Defence-related Research Action - DEFRA

ACRONYM: ARIES

Title: Advanced Resolution and Intelligence for Explosive Sensing

Duration of the project: 1/12/2025 - 1/03/2029

Key words: surface mine detection, sensor fusion, edge AI inference, benchmarking for surface mines

Budget: 2.631.000€

of which RHID contribution: 1.963.000 €

PROJECT DESCRIPTION

Context

The project addresses the critical and growing challenge of surface-landmine detection in complex operational environments. Conventional approaches (e.g., LiDAR, chemical sensing or standard optical cameras) suffer from strong limitations due to vegetation, soil conditions, camouflage, environmental noise and low discriminative power. To overcome these issues, the ARIES project proposes a context-adaptive and multi-modal sensing framework combining passive visual and geophysical sensors such as hyperspectral imaging, thermal infrared, polarization imaging and magnetometry. This approach responds directly to current defence needs, particularly in contexts of high mine contamination such as contemporary conflict zones and post-conflict areas.

Objectives

The main objective is to develop a lightweight (<5 kg), adaptable and mobile surface-mine detection system that achieves high detection performance while minimizing false alarms. The system aims to improve demining safety and efficiency through remote deployment on UAVs, UGVs or soldier-carried platforms. A further objective is to strengthen Belgian defence R&D capabilities and to reach a Technology Readiness Level of 6, paving the way for future deployment and commercialization.

Methodology

The mine detection system will be developed through a two-phase data collection process. In the first phase, a small dataset will be gathered across different environments, operational conditions, and weather scenarios to prototype the sensor fusion and mine detection algorithm. The initial results, including detection accuracy and sensor fusion weights, will guide the second phase, where a larger dataset will be acquired to optimize detection performance.

Based on the expanded dataset, the sensor fusion algorithm will be refined, and the compute-intensive mine detection system will be adapted for deployment on a mobile platform using neural network model compression and GPU acceleration, targeting a detection latency of approximately 100ms. The system will then be validated on both the acquired datasets and in field trials.

For deployment, a modular sensor rig will be designed to be carried by a soldier, mounted on a drone, or attached to a mobile rover. The system will maintain high detection performance even if some sensors are removed or ineffective under certain conditions. Additionally, an optical filter design study will optimize the hyperspectral camera for essential wavelengths, reducing weight and cost. The project consists of four main steps—data acquisition, sensor fusion development, validation and benchmarking, and optical filter design—carried out collaboratively by the project partners.

Potential Impact on Defence

The project will significantly enhance mine detection capabilities and improve the effectiveness and safety of EOD operations by delivering a scalable, adaptable and context-aware sensing system. It supports safer demining through remote operations, reduces operator exposure and improves mission effectiveness in diverse terrains and climates. It also contributes to defence innovation by reinforcing Belgian expertise in hyperspectral imaging, polarization sensing, magnetometry and AI-based sensor fusion. The system's modularity and adaptability make it suitable for integration into future unmanned platforms and defence surveillance architectures.

Expected Results and Valorisation Perspectives

Expected results include: a large annotated multi-sensor dataset; a validated context-adaptive sensor fusion model, a modular prototype sensor rig, an optimized optical filter design for hyperspectral sensors, technical and evaluation reports and contributions to scientific publications and defence benchmarks.
Short-term valorisation includes dissemination within Belgian Defence and demonstration in trials and in the wider defence innovation ecosystem, such as NATO partners.
Medium-term perspectives include technology transfer through patents and non-exclusive licensing, integration into future deployed systems, follow-up R&D projects, and potential industrial spin-offs in collaboration with defence and technology partners.

CONTACT INFORMATION

Coordinator
Bart Goossens
imec, Department of AI & algorithms
Bart.Goossens@imec.be

Partners
Hannes De Meulemeester
Royal Military Academy, Department of Mathematics, 4D Perception Lab
Hannes.DeMeulemeester@mil.be

Stefan Schulte
FLIR Systems Trading Belgium
Stefan.Schulte@teledyne.com

Philippe De Smedt
Ghent University, Faculty of Bioscience Engineering, Department of Environment
Philippe.DeSmedt@ugent.be

LINK(S)

https://ipi.ugent.be/projects/2026_aries/