From Enigma to Essential: Long-term User Testing of Seaterra's DMAG UAS

UAS, also known as drones, are a useful tool but not a magic solution. They cannot solve all your problems.

The Explosive Ordnance Knowledge Hub (EOKHUB) serves as a central point for exchanging knowledge and experience in the explosive ordnance sector. It is an independent and transparent platform where you can access information on a range of topics, from machines to policy, dogs to unmanned aerial systems.

The extensive use of landmines and improvised explosive devices (IEDs) on roads is a significant and enduring challenge that poses grave threats to civilian populations, military personnel, and humanitarian efforts in conflict zones around the world.

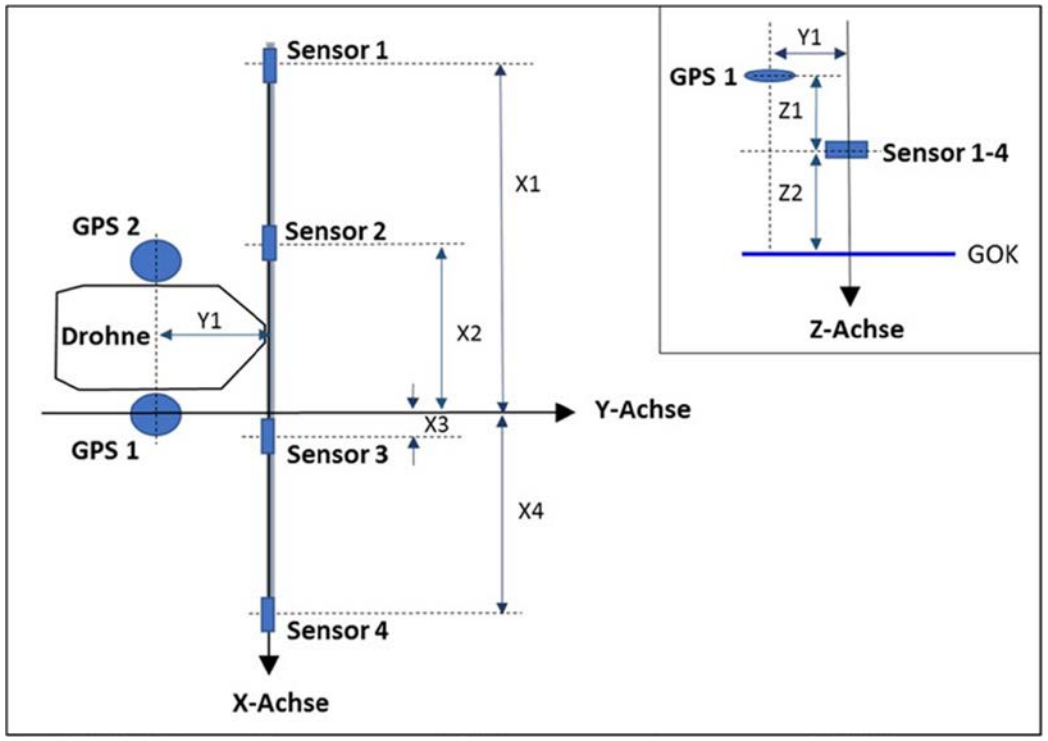
The advent of UAS technology offers a promising solution for overcoming these challenges, enabling rapid and accurate detection of explosive hazards.

Up to now DMAG is tested on the following scenarios:

- The survey of predetermined routes
- The survey of “new” routes

Field tests were planned meticulously to cover various scenarios encountered during road surveys. As of now, the testing has focused on the European region due to time constraints during the writing of this article.

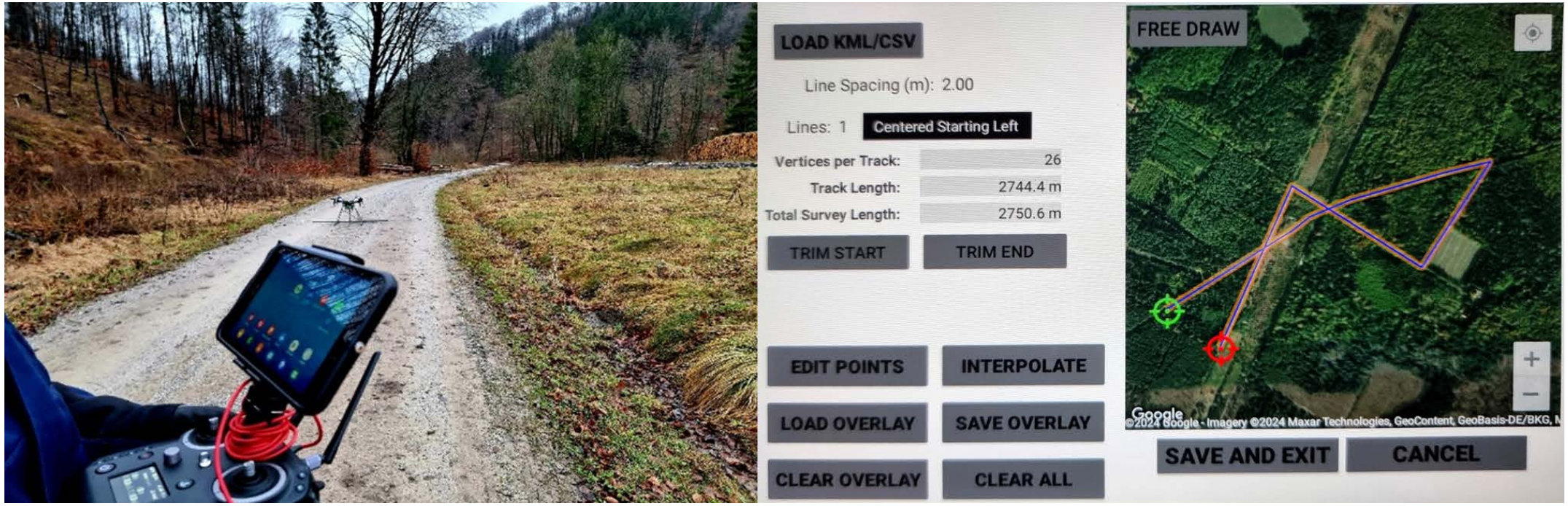
UAS DMAGv210



The DMAG system developed by Seaterra is an advanced integration of Unmanned Aerial Systems (UAS) technology, sensor arrays, and specialized software specifically designed for explosive ordnance detection. The system includes a DJI 210v2 RTK drone equipped with four 3-axis magnetometers, DJI and Trimble base stations, radio communications, and proprietary software solutions designed in-house. This system has undergone rigorous development, testing and operational use since 20219.

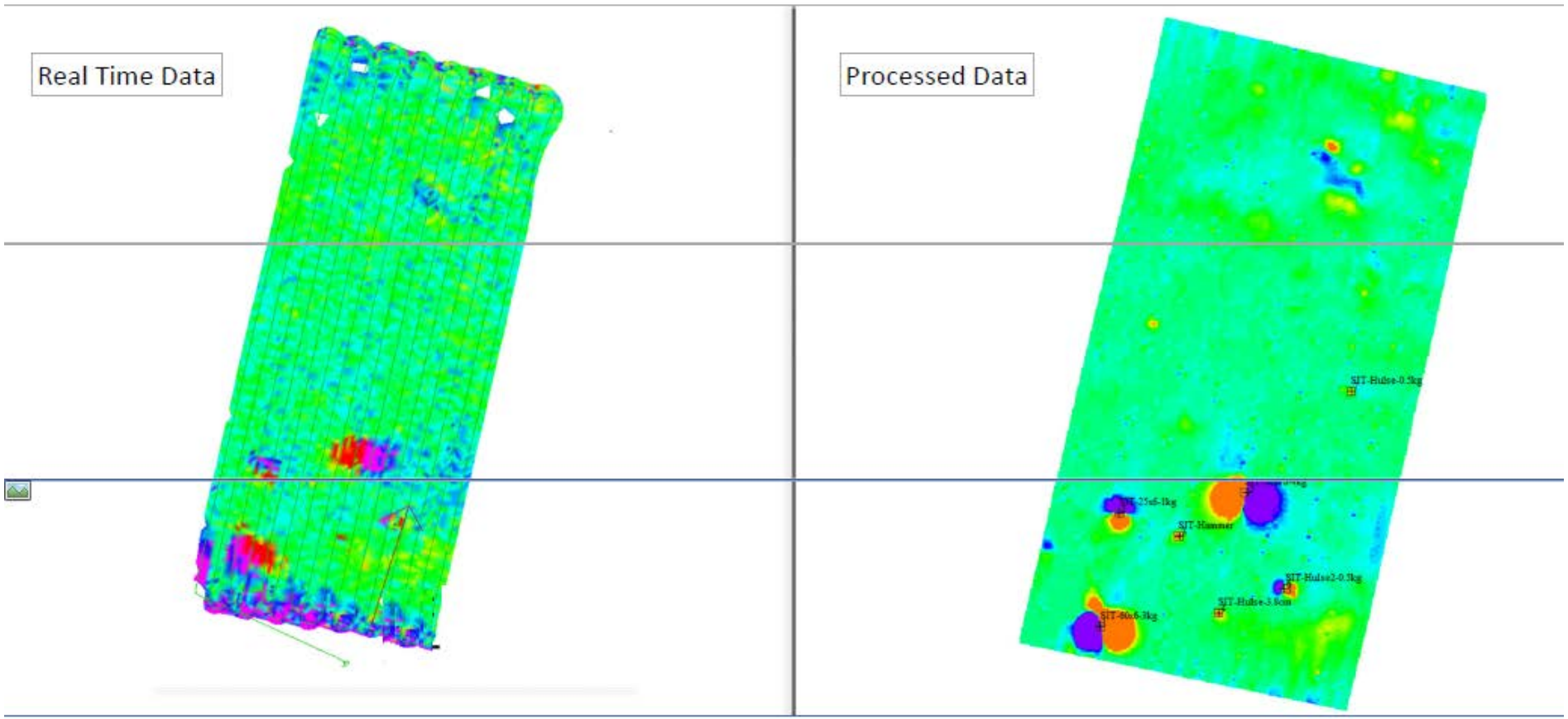
The survey of predetermined routes

The survey of predetermined routes began with an initial assessment using standard UAS survey methodology. Data collected during this phase served as a reference layer for subsequent testing. Leveraging pre-collected data enabled seamless execution of surveys in automatic mode, minimising complications. The objective was to compare real-time data with existing records to detect any changes in magnetic readings along the road, which Seaterra software AGSpro did.




The survey of
“new” routes

During the measurement, four sensors under the drone were rigidly fixed and guided parallel to the top of the terrain. Sensor and position data were continuously recorded in raw format and processed in real time using AGSDrone software. The data was mapped to calculate position information for survey control and navigation. The system communicated with the leading vehicle through radio communications.



What magnetometer can detect?

	distance to sensor*																							
UXO/mine	0.5	0.6	0.7	0.8	1.1	1.1	1.2	1.3	1.5	1.6	1.7	1.8	2.0	2.1	2.1	2.2	2.3	2.5	2.6	2.7	2.8	3.0	3.2	3.5
A mine PMR-2a	x	x	x	x																				
B mine PROM	x	x	x	x	x																			
C Mine M3	x	x	x	x	x																			
20mm / SprGr 38	x	x	x																					
37mm / PzGr 38	x	x	x	x																				
T1 60mm / GrW	x	x	x	x	x	x	x	x	x															
T2 81mm / UEBGRKPR 56A1 mit ZERS 83	x	x	x	x	x	x	x	x	x															
T3 81mm / EXGR 70/80	x	x	x	x	x	x	x	x	x	x	x													
T4 85mm / PzG BR-365	x	x	x	x	x	x	x	x	x	x	x	x												
T5 105mm / L-HLUEBG	x	x	x	x	x	x	x	x	x	x	x	x	x	x										
T6 120mm / UEBGR 78/EXAZ 66	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x							
T7 155mm / EXGR 88 M 185 w.ZERS/AZ6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
T8 155mm / UEBGR 94 w.ZERS	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
round steel / Ø100mm, l = 450mm	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
pipe/ Ø100mm, l = 450mm, s = 20mm	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
pipe / Ø100mm, l = 450mm, s = 10 mm	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

	distance to sensor*									
UXO/mine	1	2	3	4	5	6	7	8	9	10
100 lbs bomb	x	x	x	x						
200 lbs bomb	x	x	x	x	x					
500 lbs bomb	x	x	x	x	x	x	x			
1000 lbs bomb	x	x	x	x	x	x	x	x	x	
depth charge	x	x	x	x	x					
anchor mine	x	x	x	x	x	x				
ground mine	x	x	x	x	x	x	x	x		

* detection depht below ground = distance to sensor - flight hight

x 100% detected

80% detected

<80 % or no detection

The penetration depth of the sensors depends on the distance of the sensors above the terrain (the magnetic field decreases with the depth r in a ratio of $1/r^3$),

Conclusions:

- Effectiveness: DMAG UAS is effective in road surveying, offering real-time data analysis crucial for route safety assessment.
- Operational Efficiency: Semi-automatic mode and real-time data display enhance operational efficiency despite challenges like weather susceptibility and limited flight duration.
- Limitations: Restricted flight duration with older UAV models, weather susceptibility, and challenges in urban environments limit the distance and technology of real-time data transfer. Additionally, detecting low-metal content threats remains a challenge.
- Recommendations: Upgrading to newer UAV models and integrating advanced communication technologies like MESH or 5G networks can address limitations and enhance operational capabilities. Other sensors?
- Prospects: Further technological advancements are necessary for DMAG to reach its full potential in mine action and road safety efforts, ultimately aiding humanitarian efforts in conflict-affected regions.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