

Defence-related Research Action - DEFRA

ACRONYM: ALBATROSS

Title: Advanced Littoral Border Alert Through Real-time Orchestrated Sensor Synthesis

Duration of the project: 01/12/2025 - 01/03/2029

Key words: drone detection, data fusion, complex event processing, semantic data, active electronically scanned array, rf analysis

Budget: 2 730 000€

of which RHID contribution:
2 234 000€

PROJECT DESCRIPTION

Context

The proliferation of Unmanned Aerial Vehicles (UAVs) poses an escalating threat to critical maritime infrastructure. Technological advancements in precision navigation, micro-sensors, high-capacity batteries, and lightweight materials have dramatically extended UAV capabilities while significantly reducing their cost and footprint. These platforms can now deliver destructive payloads with high precision onto high-value targets, making early detection, tracking, and response a paramount priority for national security.

Current drone detection solutions each exhibit notable shortcomings. Radar systems struggle to detect small, low-flying, and slow-moving drones that often resemble birds or environmental clutter. Camera-based detection systems are highly dependent on environmental conditions with limited range and field of view. RF sensing methods only function when drones actively transmit signals, rendering autonomous drones or those using encrypted protocols nearly undetectable. Audio detection suffers from short effective range and environmental noise interference. These individual limitations necessitate an integrated approach combining multiple sensor types with intelligent data fusion to achieve reliable detection.

General Objectives

The ALBATROSS project aims to enhance maritime situational awareness of the "Maritiem Informatiekruispunt" (MIK) and the future Maritime Operations Centre (MOC) against emerging airborne threats. Three primary research objectives guide the project:

First, developing active and passive sensor capabilities including a novel long-range AESA (Active Electronically Scanned Array) radar enabling UAV detection beyond visual range under all weather conditions, exploration of compact VNIR and SWIR cameras for maritime settings, and improved machine learning systems for RF sensing.

Second, implementing multi-agent driven data fusion where each sensor acts as an intelligent agent communicating and sharing tasks with other agents, maximizing detection probability while minimizing false alerts without increasing data dissemination delays.

Third, establishing complex event processing through semantic data integration, enabling reasoning-based filtering of false positives and correlation of multi-domain event streams to enrich overall Maritime Domain Awareness.

Methodology

The project follows a three-phase approach over 36 months.

Phase-1 (6 months) encompasses requirements analysis, architectural design definition, experimental test plan development, and inventory of existing relevant data sources, gathering inputs from Belgian Defence, Elia, and Port of Antwerp-Bruges as key stakeholders.

Phase-2 (18 months) focuses on experimental testing and prototype development, conducting research on individual sensors including the novel AESA radar, agent-based data fusion, and complex event processing. A stepwise approach gradually increases complexity with sufficient iterations.

Phase-3 (12 months) delivers validation and demonstration in maritime contexts, including two demonstrations with stakeholder feedback integration. Testing progresses from land-based sites to Port of Antwerp-Bruges and finally to Lombardsijde for realistic maritime conditions.

The consortium combines complementary expertise: e-BO Enterprises coordinates and provides MIK integration expertise; Intersoft Electronics develops the AESA radar; VITO contributes AI, data fusion, and multispectral imaging capabilities; Senhive provides RF sensing and machine learning for UAV detection; imec delivers semantic web technologies and complex event processing.

Potential Impact on Defence

ALBATROSS will substantially enhance Belgian Defence capabilities for protecting critical maritime infrastructure. The multidisciplinary approach combining various active and passive sensors with advanced data fusion techniques will drastically improve awareness of small airborne maritime threats, encompassing both hostile surveillance activities and direct threats with explosive devices.

The project advances security situational awareness and decision-making support through innovative continuous sky monitoring combined with multi-domain complex event processing. This provides the MIK and MOC with enhanced maritime domain awareness in strategically important areas, early detection of different airborne threat types, agent-based data fusion reducing false alarms and managing network loads, and improved data exchange using semantic streaming technologies.

The architecture enables future integration of additional sensors and expansion toward surface and underwater detection, air-to-air threat detection via drone platforms, and tracking and identification capabilities beyond detection.

Expected Final Research Results and Valorisation Perspectives

The project will deliver several concrete outputs: a novel integrated sensor system for enhanced UAV detection in maritime environments demonstrated at TRL6; advanced data fusion algorithms achieving false positive reduction to 1% of total events; a real-time threat assessment and alert generation system integrated into the MIK environment; and semantic data models enabling interoperable event stream processing.

Five academic publications are planned covering RDF TimeSeries Snippets, hybrid stream reasoning, multimodal data fusion, multispectral sensors for aerial threat detection, and general drone detection in maritime environments.

Short-term valorisation includes direct application of individual technology building blocks by partners in their respective domains: AESA radar for airport situational awareness, multi-agent fusion for water quality management and energy applications, and complex event processing for land-based C4I systems.

Medium-term perspectives encompass development of a complete multi-domain maritime surveillance system integrating the researched components, potential integration with DEFRA SIREN project technologies, extension to underwater detection capabilities, and deployable harbour protection systems. If the TRL6 demonstration succeeds, further development to TRL7-9 will be considered in alignment with MOD investment plans and Elia's roadmap for energy island protection.

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LINK(S)

Project page link to be added.