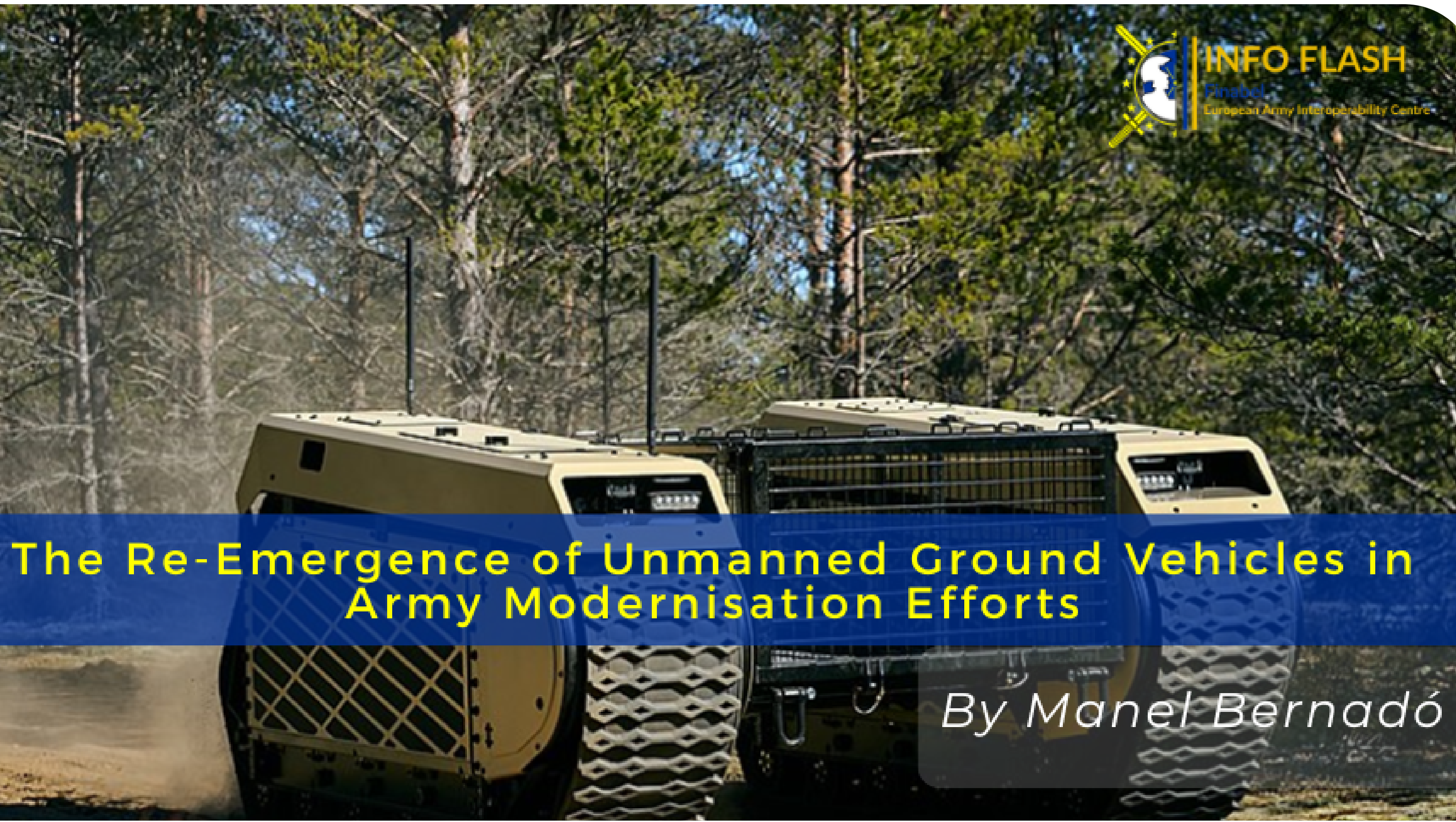
INFO FLASH
Finabel
European Army Interoperability Centre

The Re-Emergence of Unmanned Ground Vehicles in Army Modernisation Efforts

WRITTEN BY MANEL BERNADÓ

https://en.wikipedia.org/wiki/Milrem_Robotics#/media/File:THeMIS_5th_generation_UGV.jpg



The dawn of the new century seemed to promise an impending revolution in modern warfare in which unmanned, weaponised systems could augment the capabilities or even replace human elements from the battlefield. The use of unmanned systems in parallel or in lieu of human units factors would not only diversify and augment current military capabilities but also reduce the human risks of operating in hostile environments, even allowing to act in otherwise inaccessible scenarios.

In the past decades, the focus in military, academic and policy circles has primarily pivoted around Unmanned Aerial Vehicles (UAVs), partly due to their extensive use in the Global War on Terror (Blom 2010). Still, military experts and policymakers have long acknowledged the potential of Unmanned Ground Vehicles (UGVs) to shape the future of warfare, especially in the growing field of fully-autonomous UGVs (Scharre 2018; Sloan 2015). Though revived in recent years, the development of UGVs has a long lineage that can be traced back to World War II, including early versions of remotely-controlled vehicles such as the Soviet TT-26 and the German Goliath explosive-carrying tanks (Everett 2015). The field of ground robots flourished and thrived during the computing and microprocessor revolution from the 1970s onwards (Rossiter 2020; Gage 1995). Great powers devoted time and resources to developing teleoperated systems to undertake particularly hazardous functions such as de-mining activities or working under enemy fire, conducting intelligence, surveillance and reconnaissance (ISR) tasks. Although substantial advances in technology in the 1990s promised a breakthrough in UGV development, the collapse of the Soviet Union and the shift towards asymmetric warfare after 2001 deviated attention to small ground robots focused on ISR functions and dealing with Improvised Explosive Devices (IEDs), and multi-purpose UAVs (Rossiter 2020). Plans that had been created to provide militaries with large, armoured UGV systems at the vanguard of their forces were soon de-prioritised to pursue more pressing needs.

With the return of great power competition and growing prospects of interstate conflict, UGV development programmes have resurfaced worldwide for combat and support functions. The expansion and improvement of artificial intelligence allow military planners and policymakers to envisage the innovation that may come from having fully-autonomous combat UGVs to overwhelm their adversaries on the battlefield. However, history has shown that achieving technological innovation does not necessarily translate into transformative military capabilities (Coker 2015). The extent to which UGVs will eventually transform land warfare will depend on their integration within broader organisational structures, for which exposing military planners, soldiers and policymakers to these systems remains crucial.

Many challenges lay ahead for the generalised incorporation of remotely-controlled and partially-autonomous UGVs. Military organisations are intrinsically reluctant to undertake systemic overhauls, and a generalised adoption of UGVs even if it were for supportive tasks, would require deep organisational restructuring and the development and effective implementation of operational concepts and doctrine (Rossiter 2020; Ryan 2018). From a technical standpoint, specific models of teleoperated UGVs recently tested in combat environments have often failed to function appropriately, denoting an array of challenges that still need to be addressed. These include critical connectivity issues and interferences even in non-contested electromagnetic environments to the point that the system became out of service at times, problems with identifying and acquiring targets and firing mounted weapons systems, and still requiring the operator to remain close to the device (Rossiter 2020).

Part of these challenges could be overcome by developing fully-autonomous UGVs for combat and support functions. These would be able to operate and adapt to changing circumstances, even when cut off from their unit's communication network. Autonomous UGVs dealing with logistics, medical evacuation, ISR, and even combat would reduce the human footprint on the battlefield while not requiring a nearby operator nor risking malfunction due to connection issues.

Creating autonomous, weaponised UGVs with little or no human saying in the "kill chain" poses great legal and ethical dilemmas for policymakers and military experts. The United States and other NATO Member States have pledged to retain human control or overview over the use of lethal force, its adversaries have not only not committed to that but seem eager to test the potential that autonomous combat UGVs have to offer (Osborn 2020). Even then, substantial technical challenges stand in the way of their introduction on the battlefield. Autonomous UGVs need to sense and interpret their environment and be able to adapt to it, making decisions while considering a myriad of dynamic scenarios and pre-programmed conditions (Rossiter 2020). In this regard, recent initiatives have improved the ability of UGVs to navigate autonomously and assume patrolling and target identification roles. However, their ability to act with full autonomy and effectiveness in combat positions, either independently or in coordination with human elements, seems distant at the very least.

State of Affairs in UGV Development: Russia, China, and the United States

Often regarded as the leading nation in the UGV field, the Russian Federation is at the forefront of teleoperated and autonomous ground vehicles. In the past decade, Russia has fostered private and public efforts in research and development to acquire remotely-controlled and autonomous UGVs (Elfving 2019). In Valery Gerasimov's own words, in the near future Russia could have "a fully robotised unit (...) capable of independently conducting military operations" (Coalson 2014). Indeed, the Russian government approved a plan for robotic platforms to constitute 30% of Russian combat power by 2030 (Ryan 2018). These efforts have provided Russia with over 35 UGV models, some of which have been tested in real-combat environments such as Syria, Nagorno-Karabakh, and Ukraine (Orlov 2022).

One of Russia's most notable systems is the Uran-9, a remotely-controlled UGV armed with a 30-mm cannon and up to four anti-tank missiles (Elfving 2019). Despite the expectations the Uran-9 created in Russia and the alarms it raised elsewhere, the system often malfunctioned in its first deployment in the Syrian Civil War (Roblin 2021; Rossiter 2020; Brown 2018). The system lost contact with the teleoperator 19 times during its time on the field, two of which for over 1.5 hours. The operator had to remain at a maximum distance of around 300 meters from the device, often encountering problems with the robot's tracks, suspension, and weapons systems. The lack of stabilised vision systems required the Uran-9 to stop moving before firing.

Despite these failures, Russia was able and has since then further tested this and other UGVs, improving the capabilities, reliability and range of its unmanned ground systems. To pursue fully or partially-autonomous armed UGVs, recent tests have included autonomous patrolling of security perimeters, friend-or-foe identification protocols, and interaction with other human and unmanned elements, including swarms of drones (Hambling 2021; Army Recognition 2021).

Uran-9 UGV at a military parade in Moscow in 2018. Credit Dmitry Fomin / Wikipedia

China's People's Liberation Army (PLA) does not fall too far behind. In the past, China has conducted exercises combining armoured units with unmanned systems, using teleoperated UGVs for ISR and de-mining purposes in coordination with swarms of drones (Miller 2020). Since 2020, the PLA counts with a weaponised UGV, the Sharp Claw I (Ruizhao I), manufactured by China North Industries Corporation (NORINCO). The Sharp Claw I is a tracked UGV with an operational range of one kilometre. Weighing around 120kg, it can be carried aboard and deployed from the Sharp Claw II, a 6-wheeled, remotely-controlled UGV. Armed with a 7.62mm machine gun, the Sharp Claw I is equipped to offer fire support to dismounted infantry at the platoon or squad level while engaging in short-range ISR (China-Arms 2020). Although reported to be teleoperated, it is unclear whether the system may operate autonomously (Keller 2020). The PLA has also recently put into service the Dragon & Horse II, an 8x8 support UGV to deliver ammunition and other supplies to combat zones with a payload of around 1,000 kg and an autonomy of 200km on road and 100km off-road (Army Recognition 2022; Dominguez 2022).

Sharp Claw I (left) dismounting the cabin of a Sharp Claw II (right). Credit China-Arms

Across the Pacific, the US is often said to lag behind its adversaries in developing UGVs, especially for combat. In the 1980s, the Teleoperated Mobile Anti-Armor Platform (TMAP) offered an early version of a UGV to fire anti-tank missiles (Hambling 2021), which never entered into service after the US Congress prohibited placing weapons on robots in 1987 (Rossiter 2020). A renowned interest in robots in the early 2000s brought attention to UGVs as an alternative to bigger, more expensive infantry vehicles to save American lives. The Congress issued a mandate in 2000 for a third of all operational ground vehicles in the US military to be unmanned by 2015 (National Defence Authorization Act 2000). Plans were developed for the development and extensive use of teleoperated UGVs such as the Multifunction Logistics and Equipment Vehicle (MULE), and unmanned alternatives for the M1 Abram tank and the M2 Bradly infantry vehicle (Rossiter 2020). However, as the War on Terror reshaped US foreign policy and security concerns, the emphasis pivoted around small aerial and ground robots for ISR functions and IED management (Rossiter 2020), and strong UAV combat capabilities which the US has extensively used in the Middle East.

Today, to keep en par with the developments of their adversaries, the US Army has plans to acquire a robust and multi-purpose fleet of UGVs for ISR, support and combat roles to augment the capabilities of infantry and cavalry units (Mizokami 2021). The various models of a future Robotic Combat Vehicle (RCV) family will transport supplies, and heavy weaponry alongside small infantry units (RCV-Light), host teleoperated weapons stations such as the Common Remotely Operated Weapons Station – Javelin (CROWS-J) or carry chain guns and anti-tank missiles to provide support to M2 Bradley heavy infantry vehicles and M1 Abrams tanks (RCV-Medium and Heavy). An example of a system that could serve as RCV-M is Textron System's RIPSAW M5, a highly mobile UGV capable of hosting multi-domain ISR and heavy combat capabilities.

The European Way – Milrem Robotics and the THeMIS

In Europe, the Estonian company Milrem Robotics leads a consortium that received EUR 30.6 million from the European Commission as part of its European Defence Industrial Development Programme (EDIDP) to develop standardised European UGVs (Sprenger 2020). Under the Integrated Modular Unmanned Ground System (iMUGS) project, the consortium will develop an interoperable and scalable architecture for hybrid manned-unmanned systems (European Commission 2019).

Milrem's most popular UGV, the Tracked Hybrid Modular Infantry System (THeMIS), is a multi-mission system primarily designed to support ground troops for transporting up to 750kg of supplies and medical evacuation. It can also be rapidly weaponised to provide fire support to dismounted units. During its testing in a counter-insurgency operation in Mali, the THeMIS operated for over 330 hours, navigating both autonomously and under remote control for over 1,200 km of rugged and plain terrain at more than 50ºC (European Defence Review 2022). The THeMIS has so far been acquired by Germany, France, the United Kingdom, the United States, Finland, Estonia, Spain, the Netherlands, Norway, and Australia, some of which have brought their national defence industries to the project. The company also counts with a combat UGV, the Type-X, an armoured, teleoperated mini-tank armed with 20 to 50mm chain guns that could provide heavy fire support to infantry fighting vehicles or engage in independent missions (European Defence Review 2020).

Milrem Robotics Type-X Robotic Combat Vehicle. Credit Milrem Robotics / Wikipedia

The purpose of pursuing a modular device at a European level is to foster private and public research and development to expand the range of capabilities currently available for the THeMIS, including weapons systems, while promoting and facilitating European army interoperability. For example, the Spanish Army has worked with the defence company Escribano to mount an OTEOS vision device or a 12.7mm Guardian 2.0 machine gun on the THeMIS as part of the Scorpion project for army modernisation (Carrasco 2021). The THeMIS and other projects under the iMUGS programme will provide European countries and other NATO Allies with highly interoperable capabilities and create a base upon which future projects may rely upon and a platform for cooperation among relevant actors in the European defence industry (Sprenger 2020).

Bibliography

Army Recognition (2022, January 6). Chinese army uses new Dragon & Horse II 8x8 UGV Unmanned Ground Vehicle to carry ammunition. Retrieved from: https://www.armyrecognition.com/weapons_defence_industry_military_technology_uk/chinese_army_uses_new_dragon_horse_ii_8x8_ugv_unmanned_ground_vehicle_to_carry_ammunition.html

Army Recognition (2021, October 27). Russian Marker UGV robot to operate in fried-or-foe identification mode. Retrieved from: https://www.armyrecognition.com/defense_news_october_2021_global_security_army_industry/russian_marker_ugv_robot_to_operate_in_friend-or-foe_identification_mode.html

Blom, John D. (2010). Unmanned Aerial Systems: A Historical Perspective. Occasional Paper 37. Combat Studies University Press. Retrieved from: https://www.armyupress.army.mil/Portals/7/combat-studies-institute/csi-books/OP37.pdf

Brown, Daniel (2018, July 9). "Russia's Uran-9 Robot Tank Reportedly Performed Terribly in Syria. Business Insider 9, no. July 9. https://www.businessinsider.com/russias-uran-9-robot-tank-performed-horribly-in-syria-2018-7?r=US&IR=T

Carrasco, Benjamín (2021, April 11). Programa "Escorpión": En Busca de un Vehículo No Tripulado para el Ejército. La Razón. Retrieved from: https://www.larazon.es/espana/20210411/takre7fabvfzjf6loxzcauq524.html

China-Arms (2020, May 1). Ruizhao UGVs in service with Chinese army were initially for overseas market. China's New Military Weapons. Retrieved from: https://www.china-arms.com/2020/05/ruizhao-ugv-enter-service-pla/

Coalson, Robert (2014, September 2). Top Russian General Lays Bare Putin's Plan for Ukraine. Retrieved from: https://www.huffpost.com/entry/valery-gerasimov-putin-ukraine_b_5748480

Coker, Christopher (2015). Future War. Polity Press, 1st edition. ISBN: 978-1509502325

European Commission (2020). Integrated Modular Unmanned Ground System. Retrieved from: https://ec.europa.eu/commission/presscorner/api/files/attachment/865736/EDIDP%20-%20iMUGS.pdf.pdf

European Defence Review (2022, August 8). Milrem Robotics delivers the first THeMIS Unmanned Ground Vehicle to the Spanish Army. Retrieved from: https://www.edrmagazine.eu/milrem-robotics-delivers-the-first-themis-unmanned-ground-vehicle-to-the-spanish-army

Bibliography

European Defence Review (2020, June 8). Type-X: an unmanned direct fire support solution (and more) by Milrem Robotic. Retrieved from: https://www.edrmagazine.eu/type-x-an-unmanned-direct-fire-support-solution-and-more-by-milrem-robotics

Everett, H.R. (2015). Unmanned Systems of World Wars I and II. MIT Press. ISBN: 9780262029223

Gage, Douglas W. (1995). A Brief History of Unmanned Ground Vehicle (UGV) Development Efforts. Special Issue on Unmanned Ground Vehicles. Unmanned Systems Magazine. Retrieved from: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.476.588&rep=rep1&type=pdf

Hambling, David (2021, September 2). Russia's Autonomous Robot Tank Passes New Milestone (And Launches Drone Swarm). Forbes. Retrieved from: https://www.forbes.com/sites/davidhambling/2021/09/02/russias-autonomous-robot-tank-passes-new-milestone-and-launches-drone-swarm/?sh=30e80e621fa9

Dominguez, Gabriel (2022, January 11). PLA Deploying Dragon & Horse II UGV for Supply Role. Mönch Publishing Group. Retrieved from: https://monch.com/pla-deploying-dragon-horse-ii-ugv-for-supply-role/

Elfving, Jörgen (2019, November 7). Russian UGV Developments. European Security & Defence. Retrieved from: https://euro-sd.com/2019/11/articles/15193/russian-ugv-developments/

Keller, John (2020, July 14). China developing armed unmanned ground vehicles (UGVs) fighting forces as combat robots. Military+Aerospace Electronics. Retrieved from: https://www.militaryaerospace.com/unmanned/article/14179433/armed-unmanned-ground-vehicles-ugvs-robots

Miller, David (2020, August 20). The Future of Unmanned Ground Systems in the Operational Environment. US Army. Retrieved from: https://www.army.mil/article/238342/the_future_of_unmanned_ground_systems_in_the_operational_environment

Mizokami, Kyle (2021, August 3). The Army's Robotic Combat Vehicles Will Invoke WWII's 'Ghost Army'. Popular Mechanics. Retrieved from: https://www.popularmechanics.com/military/weapons/a37202757/army-robotic-combat-vehicles-ghost-army/

National Defense Authorization Act for Fiscal Year 2001 (2000). US Public Law 106–398, Section 220(a). 106th US Congress, 2nd session. Retrieved from: https://www.govinfo.gov/content/pkg/PLAW-106publ398/pdf/PLAW-106publ398.pdf

Orlov, Alex (2022, April 13). Footage suggests first recorded use of Russian UGV in Ukraine. Shephard. Retrieved from: https://www.shephardmedia.com/news/uv-online/first-recorded-use-of-a-russian-ugv-in-ukraine/

Bibliography

Osborn, Kris (2020, June 28). Robot vs. Robot War: China Deploys New Armed Robots. Warrior Maven: Center for Military Modernization. Retrieved from: https://warriormaven.com/future-weapons/robot-vs-robot-war-china-deploys-new-armed-robots

Roblin, Sebastien (2021, April 7). What Happened When Russia Tested Its Uran-9 Robot Tank in Syria? National Interest. Retrieved from: https://nationalinterest.org/blog/reboot/what-happened-when-russia-tested-its-uran-9-robot-tank-syria-182143

Rossiter, Ash (2020). Bots on the ground: an impending UGV revolution in military affairs? Small Wars & Insurgencies, 31(4), 851-873. DOI: 10.1080/09592318.2020.1743484

Ryan, Mike (2018). Human-Machine Teaming for Future Ground Forces. Center for Strategic and Budgetary Assessments, Washington, D.C. Retrieved from: https://csbaonline.org/uploads/documents/Human_Machine_Teaming_FinalFormat.pdf

Scharre, Paul (2018). Army of None: Autonomous Weapons and the Future of War. New York: W.W. Norton & Company. ISBN: 0393608980

Sloan, Elinor (2015). Robotics at War. Survival 57(5), 107–120. DOI: 10.1080/00396338.2015.1090133

Sprenger, Sebastian (2020, December 16). European Union awards grant to forge ground vehicle standard. Defense News. Retrieved from: https://www.defensenews.com/global/europe/2020/12/16/european-union-awards-grant-to-forge-unmanned-ground-vehicle-standard/