary of Defense Robert O. Work announced an unprecedented effort in the 2016 budget[3] ($14 billion) dedicated to developing technologies in five key areas, all related to robotics or artificial intelligence.

4] In fact, the results are commensurate with the financial efforts made. Boston Dynamics ' Spot demonstrator achieves a striking level of mobility in rough terrain and adaptability [5].

The DARPA[6], at its annual robotics challenge, demonstrates the advances in mobility and adaptability of autonomous machines by bringing together the best companies in the world. According to a study by WinterGreen Research, the military robotics market could more than double to $10 billion by 2021 [7], and thus represents the defence sector with the most interesting growth projections.

In South Korea, Samsung Tech 's SGR A1 autonomous platforms, in service on the border between the two Koreas, have two modes, one of which allows the machine to decide autonomously on the deployment of its weapons.

Russia is also making major efforts in the field of robotics, building on a long tradition stemming from the conquest of space. The country intends to have its nuclear missile sites monitored by autonomous platforms as early as 2019 and announced at the end of 2015 that a group of Plateform-M autonomous machines had been successfully integrated into a campaign of military exercises in the Baltic.

According to Dr. Thierry Berthier, who carries out research within the cyber security and cyber defence chair at Saint-Cyr, the autonomy objective that Russian researchers have set for themselves obliges them to equip robots with ever greater adaptability and

resilience. This need thus implies an ever more powerful and self-learning AI.

- Undoubtedly, this AI, which is so often mentioned in scientific production, is progressing at the speed of Moore's law [8] and, while it must be acknowledged that its capacities are still far from being equal to the human brain, the learning machine and deep learning have taken it to new levels in 2015. It is not a question of making predictions or even evoking the famous singularity point [9] mentioned by Raymond Kurzweil(professor at MIT [10] and Google futurologist), but just to note the factual progress of AI. In fact, scientists distinguish between "strong" AI and "weak" AI. To put it in a nutshell, this amounts to distinguishing on the one hand a "strong" AI, conscious of itself, but which scientists agree is still out of reach, and on the other hand a "weak" AI that is self-learning. However, it is indeed the "weak" AI that has seen the most significant advances in recent months, thanks in particular to neural network architectures, which are complex networks of computing units interconnected in layers, like the neuronal connections of the brain. Added to this computing power is the learning machine, which consists of supplying the computer with data to be learned, but above all deep learning, which represents a self-learning capacity enabling the machine to constantly improve its mission execution processes. Who hasn't wondered how Apple's Siri[11] assistant or Android speech recognition works? These solutions exploit the learning machine and thus the AI. It should be remembered that software solutions capable of understanding the language still required a learning phase two years ago. Now they are available online and understand you immediately.

Secondly, in this field where technologies are perfectly dual-use, the defence world is lagging behind the civilian world. And it is indeed the big digital companies that are leading the innovation, Robert O. Work recently had to acknowledge [12]. The GAFA - for Google Amazon Facebook and Apple - spend R&D budgets that no European laboratory can approach. For example, IBM 's Watson development reveals very interesting capabilities, this "weak" A.I. is a "weak" A.I. that is not yet available in Europe.so capable of giving, after learning the case, a medical diagnosis that is 95% reliable (compared to that of a doctor who is only 70%). The particularity of Watson is to fit in a shoebox and to be able to assimilate data that is not specific to a field. In terms of facial recognition, Facebook, with the Fair project, has achieved a 93% degree of effective face recognition. Facial recognition is an area of obvious benefit to Sala.

- The vision commonly accepted in France is that the machine should not decide autonomously because it is up to the human to keep the final control of the shooting [13]. 13] This is an ethical stance that is not necessarily shared by all the countries that are developing Sala. Indeed, the multiplication of autonomous machines, or even their use in swarms, will make the task of the human controller very delicate. On the one hand, it will be difficult for the operator to follow the evolution of a machine that will make decisions at speeds that are out of reach.On the other hand, the mass of information to be processed will saturate the operator's analytical capacity. For example, the F35 should in the medium term have at its disposal a swarm of drones controlled by the pilot, whose mission would be to recognise the aircraft's flight or even carry out attacks for its benefit [14]. 14] But the USAFis already considering this technology only in the context of an AI that would take control of the swarm (CODE project). In fact, it is from the use of autonomous machines that the growing need for AI will arise.

Therefore, if the current machines are still controlled by man, this situation is bound to change; this is where the stumbling block between the different visions of the use of autonomous machines lies. Indeed, the vision advocated in the United States and elsewhere by proponents of AI is that machines should be empowered as soon as technology permits. The argument put forward is that, as Ronald Arkin points out, with SALA, we have machines and not individuals, and therefore entities that are not subject to feelings as soldiers can be, and in which it would be possible to implement binding ethical rules[15].

...The stakes related to autonomous platforms are crucial...

The stakes are vital because these technologies will cause a break in both the way of thinking about war and the way of conducting it. These disruptions, both political and strategic, must be anticipated in order to avoid suffering them.

- In fact, we must be prepared for a break in military thinking, because AI could allow the machine to decide without man. Whereas, until now, war has always been fought by men against men, the perception of conflicts would be totally challenged. It is a question of preparing and thinking of war as an enterprise that could be conducted partly by autonomous machines and only supervised by man. Thus, it is possible to imagine that the planning cells of the staffs would plan specific missions for the autonomous machines with the designation of the objectives to be achieved. Once the orders have been given, the machines would be responsible for carrying out the mission autonomously, and only supervised by a military decision-maker.
- For one thing has been proven since the beginning of mankind's warfare: if a technical advance is available, it is always used for military purposes to the fullest extent of its possibilities. This truth has survived through the ages, from the replacement of bronze by iron, through the invention of gunpowder, to nuclear weapons. "The law of progress in the performance of armaments...has always been to seek to enable fewer men to fight as well from farther away, or better yet, closer. At the limit: it is up to no man to fight perfectly from afar" [16].

16] All the more so since political power, faced with its public opinion, is naturally led to the use of ever more autonomous means to avoid endangering its own soldiers. Is it necessary to recall the exponential use of drones by the Obama administration and their use outside the rules of international law[17]? [17] Thus, Western states constrained by the concept of zero deaths and obliged to preserve the trained soldier, whose cost (human and training) is increasing, are inclined to use SALA.

- Above all, these autonomous machines raise the double question of respect for ethical rules and responsibility. Thus, the increasing use of SALAs has the underlying question of lowering the threshold of tolerance to violence. As Jürgen Altmann, a scientist specializing in the law of armed conflict at the University of Dortmund, points out, the possibilities associated with the use of SALAs should give rise to fears of an ever-increasing use of this type of weapon[18]. 18] The political decision-maker, freed from the risks involved in the use of ground troops, would be in a position to launch military campaigns for reasons that would otherwise have been the subject of negotiation. This was also an essential point of the discussions conducted by the UN in April 2015 in the framework of the Convention on Certain Conventional Weapons (CCW).

…acknowledging it may represent an opportunity for France or pose a risk of strategic decommissioning

The speed of technological development implies rapid decision-making at the national and international levels.

- Firstly, it is necessary to make the development of the autonomous machine a major project, as any delay would de facto validate the capability gap. France has sufficient resources for this. The preliminary reflection work had been launched by the State and the France robot initiative plan for 2013 (Ministry of Productive Recovery and Higher Education), which outlined the strategic directions to be followed to make the country a leading player in these areas. The task now is to implement the initiatives put forward. First of all, if civil robotics is successful, it seems necessary to create a competitiveness cluster that brings together a military robotics industry that is currently fragmented into many SMEs (TECDRON, ECA ROBOTICS for the most innovative). This grouping would make it possible to direct research according to identified needs, to have a better synergy between companies and a financing of the work by public funds. Then, the same effort must be made to converge research in the field of AI, the latter being able to rely on multiple laboratories such as INRIA, ESTA or the LIP of Paris 6 to advance research in machine learning [19] and deep learning. It is a question of relaunching, nowadays, the equivalent of a computing plan in order to maintain the strategic independence of our country in the field of autonomous machines. The off-the-shelf purchase of Reaper drones from the United States is there to remind us of the constraints that a country can suffer from not having a strategic military resource in-house.
- At the same time, it is also a question of reflecting on a strategy specific to autonomous machines, by defining upstream doctrines of use so as not to be subject to their arrival. The EMA could thus embark on an in-depth reflection aimed at defining concepts of use for autonomous systems and their coordination with the soldier. Following the example of what researcher Paul Scharre of the Center for a New American Security recommends , it could be envisaged to create a single command dedicated to the issue of SALA and AI [20].

- 20] Furthermore, with the arrival of SALA and AI, the international community must conduct a reflection with the aim of framing the use of autonomous machines. Admittedly, discussions are underway in Geneva, but the speed of development of AI must lead humanity to accelerate the process. These discussions refer to the prohibition of autonomous weapons, whereas reality shows that this type of weapon is already being used by some states. France must be able to play a leading role by defining, in conjunction with its partners, a set of ethical rules that comply with international humanitarian law and that each manufacturer will have to respect for its machines. This would be a realistic approach that would take into account both the inevitable development of SALA and the need to exercise some form of upstream control.

The "robolution" has been launched; the symbiosis between autonomous machines and AI carries within it the seeds of profound changes in the way of waging war, because it calls into question the central place of man in the decision-making chain. While it is difficult to predict how long it will take before we see the widespread use of SALAs on the battlefield, it is worth considering. France had fallen behind in the use of industrial

robotics, there is still time for the country to move towards military robotics and AI.

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1] DoD: Department of Defense, US Department of Defense.

[2] Use of the Russian Plateform M autonomous machines in joint exercises.

3]"Workoutlines key steps in third offset tech development", Defense News 14 December 2015.

[4] The five pillars are: Machine learning, human-machine collaboration, automation of human assistance, advanced human-machine collaboration, autonomous weapons.

[5] https://www.youtube.com/watch?v=M8YjvHYbZ9w

6] DARPA: Defense Advanced Research Projects Agency, is an agency of the United States Department of Defense responsible for research and development of new technologies for military use.

7] WinterGreen Research Inc, Military ground Robot Plateform Systems to engage Terrorists: Market shares, strategies and forecast, Worldwide 2015 to 2021, 2015

8] Moore's Law was expressed in 1965 by Gordon E. Moore, an engineer and one of the founders of Intel. He noted that the "computing capacity of the semiconductors offered in the entry-level segment" had doubled every year at constant cost since 1959, and he predicted that this growth would continue. This exponential increase was quickly named "Moore's Law".

9] Singularity: the moment when artificial intelligence would become aware of its state and would escape the control of Man.

[10] MIT: Massachusetts Institute of Technology

11] Siri is a voice-controlled computer application that understands the verbal instructions given by users and responds to their requests.

12] "Workoutlines key steps in third offset tech development", Defense News 14 December 2015.

13] Ronan Doare, Didier Danet and Gérard de Boisboissel (eds.), "Drones etkiller robots. Should they be banned?**"Presses universitaires de Rennes, 2015.**

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[16] Alain JOXE, "Journey to the roots of war" , PUF, collection Pratiques Théoriques, 1991.

[17] Andrew COCKBURN, "Kill chain the rise of hi-tech assassins" , HH and co, 2015

18] Heinrich Böll stiftung, "Hi-tech Kriege: Frieden und Sicherheit in Zeiten von Drohnen Kampfrobotern und digitaler Kriegsführung", HBS, 2014

19]These French laboratories seem to obtain the most convincing successes in the field of machine learning: semantic recognition, knowledge learning and big data.

[20] Paul Scharre, "Robotic on the battlefield part II: the coming swarm", CNAS, 2015

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