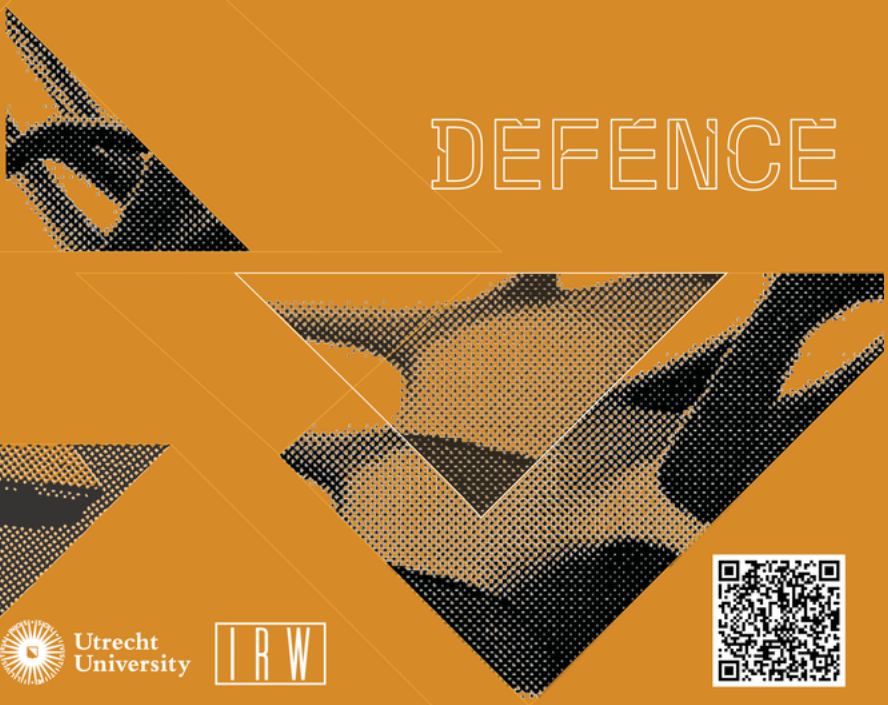
SYMPOSIUM 8 JUNE 2022 14:00-17:00 ACADEMIEGEBOUW

DEVELOPING, ANALYSING, AND REGULATING AUTONOMY IN DEFENCE SYSTEMS

REALITIES OF ALGORITHMIC DEFENCE



Utrecht University

IRW

Realities of Algorithmic Defence Symposium

As AI is increasingly integrated into all aspects of human life, advanced militaries worldwide have found themselves in what some call an AI arms race, feeding into the third revolution in warfare. In this context, advanced militaries such as those of the US, Russia, China, and the Netherlands have been experimenting with and deploying technologies with various levels of autonomy across battlefields in Libya, Syria, Mali, and Ukraine. While developers and armed forces promise more effective military engagement through increased speed and precision, academic and policy debates tend to focus on the threat of fully autonomous weapons making life-and-death decisions. Taking the AIV and CAVV's report on the development and regulation of autonomous defence systems as our starting point, the aim of the Realities of Algorithmic Defence symposium is to stimulate debate amongst key actors involved in developing, analysing, and regulating autonomous warfare in the Netherlands and beyond during three panels:

1. Realities of Developing Autonomous Weapon Systems
2. Investigating Autonomous Warfare
3. Challenges of Regulation

The Realities of Algorithmic Defence symposium is co-organized by Dr. Lauren Gould and a Community Engaged Learning (CEL) group of Conflict Studies and Human Rights students Amé den Hollander, Joel Shepard, Daan Boelens, and Linde Arentze, coordinated by Jack Davies. The symposium and CEL are a product of the Prototype Warfare project, a collaboration between Dr. Lauren Gould's Intimacies of Remote Warfare program (UGlobe and IOS's Contesting Governance platform, Utrecht University) and Dr. Marijn Hoijtink's Deadly Design project (Vrije Universiteit Amsterdam).

Featured Speakers

Panel 1

Realities of Developing Autonomous Weapon Systems

14:30 - 15:15

Moderator | **Dr. Tim Sweijs** is the Director of Research at the Hague Centre for Strategic Studies. Dr. Sweijs has worked as a researcher, analyst, security advisor, affiliate, and lecturer with, to and for a number of organisations including the Netherlands Defence Academy. He has published extensively on the changing global security landscape and has lectured at military academies and universities worldwide. Dr. Sweijs spearheads HCSS research on the impact of emerging technologies on international security, with a specific focus on how to address the political, ethical, legal, and military-strategic issues associated with their impact.

Speaker | **Lieutenant Colonel Martijn Hädicke** is the program officer of the Robotics and Autonomous Systems (RAS) unit attached to the 13th Light Brigade of the Royal Netherlands Army, located in Oirschot. Hädicke's career in the Dutch Armed Forces goes back to 1997, and he has been attached to the 13th Light Brigade since 2015. Hädicke is in charge of testing a number of technologies, including the Milrem THeMIS, SPOT, Ghost V60, Skyhive, and SPEAR.

Speaker | **Maurits Korthals Altes** is an engineer and entrepreneur, and the founder of Avalor AI, an Amsterdam-based robotics company that contracts with the Ministry of Defence to further develop and integrate autonomous vehicles and command and control systems. Avalor is currently working on swarming technologies for unmanned aerial vehicles and running three-dimensional rendered simulations in order to model the navigation and physics of various military drones.

Speaker | **Dr. Nanda Van der Stap** is a technical lead working in robotics development at TNO. She has a PhD and MsC in medical image-guided robotics and computer vision and possesses extensive experience in the field of medical technology, having contributed to numerous papers on endoscope design. At TNO, Dr. Van der Stap manages teams developing visually enhanced robotic technologies, suchs as algorithms for image based navigation. Along with 3 other TNO developers, Dr. Van der Stap co-authored a paper titled Meaningful Human Control of Drones: Exploring Human–Machine Teaming, Informed by Four Different Ethical Perspectives, published in the journal AI and Ethics in May 2022. Dr. Van der Stap is also the executive editor of MT-Integraal, a medical technology webzine.

Panel 2
Investigating Autonomous Warfare
15:15 - 16:00

Moderator | **Dr. Lauren Gould** is Assistant Professor in Conflict Studies and the project leader of the Intimacies of Remote Warfare programme on new strategies of remote warfare across Africa and the Middle East. Gould's research projects study how the US has spearheaded this form of military engagement, but also how many other advanced militaries are following suit. Gould's research projects trace how remote warfare is legitimized, what military alliances are forged, what technologies are used and how these actors and technologies interact and have an impact on local conflict dynamics and civilian harm. Gould has conducted fieldwork in Uganda, South Sudan and Iraq. From a conflict and critical security studies perspective her aim is to conceptualise the changing nature of warfare in the 21st century, as well as have an impact on policy and public debates. Visit the Intimacies of Remote Warfare website for all of her recent research and public engagement output.

Speaker | **Maaike Verbruggen** Originally a historian and a sociologist, Maaike Verbruggen now studies the future of warfare. She is a Doctoral Researcher at the Center for Security, Diplomacy and Strategy at the Brussels School of Governance at the Vrije Universiteit Brussel (Belgium). Her specialty is the intersection between emerging technologies, military innovation, and arms control, and she is currently finishing up her PhD on military innovation in Artificial Intelligence – and particularly the controversies behind it.

Speaker | **Jennifer Gibson** is an attorney with Reprieve, a UK-based human rights advocacy organization. Here, she supervises research on extrajudicial killings. Jennifer has litigated cases in many domestic and international courts, including the ICC, advocating on behalf of civilian victims of drone strikes in countries such as Yemen, Pakistan, and Niger in order to hold states accountable for civilian harm.

Speaker | **Dr. Marijn Hoijtink** is an assistant professor of International Relations at Vrije Universiteit (VU) Amsterdam. Her research focuses on the development and proliferation of new military technologies and their political consequences. Dr. Hoijtink has been awarded a Veni grant by the Netherlands Organization for Scientific Research to study how novel AI applications shape and transform military decisionmaking and contemporary warfare.

Panel 3
Challenges of Regulation
16:15 - 16:55

Moderator | **Dr. Marijn Hoijtink**

Speaker | **Frank Slijper** is a researcher and policy advisor with PAX. Frank's primary area of study is the international arms trade, arms control, and disarmament, and has provided international relations research and analysis for various organizations and policymakers since 1993. Frank has been with PAX since 2014, and since 2017, he has published reports documenting the advances made towards autonomous weapons in the Netherlands and elsewhere, as well as the ethical and legal issues surrounding them.

Speaker | **Prof. Dr. Cedric Ryngaert** is a lecturer of Public International Law at Utrecht University, where he is also head of the Department of International and European Law. Dr. Ryngeart has written extensively on jurisdiction in international law including textbooks for Oxford press. In 2012, he was awarded the Henri Rolin Prize for his contributions to the field of international law. Dr. Rynegaert is also on the editorial board for Utrecht Law Review and the Netherlands International Law Review, and is one of the authors of the 2021 AIV and CAVV report.

Speaker | **Jessica Dorsey** is an assistant professor of International and European Law at Utrecht University School of Law. Jessica's areas expertise include human rights law, counterterrorism, and armed drones. She is managing editor of legal blog Opinio Juris and a research fellow at the International Center for Counter Terrorism in the Hague.

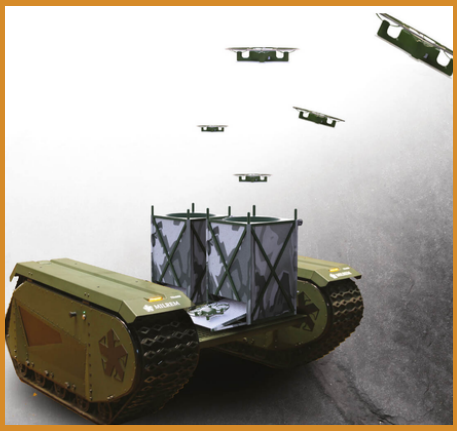
Featured Technologies

The Realities of Algorithmic Defence team has researched four cutting edge technologies with different levels of autonomy that were acquired by the Dutch military in the past decade. Profiles are provided below to facilitate an informed debate throughout the symposium.

Nederdrone

SPOT

THeMIS



SPEAR

Nederdrone

The Nederdrone is a small, fixed-wing, hybrid hydrogen drone that is innovative for its fuel base, vertical landing and take-off, and robotic controller system. The vertical landing technology allows the drone to take off from small surfaces rapidly. The drone has a battery that facilitates the take-off and landing, and which is charged by hydrogen fuel throughout its flight. Usually, this form of take-off and landing requires substantial amounts of fuel, making this type of operation inefficient and producing air pollution. Instead, Nederdrone runs on Hydrogen fuel, which does not produce carbon and thus is more ecologically friendly than the fossil fuels that power many other drones. Hydrogen fuel allows the drone to fly for about three hours, though the take-off and landing are vertical and require a large amount of it. The drone is specifically designed to fly in difficult weather conditions, especially at sea.

The Nederdrone is programmed with features to account for factors like water, salt, and wind, and autonomously adjust its flight pattern accordingly. The drone is equipped with the INDI controller system, developed at the TU Delft to have the drone adjust autonomously to disruptions. As a result, it is easier to control the drone and it is more likely that the drone will remain stable in rough weather conditions. Nederdrone does not, however, have the capacity to set out routes or engage in decision-making processes autonomously, though Nederdrone's developers are aiming to eventually make the landing and take-off functionalities fully autonomous. The unique landing technology allows the drone to land on a small moving surface, such as a ship. The drone is too light and small to be equipped with weapons, and has been developed primarily for surveillance.

THeMIS

THeMIS is an unmanned ground vehicle (UGV) developed by Milrem Robotics in Estonia. The drone is equipped with treads for rough terrain and can travel at speeds of up to 19 km/h. A sensor array including cameras and lidar feed into perception, motion planning, and decision-making software, as well as the remote command center. THeMIS makes use of following, patrol, return, and point to point functionalities while utilizing AI navigation and 3D map rendering to react to obstacles and environmental factors. The drone's platform can be used for transport of personnel, supplies, communications equipment, or an unmanned aerial vehicle (UAV). The unit is primarily designed to provide logistical and reconnaissance support to infantry units.

THeMIS was initially conceived for the purpose of cargo transport in harsh terrain, and Milrem and partners have been further developing the unit's mapping systems for surveillance purposes. However, the drone's platform can also be outfitted with armaments for providing fire support, including machine guns, missiles, or anti-armor (attachments are not manufactured by Milrem). THeMIS possesses several features to assist in targeting, including UAV assistance. However, Milrem maintains that the actual decision to fire will always be made manually and the drone is therefore not a lethal autonomous weapon. THeMIS can also be equipped for medevac, IED detection, and bomb defusal arms in order to mitigate risk to personnel. The 13th Light Brigade of the Royal Dutch Army is currently conducting exercises with the THeMIS. Estonian forces deployed the THeMIS in Mali in April of 2019, where it was used primarily for supply transport and patrolling.

SPOT

SPOT is a small dog-like robot developed by Boston Dynamics, a US-based tech company. They describe SPOT as follows: “SPOT is an agile mobile robot that navigates terrain with unprecedented mobility, allowing you to automate routine inspection tasks and data capture safely, accurately, and frequently.” SPOT can be controlled with a tablet controller or a laptop but it can also be programmed to walk preset routes autonomously. SPOT is designed with 12 actuators in the knees and hips to keep the platform balanced and 360 degrees stereo camera vision (5 cameras in total) with which it can analyse its surroundings in depth and infrared, enabling it to move around autonomously through all sorts of terrain. Besides the built-in stereo cameras, SPOT functions as a platform for a wide range of additional software and hardware features such as sensors, other cameras, an artificial, an artificial nose and much more. It can walk for 90 minutes on one battery with a top speed of 5,76km/h.

SPOT is delivered with an application programming interface (API) and a software development kit (SDK), enabling buying parties to program SPOT for performing specific tasks and to further develop autonomy and task performance. Functionalities that can be added to SPOT through further software development include autonomous navigation, high level identification (targeting), and more autonomous decision making. The Dutch MoD purchased one unit from Boston Dynamics for the Royal Military Police (KMar). A team of scientists within KMar, dubbed Deep Vision, is responsible for testing SPOT. Deep Vision has expressed that they are currently assessing three possible functions for spot: site-scanning for arrestation teams, detection of dangerous or illegal substances with an artificial nose and general surveillance.

SPEAR

SPEAR (Swarm-based Persistent Autonomous Reconnaissance) is a swarming technology being developed by Delft Dynamics and Tective Robotics, with algorithms programmed by TNO and Avalor AI. Swarming technology allows multiple aerial quadcopter drones to be launched and controlled simultaneously by a single operator. Once launched, the UAVs autonomously fly in a coordinated pattern to provide tactical intelligence. The drones are trained by machine-learning algorithms to visually identify targets, as well as providing live video feed.

One of the biggest issues with many of the existing autonomous drone swarms is that their operability is often limited by battery life. The launching module in Tective Robotics' Skyhive system therefore doubles as a charging station, so that the drones can be launched and charged autonomously while in operation. This allows any single drone to return to its launchpad to recharge while the other drones continue to swarm. Skyhive stations can be mounted on vehicles such as the Milrem THeMIS, or carried like a backpack. The hives are capable of storing, launching, and charging 10 quadcopter drones at a time. The SPEAR system is being tested by the 13th Light Brigade in Oirschot, and could see civilian use in search and rescue operations in the near future.

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