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Seventh Mine Action Technology Workshop: A Space for Innovation

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SEVENTH MINE ACTION TECHNOLOGY WORKSHOP
A SPACE FOR INNOVATION

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Attendees listen to presentations at the Seventh Mine Action Technology Workshop in Basel, Switzerland.
All graphics courtesy of the authors.

The 7th edition of the Mine Action Technology Workshop, a biennial event organized by the Geneva International Centre for Humanitarian Demining (GICHD), took place from 7 to 8 November 2019 in Basel, Switzerland. Titled *Remote Sensing and Robotics in Mine Action*, the workshop welcomed 165 participants from forty-nine countries, representing eighty-five organizations.[1] It offered a platform to discuss and share ideas and experiences that promote the efficient use of innovation and technology in humanitarian mine action (HMA).

This unique event is aimed at bringing together mine action professionals, manufacturers, national authorities, operators, and representatives from the United Nations as well as other international organizations. It focuses on the vital role technological innovation plays in increasing efficiency and effectiveness in emergency response, humanitarian aid, and development.

TECHNOLOGICAL INNOVATION RESHAPES HMA

Innovation is reshaping HMA, bringing about fundamentally new and potentially much more efficient approaches to our work. The changes represent a real opportunity for the mine action sector to learn about new, more effective, and safer ways of working. For example, remote sensing is now used in mine action, not only to assist in planning, monitoring, and evaluating clearance operations, but also to support the land release process and help measure impact.

Initially developed for military purposes, unmanned aerial systems (UAS) have rapidly gained traction in civilian sectors, and increasingly so in humanitarian aid and development assistance. In HMA, UAS are currently used as one of many tools to support operations to tackle the most important challenge—human safety. Numerous presentations given during the workshop were testament to the fact that information gathered from the use of UAS in HMA adds value across a wide range of different applications in planning, implementing, and impact-assessing activities.

LESSONS FROM THE FIELD

During the workshop, mine action operators, technology developers, and researchers showed examples of how UAS can support mine action operations in the field. They presented innovative applications for close inspection, direct and indirect evidence detection, ground penetrating radar (GPR) potential, and the use of multispectral and hyperspectral sensors for evidence records. The workshop also illustrated how HMA organizations are currently using or testing UAS in their operations.

The HALO Trust presented several case studies where UAS were being used in mine-affected countries and territories (Angola, Cambodia, Colombia, Georgia, Guinea-Bissau, Lao PDR, Somaliland, Sri Lanka, and the West Bank) to support various mine action activities, such as pre-deployment planning, remote monitoring of operations, terrain inspection, and impact assessment. The evidence for using UAS in operational planning was also presented by (MAG) Mines Advisory Group, who have used UAS in northeast and northwest Cambodia. High-resolution images were used by MAG for terrain and vegetation analysis to plan task sites prior to clearance and to provide a better overview for deploying various mine clearance assets (mechanical, animal, and manual detection systems).

John Fardoulis of Mobility Robotics and Humanity and Inclusion presents on drone trials in Chad.

CATEGORY	EXAMPLES
Non-Technical Survey	Confirm visible (direct or indirect) evidence of mines, explosive ordnance or other evidence to identify a suspected hazardous area (SHA)
	Confirm evidence of land use to contribute to all reasonable effort for area cancellation
	Conduct an assessment of soil, topography, and other environmental characteristics of SHAs and confirmed hazardous areas (CHAs)
	Quality control of data and information
Operational Oversight	Task planning
	Mapping of demolition sites/effects and mine lines
	Cordon enforcement
	Demolition monitoring
	Mapping progress and completion
	Accident investigation
Post-Clearance	Monitoring and evaluation of clearance impact
	External communications
Other	Damage assessment after unplanned explosions at munitions sites
	Analysis of current and planned ammunition storage areas
	High-resolution mapping
	Further spatial analyses
	Task prioritization

Figure 1. The demonstrated use of UAS.

CATEGORY	CHALLENGE/OBSTACLE/RISK
Political	Perception of drones and their usage by criminals (e.g., ISIS in Iraq)
Economic	High cost of some of the larger drones
	Cost of failure
	Cost of logistics and support
Social	Technophobia
	Local capacity
	Staff turnover within mine action programs (skills/knowledge loss in programs)
Technological	Lack of spare parts in country
	Lack of repair facilities
	Short flight duration
Legal/ Regulatory	Understanding aviation regulations in each country, which include: • Import/export permissions; • Permission for use from local government and local communities; • Flight consent from the airspace controlling authority; • Awareness of limitations with regards to forbidden areas, maximum altitude levels; • Licenses and additional permissions required, depending on each country's regulations.
	Privacy and data protection laws
	Lack of technological and operational standards to guide safe and consistent performance of UAVs in HMA
Environmental	Soil conditions (which dictate choice of sensors)
	Depth of mines and explosive ordnance

Figure 2. Risks and challenges of using UAS in HMA.

Norwegian People's Aid (NPA) has been testing UAS in Bosnia and Herzegovina and in Montenegro since 2018, using red-green-blue (RGB) color and thermal cameras to assist in drawing more precise boundaries of suspected hazardous areas (SHAs) and assess the environmental characteristics of SHAs. UAS are also able to more accurately locate evidence that was previously found using other techniques.

The presentation made by the GICHD covered several aspects of UAS use in mine action and described the UAS module available on the GICHD e-learning platform. The platform contains case studies that explore how UAS imagery enhances land release activities as well as how UAS provide practical advice and guidance on UAS operations.

Mobility Robotics and Humanity and Inclusion (HI) presented on the Odyssey 2025 project and discussed their trials in Chad. This project further demonstrated how UAS and remote sensing could be used in pre-deployment planning, cartography, and operational research. In particular, it has been demonstrated that an infrared camera was able to geolocate anti-vehicle mines buried in sandy soil, thus facilitating manual demining activities.

UAS pose multiple challenges for HMA operators, who cite legal and regulatory issues as the most common, particularly individual countries' UAS regulations and importation/customs restrictions. The main challenges are listed in Figure 2.

RESEARCH AND DEVELOPMENT

Several organizations and research institutions presented their work on integrated remote sensing technologies:

The project SAFEDRONE, presented by the Counter Improvised Explosive Devices Centre of Excellence (C-IED COE), aims to develop and test an enhanced system for improvised explosive device (IED) detection using a high-resolution GPR mounted on board an unmanned aerial vehicle (UAV) that is being developed in cooperation with the University of Oviedo (Spain). The methodology is based on a synthetic aperture radar technique, high positioning accuracy (< 2 cm), and a deep and broad processing of signals by means of groups of coherent algorithms and artificial intelligence. Field tests of the system are planned to begin in October 2020.

In their presentation on the development and tests of the SeaTerra unexploded ordnance (UXO) survey drone system, UXO survey and clearance company SeaTerra summarized the different criteria to keep in mind when deciding to purchase and use drones; these included price, weight/payload, data, stability, sensors, positioning, and battery life.

Cobham Aerospace Connectivity presented their product, Amulet UAS, a medium-sized UAV that carries a GPR capable of searching for explosive ordnance (EO) in areas that would otherwise be too high-risk or inaccessible for human deminers.

The Urs Endress Foundation presented on the FindMine project, which has been running since 2016, in collaboration with Swiss and German universities, to develop a UAV-based system for mine detection. The system consists of a multirotor UAV with a ground penetrating synthetic aperture radar[2] as its prime sensor for mine localization. The system will be further developed by integrating additional sensors and by increasing flying capabilities in suspect buildings, dense forests, and jungles.

A panel discussion on remote sensing and IMAS.

Exploration for Humanity, together with Mobile Geophysical Technologies (MGT), presented the MGT DroneMag5 Landmine Detection System "Penta Mag" using eight rotors, a coaxial configuration multirotor UAV used for ordnance detection with magnetic sensors. The Penta Mag system contains five fluxgate sensors[3] in horizontal alignment and is particularly developed for use on a multirotor.

RPS Energy Ltd. presented an overview of their remote aerial multidiscipline survey system that consists of a small unmanned aircraft fitted with various payloads to collect geodetic, remote sensing, and instrument data sets to aid in the identification of EO. To assist in the data processing phase, RPS has developed bespoke artificial intelligence software programs that can quickly analyze large data sets and present their findings as a level-of-certainty percentile.

Ukrainian Multirotor Technologies (UMT) presented the results of a field study to remotely detect and identify the most common rocket-launched ordnance, relying on rapid, wide-area scanning by a UAV-based, microfabricated, atomic magnetometer mounted on a UMT Cicada-M hybrid-powered UAS platform.

SENSYS presented the MagDrone R4, an ultralight-weight magnetometer survey kit with multiple sensors to allow either large area coverage per flight time or high-resolution area scans. Due to its reduced weight of less than 4 kg and unique folding mechanisms, SENSYS suggested that it could be used with inexpensive commercial drones/UAVs.

UNIQUE CHALLENGES: URBAN AREAS

The participants of the technology workshop also discussed the significance of technological innovation in urban areas. Due to changes in the characteristics and nature of conflicts and widespread use of IEDs in urban areas, traditional clearing operations have become increasingly difficult in cities. UAS have been used to check roofs and inside buildings. In this context, the consulting and engineering firm Tetra Tech presented on the use of UAS in urban environments and presented UAS trials to address passive infrared threats in Syrian and Iraqi cities. To help assess the threat inside the IED-suspected buildings, Tetra Tech employs relatively small drones that are commonly used in urban areas. Numerous mine action operators are investigating the use of UAS platforms and sensors during technical survey for IED clearance in urban areas.

SIGNIFICANCE OF COLLABORATION AND KNOWLEDGE EXCHANGE

Feedback from workshop participants during and after the event indicate that the Mine Action Technology Workshop will continue to be crucial for the sector. Workshop attendees emphasized that the full potential of remote-sensing technologies can only be achieved through close collaboration between national operators and research institutions by exactly defining field needs, adapting technology to field conditions, and testing in the field. One of the main benefits of such an event is to provide a platform for product developers and end users to meet and exchange experiences and opinions. This serves to provide insight into the practicality, limitations, and achievements of the various technologies that are being developed and used to enhance HMA. This is not only on an operational level but also from an information management, planning, and decision-making perspective.

If you have any comments or questions, please contact the GICHD technology team at technology@gichd.org.

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Arsen Khanyan joined the Geneva International Centre for Humanitarian Demining (GICHD) in 2018. He is currently working as Programme Officer on policy-related topics, particularly on the links between mine action, peace, security, and Sustainable Development Goals. Prior to joining the GICHD, Khanyan worked for the UN High Commissioner for Refugees (UNHCR) and Office of the High Commissioner for Human Rights (OHCHR) in Geneva and for the Council of Europe Liaison Office to the EU in Brussels. Khanyan holds a master's degree in Russian and Eurasian studies (international affairs) from the University of Geneva and a second master's degree in international affairs and diplomacy from the European University of Armenia.

Inna Cruz
Information Management Advisor

Inna Cruz is an independent Information Management Advisor. She worked at the GICHD for ten years. Her expertise lies in geographic information systems (GIS), remote sensing, aerial imagery, cartography, and geodetics. One of her key projects was the use of UAS for mapping and reporting in mine action. She was also the country focal point for support to users in Eastern Europe and the Caucasus. Prior to joining the GICHD, she worked as a consultant for two projects for the United Nations Environmental Programme (UNEP) using GIS technologies. Cruz has a degree in environmental sciences from the National University of Kyiv-Mohyla Academy in Ukraine and a master's degree in environmental natural sciences from Geneva University, and she recently obtained Project Management Certification (PMP).