



Defence-related Research Action - DEFRA

ACRONYM: MARISPEC

Title: Maritime Infrastructure Security and Protection through Enhanced Multi-wavelength

Duration of the project: 01/12/2024-01/03/2028

Key words: Maritime Surveillance, Autonomous Drones, Multi-wavelength Cameras, Machine Learning Budget: 1.487.919 €

of which RHID contribution: 1.302.366 €

PROJECT DESCRIPTION

Context

The MARISPEC project addresses the growing need for enhanced maritime surveillance, particularly in securing critical maritime infrastructure. With increasing threats from unidentified ships and illicit activities, current surveillance systems face limitations in detecting potential dangers under harsh environmental conditions, such as at night, in fog, or during storms. The project aims to develop a fully autonomous drone system, equipped with multi-sensor, multi-wavelength cameras, capable of continuous monitoring of maritime zones, ensuring reliable detection of ships even under difficult conditions.

General objectives

The MARISPEC project aims to develop a fully autonomous drone platform designed for real-time maritime surveillance, focusing on detecting ships in challenging conditions such as fog, rain, and night. The core objective is to equip the drone with advanced multi-sensor cameras, including visible light, infrared, and night vision, to improve detection capabilities in low-visibility scenarios. By integrating multi-wavelength cameras, the drone will provide comprehensive visual coverage and ensure reliable detection of vessels in adverse weather and lighting conditions.

A key aspect of the project is the development of sophisticated real-time image processing algorithms powered by machine learning. These algorithms will be able to identify and classify various types of maritime objects, with a focus on differentiating between civilian ships, cargo vessels, and potential threats. The system will also include anomaly detection features, such as ships not transmitting AIS signals. The platform will be built to operate autonomously, reducing the need for human intervention and enabling continuous surveillance over large maritime zones, including critical infrastructure such as offshore wind farms, energy platforms, and territorial waters. The drone system will support military applications by enhancing situational awareness and enabling quicker decision-making in response to potential threats.

Methodology

The MARISPEC project follows a multi-phase methodology. Initially, the drone platform will be developed and equipped with multi-wavelength cameras (visible, infrared, and night vision) to capture detailed imagery in low-visibility maritime environments. Simultaneously, real-time image processing algorithms will be developed using machine learning to detect and classify ships. These algorithms will be trained on datasets collected in varied conditions, enhancing their ability to recognize vessels in challenging scenarios such as night, fog, and rain. The system will be tested through simulations and real-world field trials in maritime environments to validate its performance. Finally, feedback from trials will inform adjustments to the algorithms and hardware, ensuring optimal performance for real-time maritime surveillance. The project will culminate with field-tested drone demonstrations and the deployment of a fully functional system.

Potential impact of the research on Defence

The MARISPEC platform will significantly enhance the military's maritime surveillance capabilities by offering three key advantages:

- **Complement Current Detection Abilities of MIK**: The platform will augment the existing detection systems of the Maritime Informatie Kruispunt (MIK) by providing an additional layer of real-time aerial surveillance.
- Enable Further Visual Inspection of Threats for MIK and MOC: The multi-wavelength cameras and advanced image processing algorithms will allow the platform to visually inspect potential threats in more detail, enabling both MIK and the Maritime Operations Centre (MOC) to assess suspicious vessels with greater accuracy, especially when existing systems are limited by environmental factors.
- Support for Patrol Operations of MOC: The drone system can be used to support patrol
 operations by the MOC, providing real-time reconnaissance and enabling faster, data-driven
 responses to detected threats. This will significantly enhance the situational awareness and
 operational efficiency of maritime patrols.

Expected final research results

The research will deliver several tangible outcomes, including:

- A fully functioning autonomous drone demonstrator platform.
- A robust multi-camera system with real-time image processing and machine learning algorithms for ship detection.
- Field-tested detection models capable of operating in various harsh conditions.
- Reports and scientific publications on the advancements in multi-wavelength camera technology and real-time image analysis.
- Engagement with stakeholders through workshops and demonstration events.

• A comprehensive scenario-based report on the system's performance, with recommendations for integrating it into Defence operations.

Valorisation perspectives (short and medium-term):

- Short-term: Immediate dissemination of the research findings through scientific publications, workshops, and stakeholder meetings. Demonstration of the developed technology in real-world settings to attract potential commercial and Defence partners.
- Medium-term: The system will be prepared for further development into a market-ready product. Follow-up projects will focus on scaling up the technology and adapting it for broader surveillance and security applications, such as port security, search and rescue, and environmental monitoring.

CONTACT INFORMATION

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LINK(S)

https://www.invilab.be/research/marispec





