10th
ANNUAL

KINGSTON CONFERENCE ON INTERNATIONAL SECURITY

ROBOTICS AND MILITARY OPERATIONS

Image © QinetiQ.com

11 - 13 May
Kingston, Ontario

2015

Kingston
Conference on
International
Security

Tenth Annual
Kingston Conference on International Security

ROBOTICS AND MILITARY OPERATIONS

11-13 May 2015
Kingston, Ontario

Conference Report

Sara Greco
Queen's University

Table of Contents

Technical Abbreviations

- AACUS – Autonomous Aerial Cargo/Utility System
- CCW – Convention of Certain Conventional Weapons
- CII - Collaboration, Interoperability, and Innovation
- DARPA – Defense Advance Research Project
- IED - Improvised Explosive Device Disposal
- IEDD - Improvised Explosive Device
- LOAC – Law of Armed Conflict
- NGO – Non-Governmental Organization
- OODA loop – Observe, Orient, Decide, Act loop
- RAS – Robotics and Autonomous Systems
- SMSS – Squad Mission Support System
- UAS – Unmanned Aircraft System
- UAV – Unmanned Aerial Vehicle
- UN – United Nations
- WMD – Weapons of Mass Destruction

Key Insights

Definitional debates vis-à-vis RAS can cause stalemates but so can definitional ambiguity

Currently, there is no operational and internationally recognized definition of RAS. Definitional ambiguity and disagreement can suspend pertinent points of discussion relating to RAS. However, definitions do matter insofar as states cannot agree on hard or soft regulations if they cannot define these systems. Such definitional complexity can cause issues both domestically and internationally. We are also observing definitional dissonance between what robots actually are and what they are perceived as being. Definitions matter to varying degrees, depending on one's sector, be it academic, governmental, military, non-governmental, and private sector personnel, for example.

A realistic understanding of RAS is imperative

A realistic understanding of RAS is necessary for the production of valid and feasible policy. It is important to acknowledge the role of science fiction in inducing undue fear relating to RAS and clouding judgment. Enormous ethical, legal, and moral mistakes can be made if we do not view emerging technology for what it actually is.

What is ethical, legal, and moral can change over time

RAS and related technologies raise important ethical, legal, and moral considerations, however, it is important not to conflate the three discussions. It is pertinent to remember that what is deemed ethical, legal, and moral evolves over time. Such changes can occur drastically or gradually. As well, what is ethical, legal, and moral remains relative.

Transparency at the level of international law is a productive way to regulate RAS

Hard international law vis-à-vis RAS is unlikely. What is more, it will also prove ineffective. In lieu of hard international legislation, states should encourage other states designing RAS to share best practices and standards on how they assess the legality of their own developments. Soft law governance is a productive alternative to hard international law. Soft law governance could involve stakeholders defining and imposing codes of conduct, guidelines, percepts, and principles for good practice.

States are not the only actors acquiring and/or developing RAS

Non-state actors, including criminal, terrorist, and insurgent groups already possess certain dangerous technologies. These non-state groups will continue to acquire and seek to develop RAS and related technologies. In the face of these non-state actors, legislation proves ineffective. It is important to be prepared to respond to adversaries that possess such technologies.

The inclusion of RAS signifies an evolutionary process, not a revolutionary one

The development and inclusion of RAS technology will not revolutionize military operations. The creation and use of these technologies has and will continue to remain gradual. The application of RAS cannot and will not change the nature of war.

Humans will retain control of these machines

Into the future, it is most likely that humans will remain in control of these technologies. We are not near the time when robots will be capable of functioning without human control.

Day I: May 12

Conference Introductions

Dr. Stéfanie von Hlatky[1] opened the conference with a discussion of the topic of robotics and autonomous systems (RAS), its significance, and implications. In doing so, she illustrated some of the key issues surrounding RAS and how these issues transcend categories, such as fields of study and levels of analysis, as the topic of RAS is pertinent to academic, governmental, military, non-governmental, and private sector personnel at individual, state, regional, and international levels alike. Dr. von Hlatky noted issues of relevance vis-à-vis RAS, which included the absence of an operational and internationally recognized definition of RAS, the virtual inexistence of policy guidance concerning RAS, and a lack of understanding vis-à-vis the incorporation of RAS in security.

Challenge to the Conference

Lieutenant-General Guy Thibault[2] offered his views on the potential outcomes of the conference. He discussed what the conference ought to help us understand vis-à-vis RAS, particular points of pertinence relating to the conference topic, as well as five key challenges participants should endeavour to discuss over the course of the conference. In sum, it was his articulated hope that the conference would increase our academic, practical/technical, and professional understanding of how to best employ RAS technology. Lieutenant-General Thibault articulated a number of questions for attendees to ponder over the course of the conference. He asked the those in attendance to consider: how to incorporate RAS and in what environments or realms, whether or not the military will be able to keep up with the pace of emerging RAS technologies, if and how these systems can pose an ethical and moral threat to the human condition, and what will be the response to RAS by both allies and enemies alike. Most pertinent was Lieutenant-General Thibault's discussion of the five related voids in our understanding relating to RAS at the domestic, regional, and international levels, that he requested the conference address. In his view, these gaps exist in the following five realms: (1) the environment in which RAS operate, (2) the ethical and moral implications of these technologies, (3) the strategic implications of such systems, (4) potential unintended consequences that may ensue from these technologies, and (5) the relationship between the human and the machine.

Opening Address

Lieutenant-General H.R. McMaster[3] gave the conference's opening address, which pivoted on his proposed framework for how to incorporate RAS into future military missions. The first element of his framework encompassed the concept of change. In his view, notwithstanding the military implications of these technologies, RAS are not revolutionary, as they cannot and will not be able to change the continuities of war, which include war as: an extension of politics, a human process, an exhibition of fear, honour, and interest, an uncertain endeavour, and an occurrence that develops in a myriad of contexts (air, cyber, land, and naval

1. Assistant Professor of Political Studies, Queen's University; Director of the Queen's Centre for International and Defence Policy

2. Vice Chief of Defense Staff of the Canadian Armed Forces

3. Director of the Army Capabilities Integration Center and Deputy Commanding General of Futures US Army Capabilities Integration Center

for example). The second factor of Lieutenant-General McMaster's framework was a consideration of the effects that RAS will have on armed conflict. Such a reflection necessarily requires us to contemplate the potential evolutionary effects of RAS on warfare. To expand, that entails a consideration of the application of these systems and how they will evolve military capabilities. The framework's third component engages the issue surrounding counter-measures. Lieutenant-General McMaster reminded us that allies and enemies, alike are creating and seeking RAS technology, and as such, we ought to consider what some of these counter-measures might be. The final element that comprised Lieutenant-General McMaster's framework was a consideration of RAS in the context of humanity and war. If war will always be a requisite – insofar as war is a natural and necessary outcome of the existence of enemies that pose threats to humanity – then, we must consider whether RAS can eradicate the human element from war.

Panel I: State of the Art: Current and Emerging Technologies

This first panel provided an outline of the current and developing RAS technologies, as well as an overview of potential future prospects in the realm of RAS. The panel was moderated by **Dr. Stephanie Carvin**[4] who articulated that this panel would set the stage for what RAS technologies are and where they may be going. In Dr. Carvin's view, it is pertinent for us to identify the impetus to these systems and technologies, and she speculated that perhaps it is the value placed on human life that propels the advancement of RAS technologies. Dr. Carvin's introductory comments also reminded us that while no government is building a fully autonomous weapons system, thirty states have developed semi-autonomous systems. Although, she speculated that humans will remain in control of these technologies into the future. Dr. Carvin also illustrated the connection between discussions relating to the future directions of RAS and the need to avoid strategic surprise.

Dr. Peter Staritz[5] provided an overview of five different systems that Lockheed Martin has constructed and is currently establishing. Particularly pertinent, was Dr. Staritz's articulation that the goal of these technologies is to remove the soldier from the increasingly complex environment during warfare to increase human survival. Dr. Staritz discussed the KMAX, an autonomous helicopter that was utilized in Afghanistan to transport items. For example, during its time in Afghanistan, this system flew 4.5 million pounds of cargo and equipment to bases, wherein it was able to make critical deliveries in a timely manner. This system can transport items ten times faster than a regular helicopter. The helicoper is equipped with auto-landing and auto-taking off, and precision delivery capabilities. To that end, no solider has to move with the system, which nullifies exposure time from enemy contact. The Autonomous Aerial Cargo/Utility System (AACUS) is a system similar to the KMAX, as it is an aerial cargo system, however, it has not yet been employed. The INDAGO is a small (can fit in a backpack), unmanned aircraft system (UAS) that can be deployed quickly. This system has a fair amount of autonomy on board, as it can navigate autonomously and perform area coverage. The INDAGO also has a stand-off mode, which allows it to maintain a particular position with respect to a moving object. The Squad Mission Support System (SMSS) is an unmanned ground vehicle; capable of traversing long distances (up to 60 miles) autonomously (performs long-range planning on board and short-range obstacle avoidance). To that end, this system can follow a

4. Visiting Fellow at the Centre for International Policy Studies, University of Ottawa; Assistant Professor, Carleton University's Norman Patterson School of International Affairs

5. Intelligence Robotics Lab, Lockheed Martin's Advanced Technology Laboratories

soldier and is controllable through auditory directions. The Autonomous Mobility Applique System is a robotic driver that was enabled to perform dynamic re-routing, and can re-plan a route in the most logical manner. Dr. Staritz also discussed Team TROOPER, a system created by the Defense Advance Research Project Agency (DARPA), a company focused on creating robots for disaster response in human-engineered environments (environments that require movements of the human body's legs, arms, and hands, for example). In Dr. Staritz's view, the focus on these disaster response robots is to create an effective collaboration between human and machine.

Dr. Simon Monckton[6] began his presentation with a brief discussion of why we seek to pursue RAS. In essence, Dr. Monckton suggested that we are pursuing these systems because we want to keep troops out of harms way and want to achieve target precision. For Dr. Monckton, autonomy is a subjective definition of how a robot is performing. In his view, we do not presently have robot soldiers because of the robotics complexity problem, which encompasses environmental, mechanical, and mission complexities. Dr. Monckton's presentation focused on the key components that comprise RAS today. He asserted that there are three key features in all robots today: global positioning systems (GPS), telecommunications, and electronic miniaturization. Dr. Monckton provided a video illustration of a simple robotic system performing a cargo delivery to reinforce his claim that the three necessities for robotic technology are GPS, telecommunications, and electronic miniaturization.

Relatedly, he introduced the Sense, Model, Plan, Act (SMPA) Problem, which describes issues relating to the construction of robots. He explained that most systems are unpredictable, as they function without modeling and planning capabilities. To achieve robotic predictability, the robot needs to have a deliberative system, which requires modeling and planning capabilities. Also pertinent to take from Dr. Monckton's discussion are developments in the RAS realm. The first developing technology Dr. Monckton explained was probabilistic robotics, which is the ability to program imperfect models into a robot, such that the robot has been programmed to expect and overcome uncertainties. The second advancement emerging in the field of RAS is networking, the ability of researchers to build on the work of others through the sharing of codes, which has increased the development of RAS exponentially. The third development pertains to parallel processing, the ability of these technologies to process faster than real time dynamic modeling and planning. In his concluding remarks, Dr. Moncton articulated that humans should and will continue to support robotic technology, as human oversight is required.

Dr. Jean-Charles Ledé[7] focused his presentation on how the technologies of today developed and the direction of RAS-related programs into the future. In his view, autonomy is not new, but rather, connotes a continuum of development. To that end, Dr. Ledé suggests that there is nothing revolutionary about robotics and that the development of robotic and related technology is indicative of an evolutionary process rather than a revolutionary occurrence. What is more, Dr. Ledé outlined his view of what differentiates the concept of autonomy from automation and independence. For Dr. Ledé, automation occurs when people become comfortable with a particular type of technology that it becomes involuntary. With regard to the

6. Group Head of the Autonomous Systems Operations at the Air/Counter Terrorism Technology Centre (Defence Research and Development Canada Suffield, Department of National Defence, Government of Canada)

7. Program Manager in the Tactical Technology Office, DARPA Collaborative Operations in Denied Environment

distinction between autonomy and independence, he defined autonomy as something you give and independence as something you take. For him, the largest setback vis-à-vis RAS is the absence of operationalization for testing. Dr. Ledé discussed the single platform approach taken to the development of robotic technologies. He illustrated how one system was developed at a time, wherein one system was advanced as much as possible and then those technologies were transplanted into other systems. In his view, programs into the future will look beyond the single platform model, and will focus on vehicle level autonomy, collaborative autonomy, and supervisory interface. The move away from a single platform model stems from the existence of a denied environment, wherein adversaries, who have been studying how we wage war, are able to successfully and systematically blocks our efforts. Examples of adversarial endeavours that succeed in blocking our efforts include placing more distance between us and them, challenging electromagnetic systems, and using moving targets. In Dr. Ledé's view, in order to deal with the difficult environments fostered by our enemies, we need to employ stealth, speed, numbers, cyber poison, and collaboration.

Panel II: State of Play: Robotics and Autonomous Systems in Recent Operations (Allies and Adversaries)

The purpose of the second panel was to examine the current use of RAS technologies by Canada, the United States (US), and its allies. This second panel also focused on how successful or unsuccessful these systems have been.

The panel opened with **Lieutenant-Commander John Keenan**,[8] whose presentation focused on explaining the current Improvised Explosive Device Disposal (IEDD) technologies, their significance to IEDD operations, and future avenues of development, all in the Canadian context. The first remote means in IEDD was Little Willie, which was developed in 1970. An example of what Canada currently has in its IEDD toolkit is the TEODOR, which carries up to four weapons, has Bluetooth capabilities, uses five different cameras, and is capable of dragging heavy vehicles. Lieutenant-Commander Keenan illustrated the many benefits associated with IEDD operations, which include: the prevention of loss of life, the protection of property and infrastructure, the preservation and collection of forensic evidence, the capacity to permit freedom of movement, and the ability to return the scene to normalcy. In his view, RAS technologies are desirable because they allow for: mobility, dexterity, connectivity, visual acuity, and versatility.

He also articulated that these technologies are important because they allow more to be achieved faster, as these technologies can be employed in situations before humans. To expand, a mandatory soak time must be observed before any manual human approach to a known or suspected devise. Lieutenant-Commander Keenan suggested that upcoming technologies will seek to overcome one of the largest obstacles for IEDD operations, which is the inability of current technologies to utilize three-dimensional imaging. To that end, the hope is that new IEDD technologies will have capabilities including: binocular systems, feedback control, multi-arm manipulators, interchangeable purpose build arms, semi-autonomous navigation and obstacle avoidance, and multi-barrel and disposal disruptors. Related to future developments, Lieutenant-Commander Keenan also asserted that IEDD technologies will expand to include not only ground systems but also air and sea platforms. With regard to definitions, Lieutenant-

8. Canadian Armed Forces Joint Counter Explosive Threat Task Force

Commander Keenan defined an IEDD as a science of vague assumptions based on debatable figures derived from inconclusive experiments, performed by persons for doubtful mental capability with instruments of problematic accuracy. It is pertinent to note Lieutenant-Commander Keenan's view that these technologies are just tools and that we need people who know how to operate these tools, particularly in terms of the use of human judgment.

Lieutenant-Colonel John "Flash" Fontenot[9] provided an American perspective vis-à-vis Remotely Piloted Aircraft (RPA). In his introductory remarks, Lieutenant-Colonel Flash reminded those in attendance that an RPA is not a drone. He discussed the versatility and utility of RPA, particularly in the context of observation and surveillance. His discussion centered around three points, the current use of RPA, the complexities associated with their use, and the future development of RPA. In his view, RPA have grown exponentially given the flexibility it has provided and the success it has fostered. Lieutenant-Colonel Flash discussed how American RPA were used to recapture the Mosul dam, a mission that did not require any troops on the ground. In this mission, RPA feeds were used for viewing and communication purposes, between fighters and bombers. To that end, Lieutenant-Colonel Flash stressed the complexity associated with RPA feeds, as they pass through many hands and are shared by a number of individuals. Relatedly, he explained how RPA require multiple layers of human executing, and therefore, the discussion should not just be about RPA, it should expand to examine the system that needs to be constructed so that these technologies can be used effectively and optimally. Notwithstanding his view that autonomy is difficult to achieve, he argued that innovation is not difficult and innovation is what drives new RPA technology. For example, he discussed how the Predator and the Reaper are not autonomous systems but are innovative ones. Into the future, Lieutenant-Colonel Flash argued that RPA will become the largest weapons system, particularly given all of the innovation surrounding this device. In support of his claim, he went on to state that if priorities are determined by dollars and demand, both elements are currently present.

Mr. Donald Sando[10] provided insight into questions surrounding what makes RAS attractive, how RAS will change warfare, and what are some of the financial concerns relating to the investment of RAS technology. Mr. Sando explained how the US Army intends to be concept driven in the future, an example being the movement-maneuver concept, which stipulates that moving forward, soldiers need to be smart, fast, lethal, and precise. In his view, since there are elements that obstruct a soldier's ability to be smart, fast, lethal, and precise, RAS are necessary in order for the US Army to achieve its conceptual goal. In response to the question of why would we want to employ RAS on the battlefield, Mr. Sando's response was simply why not. He articulated that the aim of employing RAS on the battlefield is to assist soldiers in accomplishing their mission successfully and safely. However, in his view, the desire not to change a soldier's job should not be that which denies technological advancement and change. Also related to the investment of technology, Mr. Sando asserted that cost – neither financial nor other drawbacks – should not dissuade the government from investing in and supporting the application of RAS technology. To expand, he argued for the need to first, freely investigate and develop different technologies and then second, assess the costs and benefits associated with the new technology. In his view, it is dangerous to be playing catch up, as other individuals, group, and states are

9. Commander of the 18th Reconnaissance and Squadron, 432d Wing, Creech Air Force Base, Navada

10. Deputy to the Commanding General and Director of Capabilities Development and Integration for the Maneuver Center of Excellence at Fort Benning, Georgia

going to be developing this technology. Mr. Sando discussed the use of armed robotic systems in Operation Iraqi Freedom. He mentioned that these armed robotic systems were relatively successful, notwithstanding that soldiers did not train extensively with these technologies before their use. In his view, RAS will eventually enable commanders to reduce force density in conditions of uncertainty and expand the area and time over which maneuver forcer can be effective.

Panel moderator, Dr. Robert J. Bunker[11] navigated a discussion on the use of UAS by criminal, terrorist, and insurgent groups. He explained how drug cartels are able to use UAS technology to transport drugs. For example, drugs and weapons are being transported into jails using this technology. He discussed the use of UAS by a number of terrorist groups including: Al Qaida (2001, 2002(2), 2005, 2006-2007, 2011), Aum Shinrikyo (1994), FARC (2012), Fatah (2002, 2004), HAMAS (2013, 2014), Hezbollah (2003, 2004, 2005, 2006, 2012, 2013, 2014), and the Islamic State (2014 (3), 2015). Dr. Bunker noted that Hezbollah is a heavy weight in terms of its use of UAS and that is has acquired such systems from Iran. Additionally, Dr. Bunker stated that the use of UAS by the Islamic State has been primarily for reconnaissance purposes. To that end, Dr. Bunker explained why terrorist insurgent groups use UAS, which included discussions of reconnaissance and surveillance, messaging (protest, propaganda, and warning), Improvised Explosive Device (IED) delivery, weapons of mass destruction (WMD) delivery, and weapons platforms. For example, the Free Syrian Army (2013) possessed remote controlled fixed weapons, which are guns that can be operated from another location. Dr. Bunker also discussed how he perceives UAS operated by terrorist and insurgent groups will pose an increased threat into the future. He explained that today's present threat vis-à-vis unmanned aerial vehicles (UAV) comes from a single UAV that is human controlled. However, he asserts that in the future, we will likely obverse the use of a group of UAVs that are human controlled or semi-autonomous, or a swarm of UAVs that are completely autonomous.

Panel III: State of Governance: Law and Policy

The third panel concentrated on legality and the existing policies that govern the use of RAS in military operations. It sought to stimulate insight concerning the relevance of the Law of Armed Conflict (LOAC) vis-à-vis RAS and the potential necessity for an international treaty to govern the use of RAS in military operations. This panel also focused on how organizations such as the North Atlantic Treaty Organization (NATO) and the United Nations (UN) perceive the use of RAS in their missions. **Dr. Jeff Larsen**[12] moderated this panel and opened with his assertion that RAS will not revolutionize warfare, as he articulated that the last 20 meters of warfare will not change.

The first panel presenter, **Dr. Wolff Heintschel von Heinegg**,[13] focused on the definitional issues relating to RAS, and what the current LOAC says and how it relates to RAS. In his view, no definitional issues exist vis-à-vis RAS in international law. Dr. von Heinegg illustrated how definitional dissonance exists between what a robot actually is and the public's conception of a robot. He asserted that definitional ambiguity is a red herring that is simply

11. Futurist in Residence, Federal Bureau of Investigation Academy, Quantico, VA; Adjunct Research Fellow at the Strategic Studies Institute, US Army War College

12. Director of the Research Division at the NATO Defense College

13. Chair of Public Law (Public International Law, European Law and Foreign Constitutional Law) at the Europa-Universität Viadrina in Frankfurt, Germany

distracting us from discussing important matters relating to RAS. Dr. von Heinegg defined autonomy as freedom of action and self-government. To that end, he illustrated that a mobile robot is not autonomous, since it has no decisional autonomy and has been programed to achieve the best expected outcome in the face of uncertainty. He also clarified that robots are deemed means of warfare if they are designed or used for attack, if they are purposed to inflict damage, death, destruction, or injury. In Dr. von Heinegg's view, the arms control approach to RAS – a total ban on "killer robots," systems that are not under meaningful human control – is nonsensical, given in everyday life, humans trust and rely on technology. For example, he noted that humans trust when their computer tells them that it needs to update. To that end, Dr. von Heinegg asserted that the demand for a total ban on RAS is based on imprecise legal arguments. He stated that the arms control approach is not meaningful or promising, particularly given it will not likely be pursued by many states and that those states that do pursue the approach are without clout in the realm of international security. While the control of RAS resides under the LOAC, currently it does not express any prohibition vis-à-vis RAS. Currently, no conventional weapons system is in non-compliance with the principles of the LOAC.

Dr. Gilles Giacca[14] opened his presentation by stating that all weapons must be used in accordance with international humanitarian law. Dr. Giacca asserted that the campaign coalition to stop "killer robots" conflates what is legal with what is ethical. Dr. Giacca's presentation outlined the debate concerning whether humanitarian law requires targeting decisions be made by humans, how the characteristics of RAS can be used in conformity with international law, and the importance of the legal reviews of weapons. Dr. Giacca began by outlining definitional issues relating to RAS. In his view, an autonomous weapons system is an umbrella term that encompasses many different systems that can independently use force. Regarding legal review, Dr. Giacca noted that there are two different approaches to reviewing these types of warfare technology, the result centered approach and the process based approach. To promote the importance of the legal reviews of weapons, Dr. Giacca suggested that states share best practices, which allows policy considerations to be made for both state and international law. In his view, policy review must not only examine the weapons themselves but also their expected use on the battlefield. In Dr. Giacca's view, it is imperative to understand these technologies in order to make the proper legal assessments, which necessitates a consideration of: what the technology or weapon is being used for, the context in which it will be used, the type of weapon it is, the type of force it will inflict, the freedom of the weapon to move in space, the time frame of action of the weapon, and the predictability and reliability of the weapon. Dr. Giacca argued that legal review is the preliminary step toward ensuring compliance and that needs to be a new legal review process for RAS. The Red Cross derived a document for how to develop a process of legal review for RAS. While only a dozen states have participated in the formulation of this document, Dr. Giacca hopes that more states will come forward and share their perspectives, with the aim of formulating a well-supported process of legal review relating to RAS at the international level.

14. Legal Adviser in the Arms Unit of the International Committee of the Red Cross's Legal Division; Research Associate at the Oxford Institute for Ethics Law and Armed Conflict

Dr. Kenneth Anderson[15] focused his presentation on the question of what are we trying to regulate and why. In his view, the issue is not whether the weapon is a creature or a thing, or a who or a what, but rather the effects of these technologies. First, Dr. Anderson discussed what it is that we want to regulate in the realm of increasing automation. Here he introduced two conceptual tracks or ways of perceiving emerging RAS and related technology. The first track encompasses those who view emerging technology for what it is – advancements in physics, chemistry, engineering, and computer science – while the second track includes those who view such technological advancements through a science fiction lens. To that end, Dr. Anderson articulated that what we should be trying to regulate is technology viewed through the track one approach. In his view, unless we distinguish between the two tracks, we will make enormous legal mistakes. Second, Dr. Anderson discussed the aspects of this technology that people fear that has led to the desire for international regulation. His response was contingent on his two-track vision, wherein the fear for those adhering to track one and two is that the system is not capable of delivering on what it was designed to deliver on and the system is too capable, respectively. Third, Dr. Anderson considered how and why we are at the point where we are debating human control. The concern from a legal standpoint is the speed of operations (whether the technology can operate faster than a human) and independent decision-making (whether the technology can make decisions without human control). Fourth, Dr. Anderson approached the question of human control from the direction of the Convention of Certain Conventional Weapons (CCW). He asserted that we cannot regulate in the abstract, that is, systems must be assessed on an individual basis. As well, regarding international legislation, Dr. Anderson asserted that it is too early to be formulating and contemplating legal treaties. In his view, what can be done is the encouragement of states that are designing RAS to become more transparent and share their standards on how they assess the legality of their own developments.

Panel IV: Ethical Considerations

Colonel James Cook[16] moderated the fourth panel, which examined the ethical considerations for the military's use of RAS. This panel served as an important reminder that the use of RAS in the military is not just a legal concern but also an ethical one. The three main questions posed to the panelists were: is it ethical for a machine to decide what is a target, where do you draw the line between friendly force protection and risk of civilian casualties, and who is a combatant and what is battle space within a global RAS environment?

Dr. Wendell Wallach[17] first posed a question to those in attendance. He asked us to ascertain if we would be comfortable in a situation where a human is in combat against a robot that has been designed to draw and shoot more quickly than a human. He explained that over 50% of Americans are against the use of robotics in military activities, a statistic that comprises individuals mostly from the far left, far right, and active and retired military personnel. Dr. Wallach chose not to define lethal autonomy, as he asserted that definitional debate consume

15. J.D. Professor of Law at American University Washington College of Law; Visiting Fellow, the Hoover Institution; Non-Resident Senior Fellow, the Brookings Institution

16. Permanent Professor and Head, Department of Philosophy, US Air Force Academy (Colorado Springs, Colorado)

17. Scholar at Yale University's Interdisciplinary Center for Bioethics; Senior Advisor to the Hasting's Center; Scholar at the Lincoln Center for Applied Ethics; Fellow of the Institute for Ethics and Emerging Technology

discourse and detract from other important considerations. He reminded us that law and ethics evolve other time. For example, he noted that the LOAC has evolved over the past 150 years in terms of the legal stipulations concerning how a war should be fought. Dr. Wallach raised an argument that had not yet been discussed at the conference, concerning whether robots can be made to comply with the rules of war or the LOAC better than human soldiers. In his view, such a scenario is unlikely. He also asserted that if and when robots are empathetic machines and can show the moral sensitivity that they can obey the LOAC, only then can we assess whether these machines should be given the status of a person. In sum, Dr. Wallach's presentation centered around two main points. First, Dr. Wallach suggested that we are at a point of inflection, where there is a possibility of putting a certain type of moral constrain in place that will soon disappear, but not because robots are smarter than humans. Second, he asserted that we need to be careful of the dissolution of responsibility, as the addition of new technologies to our repertoire will make it more difficult for people to take responsibility for their actions.

In essence, Dr. Wallach asserted that our discussion of the implications of RAS on humanity is misplaced, as we ought not to blame technology for the devolution of human responsibility but rather ourselves. In his discussion of whether fully autonomous systems will develop, Dr. Wallach reminded us that humans introduce artifacts. He noted that there is a concern for us not to undermine this principle of human responsibility that we are currently diluting. He stated that the principle of meaningfulness is less about meaningful human control of robots or military technology and more about crystallizing human responsibility. Dr. Wallach discussed the probability and payoff of an arms control agreement on robotics. In his view, it is both unlikely and problematic to have an arms control agreement on robotics. He explained the Martens Clause in the LOAC, its meaning and applicability today vis-à-vis RAS. The Martens clause stipulates that the human person remains under the protection of the principles of humanity and public conscience. The inability of the LOAC to remain up to date with technology was the impetus to the Clause. In his explanation of the Martens Clause, Dr. Wallach discussed the extent to which public conscience has been made fearful by all the negative hype surrounding RAS.

The second panel presenter, **Dr. George Lucas**[18] focused on the concept of fear and its ethical and legal implications. In his view, fear is not a good strategic posture, as it simply ignites public interest centered on worry and anxiety. He also stated that fear dissuades the development and use of robotics, which are promising technologies. Dr. Lucas called for thoughtful and un-hysterical ethical thinking. He asserted that a consideration of the impact of RAS on human beings is not just an ethical question but also a philosophical one as well. In his view, fear-mongering vis-à-vis RAS has occurred because these technologies have been vastly oversold. As an example, Dr. Lucas pointed to the Google Self-Driving Car and discussed how the public is not worried by the idea of removing the driver from the driver's seat, yet when these technologies fail, they inflate the public's anxiety. Dr. Lucas also discussed his views on how best to control RAS. Dr. Lucas noted that there is very little in the way of specific legislation pertaining to robots, particularly in the context of international law. He stated that in lieu of an arms control convention, we ought to look to the application of soft law governance, wherein stakeholders define and impose codes of conduct, guidelines, percepts, and principles for good practice. As an example of a principle that could be incorporated in soft law governance vis-à-vis

18. Professor of ethics and public policy at the Graduate School of Public Policy at the Naval Postgraduate School (Monterey, California)

RAS is the principle of unnecessary risk, which stipulates that security forces should have everything they need for them to be more effective and safe in their jobs. Dr. Lucas argued that if developing particular types of technology will allow soldiers to pursue legally and morally justifiable endeavours, then it is owed to the fighting forces to have such technology.

Keynote Address: Robots, Autonomy, and the Next World War – Dr. Peter W. Singer

Dr. Peter W. Singer[19] provided the conference's keynote address. He opened with his assertion that the next generation of robotics will be like observing science fiction play out. As an example, he noted that when the US military entered into Afghanistan it possessed unarmed drones and now, the US has both air and land drones that are armed. In his view, the questions of concern are related to how to staff and command units that operate such technology and how this technology impacts when and where people go to war. Relatedly, Dr. Singer asserted that the human-machine relationship has and will continue to evolve, such that there will be a shift from humans remotely operating machines to these machines taking on mission sets all on their own. That is, humans will move from being in the loop of decision making to being on the loop of decision-making, to perhaps being out of the loop of decision-making. However, Dr. Singer argued that in the war between manned and unmanned systems, manned systems are winning.

Dr. Singer asserted that there are five key reasons for the opposition of RAS. First, individuals oppose such technology on normative and ethical grounds. To expand, Dr. Singer noted that the controversy surrounding this technology has led to a slowdown in its development, particularly through non-governmental organization (NGO) activities, UN meetings, and Pentagon policies. Second, a lack of government spending on RAS and related technologies has also led to their opposition. To that end, Dr. Singer discussed the conflict that exists between existing and new government programs, wherein new programs are those that face the disadvantage. Third, opposition to RAS and related technologies is owed to the Innovator's Dilemma, which describes how first generation technology is often worse than the old technology it is intended to replace. As an example, Dr. Singer discussed the US Army's shift toward mechanization that replaced horses with trucks and tanks. The decision was viewed as a poor one by some personnel, who argued that horses had 4,000 years of combat experience, while tanks only had a few years on record of below average records in World War I. Dr. Singer articulated that the problem with such an assertion is that it is right in the historical sense but wrong in interpretation. Fourth, in Dr. Singer's view, people distrust and therefore oppose new technology based on misperceptions. Fifth, opposition to such technology often occurs because of uncertainty relating to questions of how new systems will link to existing ones.

Dr. Singer then addressed the question of what will drive us to RAS and related technologies, to which his response was four-fold. First, Dr. Singer indicated that the pursuit of these technologies by others will lead us to develop and use them. Relatedly, Dr. Singer discussed China's activity in the realm of RAS. He noted that China is selling armed planes to Nigeria and has plans to create various types of unmanned systems. The fear of what others can build and use will prompt us to drive these technologies further ourselves. Second, RAS technology will develop because such technology is becoming increasingly common in civilian life. As an example, Dr. Singer noted the developments relating to driverless cars. To that end, in

19. Strategist and Senior Fellow at the New America Foundation; Founder of NeoLuddite; award winning author; editor at Popular Science Magazine

his view, such technologies are not going to stop at the civilian border. Third, Dr. Singer argued that personnel shifts will prompt such technological development. He explained that the response to the provision of huge amounts of information by these new systems is to apply technology to help sift through data more effectively. Fourth, the drive to create and utilize new technology relating to RAS will be the result of the natural evolution of norms and laws. To expand, Dr. Singer stated that what was once unthinkable and unallowable can become acceptable, ethically and legally. For example, he noted that it took the US five hours after the attack on Pearl Harbor to change its ethics on the use of submarines.

Day II: May 13

Overview of Day I

Major-General Jean-Marc Lanthier[20] opened the second day of the conference with an overview of the previous day. Major-General Lanthier reviewed, what he perceived were the challenges from day one, which included confusion regarding where to focus efforts, how best to keep pace, and the threats posed by RAS technologies. He asserted that the two-track approach to understanding RAS was particularly helpful. He also argued that while no system is fail proof, we must endeavour to reduce the likelihood of failures. Like many other speakers, Major-General Lanthier also asserted that war is a human endeavour that is self-constrained by human emotion. He asked how war can be constrained if robots dominate war and suggested that we ought to consider the impact of RAS technologies on the human nature of war.

Panel V: Assessing, Detecting, and Responding to RAS Threats

First panel presenter, **Dr. Guy Vézina**[21] provided three insights during his presentation. First, he suggested that our discussions surrounding RAS will not be fully realized as we expect. That is, he asserted that autonomy will eventually seep gradually into every aspect of our lives. Second, he discussed the revolution versus evolution debate. He argued that while hardware is evolving through technological advancements, what will make a larger impact is the software, as it will allow for an easier evolutionary process. Third, Dr. Vézina noted that the challenge of assessing, monitoring, and predicting systems will remain a longstanding challenge. In his view, the topic of defeating RAS systems is extensively studied, with the aim of increasing our understanding of how to react to these systems when employed offensively by adversaries and how to build resilient systems that can withstand attacks.

Following Dr. Vézina's discussion, **Colonel Richard Dickson**[22] spoke to autonomous systems as disruptive systems. In his view, we ought to focus less on how to defeat these systems and think more about how to respond to the adversary who is using these systems, as it is ultimately humans behind the machines. He argued that no matter how sophisticated these technologies become humans will remain behind them.

---

20. Commander, Canadian Army Doctrine and Training Centre

21. Director General Science and Technology Army; Scientific Advisor to the Chief of the Canadian Army

22. Director of the Canadian Army Land Warfare Centre

Presentation discussions were in response to four questions. The first question was how will RAS adversary systems – either non-lethal or lethal – affect our own tactical operations? Dr. Vézina argued that the RAS adversary system will prove disruptive, as many different technologies coming together will create havoc. In his view, the whether a system is lethal or non-lethal will shape behaviours and responses. Although, Dr. Vézina acknowledged that the line between lethal and non-lethal systems is often blurred. Colonel Dickson agreed with Dr. Vézina's remarks and echoed his sentiments in response.

The second question of focus was how should threats be anticipated given technical, legal, moral, and ethical constraints of state and non-state groups, and individual actors. Dr. Vézina stated that many pieces of technology already in existence can pose real threats. For example, he discussed three-dimensional printing and argued that such a tool allows for dangerous replications. To that end, he stated that we should be concerned about connectivity and how it can be exploited. Dr. Vézina asserted that the implementation of any legal framework is a challenge, particularly vis-à-vis enemies. Colonel Dickson argued that we must anticipate these technologies. In his view, the legal, moral, and ethical constraints are moot points because what is ethical and moral is relative, and because what is ethical and moral can change over time. He also noted that changes will not occur drastically but rather gradually, which will allow for appropriate modifications to be made in practice.

Third, the panel was asked how unstructured or complex environments and unpredictable or evolving scenarios will affect our ability to respond. The challenge in such situations, according to Dr. Vézina is predicting adversaries' behaviour, which can be done by coding and decoding their behaviour to assess how they will behave with new RAS technology. In response to this question, Colonel Dickson suggested complex and unpredictable situations favour the human. However, he also claimed that encountering robotic systems may require us to respond rapidly, which may obligate us to retaliate using robotics if robots can respond faster than humans.

The fourth question the panelists were asked to speak to concerned how Canada should approach the development of capabilities to counter such systems. Dr. Vézina advocated for a four-step approach that involves: threat modeling and assessment, threat detection and behaviour prediction, threat counter measures, and experimentation. Colonel Dickson stated that strategically, we want to avoid being surprised and dislocated. To that end, he argued that there is utility in reducing surprise by anticipating how other groups or states will act. He noted that intentions and risk are different for state and non-state groups. For example, in his view, non-state actors are not going to have as sophisticated technology as states.

Panel moderator, **Dr. von Hlatky**[23] presented a number of pertinent considerations that followed from the panel discussion questions and responses. She asked about the benefits that RAS can deliver vis-à-vis adversaries. In her view, it is striking that there is faith in the benefit of RAS technologies as being force multipliers. She also raised potential connections between the development of nuclear weapons and RAS. She questioned whether RAS are or will be used to reduce a conventional gap, as was the case with nuclear weapons between the US and the Soviet Union. Dr. von Hlatky also asserted that the moral constraint that exists with nuclear weapons

23. Assistant Professor, Queen's University; Director of the Queen's Centre for International and Defence Policy

does not exist for RAS because of how robotic technology has evolved incrementally. Dr. von Hlatky also asked that we consider if and how some actors may exploit the ambiguity of international legislation and its implications. Focusing on the Canadian context, Dr. von Hlatky suggested that it would be interesting to compare different Western countries' approaches to robotics and seek insight into why certain states have the policies they do regarding the pursuit of lethal versus non-lethal robots.

Panel VI: Force Development Strategies: Revolution vs. Evolution

In addition to sparking discussion regarding RAS technologies as revolutionary or evolutionary, the sixth panel intended to spark insights into whether we can innovate using existing RAS technology or if we must invest in leading-edge science and technology, and the challenges in doing so. **Major-General Stephen J. (Steve) Bowes**[24] was the first to present his insights from a Canadian perspective. In short, Major-General Bowes asserted that Canada is not positioned to take a revolutionary approach to RAS technologies and as such, Canada's development with RAS will be an evolutionary process. He noted that Canada is not as involved in the development of this technology, as compared to other states. He argued that from both a global and state level of analysis, Canada needs to keep pace with technological changes. To that end, he stated that there are fundamental changes within the international community that Canada needs to incorporate into its own spending. Given Canada's defense budget challenges, Major-General Bowes advised that Canada ought to work with its partners to complement what other countries are doing and leverage these developments. Pertinent to note is Major-General Bowes' claim that academic sectors and commercial actors are leading the dialogue on RAS. As well, he discussed how it is undesirable for companies to work and service the defense industry because there is more benefit in the private industry and therefore private companies will switch from servicing the department of defense to servicing the public. Major-General Bowes concluded his presentation by outlining the implications of his claims. He stated that Canada is likely to innovate to the best of its ability with the limited resources it has. As well, he noted that the government should continue to develop niche technologies, as it is one of Canada's strengths and allies want Canada to continue advancing these niche technologies.

Major-General Robert M. (Bo) Dyess[25] provided an American perspective to the revolution-evolution debate. Major-General Dyess echoed the sentiments of Major-General Bowes, for example, noting how the US Army has not been revolutionary vis-à-vis RAS technologies. Although Major-General Dyess noted the inability of the US Army to revolutionize with new technology, he argued that it is possible to be innovative by using a combination of existing and new technology. He also noted that innovation will come from soldiers learning how to use existing technology in novel ways. Although there is an overall pressure for reduction in all federal budgets, Major-General Dyess discussed how an increase in one area of spending will result in a decrease in another. For example, he noted that funding for unmanned ground systems is going up while funding for UAS is going down. Relatedly, he noted the US Department of National Defense's statement that unmanned systems must become more efficient in addressing capability gaps, including increases in autonomy, effectiveness, interoperability, modularity, and teaming with manned systems.

24. Chief of Force Development, Canadian Armed Forces
25. Director, Force Development, Office of the US Army Deputy Chief of Staff

Panel moderator**, Dr. Veronica Kitchen**[26] asked that the panelists speak to how Canadian and US forces are matching technical and social innovation. In response, both panelists acknowledged that more developments are taking place in the social versus the military context. As well, Dr. Kitchen asked Major-General Bowes and Major-General Dyess whether the increased use of RAS will lead to moral de-skilling. In response, Major-General Dyess asserted that we are a long way away from the development of these technologies, which means that training is not yet necessary. Conversely, Major-General Bowes argued that training and education is necessary, as the military must maintain the ability of its personnel to operate effectively by keeping them up to date.

Panel VII: Policy Recommendations

Panel moderator, **Dr. Steve Metz**[27] introduced the seventh and final panel of the conference as the "so what" panel. He articulated that the purpose of the panel was to stimulate thinking about how to operationalize the insights from the conference, to produce feasible and realistic policy. Dr. Metz suggested that we are progressing in robotic technology much faster than we originally perceived. To that end, he asserted that the challenge vis-à-vis RAS will come when humans become the grandparents of this technology, that is, when machines are able to create other machines.

Dr. Elinor Sloan[28] observed that the conference did not focus on defining a robot, with the exception of Dr. Singer, who noted a machine is a robot if it has sensors to monitor the environment, processors, and tools to conduct a response. She articulated that lethal weapons are already part of remote control warfare and are semi-autonomous, such as a cruise missile. In her view, there are three operational shortcomings of remote control platforms that are driving the move toward autonomous systems, which include connection control, high-manning requirements, and the OODA loop decision cycle (which includes the following processes: observation, orientation, decision, and action). She noted two ways in which robots could be used in combat. The first strategy revolves around the mother ship concept, which involves a small number of high value robots that are sent out to perform a task and then return. The second strategy is one of swarming, wherein a number of cheap, disposable robots are employed without the intention of their return. Dr. Sloan asserted that for two centuries, the battlefield has been getting smaller. She argued that swarming will reverse the aforementioned trend. Regarding the implications of RAS for civilian and military leadership, Dr. Sloan suggested that the core of the issue is not the degree of autonomy, but rather the coupling of increased autonomy with lethality. To that end, she recommended that we distinguish between lethal and non-lethal platforms as opposed to degree of autonomy. In her view, the implications for non-lethal and lethal systems are different. For example, she views non-lethal systems positively and argued that they should be pursued and used particularly for the purpose of risk reduction. Conversely, Dr. Sloan divides lethal systems into those that are remote controlled and those that are semi-autonomous or autonomous. She asserted that remote controlled systems should be pursued to help the

[26] Associate Professor of Political Science, University of Waterloo and the Balsillie School of International Affairs

27. Research Professor and Director of Research at the US Army War College Strategic Studies Institute

28. Professor of International Relations in Carleton University's Department of Political Science

warfighter on the ground. However, she viewed semi-autonomous and autonomous systems as qualitatively different from remote controlled systems, as they remove the human from the loop of control. To that end, she still suggested that good reasons do exist for us to develop lethal semi-autonomous and autonomous weapons. Perhaps, she suggested, such technologies should be utilized against other robots.

Dr. Kim Richard Nossal[29] opened with his observations from the conference before delving into the policy implications and recommendations vis-à-vis the role of robotics in defense procurement. He discussed the depth of agreement that we are nowhere near the type of autonomous lethal weapons systems that concern most of those who would want to ban killer robots, for example. He noted that the near consensus at the conference that we are far away from the time when robots can operate without humans being in the loop of control has clear policy implications. In his view, robotic systems will remain pertinent in military operations. As such, Dr. Nossal argued that we ought to put the issue of reflecting on the role of robotics in the context of traditional views of what war is, who it is for, and who it involves. He suggested that we need to think about robotics in the context of kinetic operations as part of the overall kit that armed forces will need to pursue military operations in the future. Dr. Nossal also asserted that if there is no role for robotics in the recapitalization of the military, difficulties will ensue. Regarding Canada's position in surface combattants, Dr. Nossal articulated that the problem is a structural one. He noted that robotics is not a part of the Canadian recapitalization program because those in political authority have not thought about the armed forces, what they are for, and what they need to carry out defense policy. Dr. Nossal asserted that notwithstanding Canada's largely pro-military governments, there has been very little strategic thought in Canada. In his view, this lack of strategic thought is reflected in the problems relating to a focus on recapitalization. His policy recommendation was a structural one, as he urged for strategic thinking of defense policy in Canada.

Mr. Tony Battista[30] likened the introduction of RAS and other related technologies in military operations to an "old dance to new musical instruments." In his view, we will eventually get close to removing the human from the loop of control. He presented his policy recommendations in the form of a new acronym CII, which stands for collaboration, interoperability, and innovation. Mr. Battista argued that in today's environment, collaboration is imperative. He noted that this recommendation applies not just to great powers, but to all states, as no one country can operate individually. To expand, Mr. Battista noted that terrorism and extremism has had a monopoly on the last 15 years of conflict and he predicted this trend to continue into the future. He noted that in terrorist and extremist warfare, the enemy is both a chameleon and a parasite, and that the enemy will not comply with the rules of warfare stipulated under international law, so it is for these reasons that collaboration is necessary. Related to the concept of collaboration, Mr. Battista called for policy that incorporates interoperability. He stated that if we accept the premise that moving to semi-autonomous or autonomous systems is inevitable, then we need to move to these systems with likeminded others. In addition to policy that incorporates collaboration and interoperability, Mr. Battista's final suggestion was for policy to be innovative.

---

29. Professor in the Department of political Studies at Queen's University; Director of the Queen's School of Policy Studies

30. Conference of Defense Associations Institute

Closing Remarks

Professor **Douglas C. Lovelace, Jr.**[31] provided the closing remarks for this year's KCIS conference. Professor Lovelace noticed that the conference did not discuss RAS in the context of peacetime competition among states. He noted that conflict is not always defined as war but that conflict can devolve into war if it is not properly mitigated. In his view, it is worth exploring whether RAS can fill the void between "shouting and shooting." That is, in situations where shouting is not enough but shooting is too much. From this perspective, he asked those in attendance to consider the utility of robotics across the continuum of military operations, not just in war. Relatedly, Professor Lovelace raised the question of the use of robotic systems in peacetime engagements. Professor Lovelace also discussed pertinent insights he took from the conference. First, he noted his agreement that robotics can be used for deterrent effects. Second, he reiterated the widely held view that the infusion of RAS in military operations is an evolutionary as opposed to a revolutionary process. He questioned this assumption, as he articulated that things that appear to be evolutionary at a particular point in time, in hindsight, were revolutionary. Lastly, he asserted that definitions indeed matter, as states cannot agree on rules that regulate systems if they cannot agree upon a definition for these systems.

31. Director of the Strategic Studies Institute (US Army War College)

PARTNERS

CANADIAN ARMY ARMÉE CANADIENNE

STRONG. PROUD. READY.
FORTS. FIERS. PRÊTS.

CENTRE FOR INTERNATIONAL AND DEFENCE POLICY
QUEEN'S UNIVERSITY

SSI
STRATEGIC STUDIES INSTITUTE

SPONSORS

NATO
Defence College

UNITED STATES OF AMERICA
EMBASSY

MDA

MEGGITT
smart engineering for
extreme environments

KEDCO
KINGSTON ECONOMIC
Development Corporation

active bionics INC
overcome.

Queen's
UNIVERSITY

THE FORUM FOR CANADA'S SECURITY AND DEFENCE COMMUNITY
VANGUARD