Defence-related Research Action - DEFRA

ACRONYM: SAILS

Title: Safe Autonomous Integrated Landing system for Ships

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

Budget: 1.632.883 €

of which RHID contribution: 1.335.785 €

Key words: SLAM, Sensor fusion, UAS precision landing, safe operations, flight control, Ultra Wide Band positioning

PROJECT DESCRIPTION

Context

Maritime unmanned aerial systems (UAS) have become an increasingly valuable tool for military operations, especially in the naval domain. We believe that in a near future, every military ship will be equipped with its own UAS. These systems can provide valuable real-time intelligence, surveillance, and reconnaissance (ISR) data to the vessel, enhancing situational awareness to improving decision-making, perform off-shore inspections, assist in search-and-rescue operations, or enable ship-to-ship and ship-to-shore logistic deliveries of small goods or documents. However, one of the key challenges of using maritime UAS is the safe manual landing and taking-off from moving vessels, coping with the six-degree movements of the vessel through diverse weather and sea conditions. This is, even for the most experienced UAS pilots, extremely difficult and dangerous.

General objectives

The overall scope of the project is to implement a solution for safe autonomous approach and landing of a maritime UAS on a moving/sailing vessel. To reach this goal the following intermediate objectives are defined:

- Enhanced UWB local positioning system
- Reliable real-time sensor data fusion for the approach and landing phase
- Multi-sensor UAS integration
- Proof-of-concept/demonstrator development

Methodology

The SAILS project will adopt a 4-phase approach:

- In a first phase, the advanced multi-sensor system will be designed, which will involve selecting appropriate sensors, designing the system architecture, defining the hardware and software interfaces and developing the necessary software and algorithms for autonomous approach and landing of maritime UAS on ships.
- With the design complete, the project team will proceed to develop and test the system. This will involve building hardware components, coding the software and algorithms for real-time systems, integrating and testing the system in a controlled environment to ensure it meets the project requirements.
- Phase 3, the system will be tested in collaboration with the Belgian Navy and in a civil environment in co-operation with 'Maritieme Dienstverlening en Kust' (MDK). This to test the system in a realistic environment, i.e. on a Navy vessel (coastal patrol vessel) in different weather and sea state conditions.
- Last phase, the project team will evaluate the system's performance and optimize it as necessary to ensure it meets project goals and objectives. This will involve further testing and refinement, and potentially also the addition of new features and capabilities.

Potential impact of the research on Defence

The expected results and impacts for Belgian Defence are as follows:

- **Enhanced Safety:** One of the key benefits of the system would be to improve safety during UAS operations on Navy ships. The system would enable precise and safe landings, reducing the risk of accidents, injuries, and equipment damage.
- **Increased Efficiency:** The use of an autonomous system would also increase efficiency in UAS operations, reducing the need for highly trained human operators and enabling more frequent and rapid deployments. This would increase the capability of the Navy to carry out missions more effectively and efficiently.
- **Improved Situational Awareness:** The multi-sensor system would enable the UAS to gather and transmit real-time data to the ship's crew, providing improved situational awareness and decision-making capabilities. This would enhance the Navy's ability to detect, track, and respond to potential threats in real-time.
- **Reduced Costs:** The autonomous system would also reduce the overall cost of UAS operations, as it would require fewer personnel and equipment resources to operate. This would enable the Navy to allocate resources more effectively, reducing costs while enhancing capabilities.

Final research results

The SAILS concept aims to develop an advanced multi sensor system, enabling the autonomous operation of maritime UAS. Arguably, the most difficult part of any flight operation is the approach and landing, and this is certainly the case when the landing is to be performed on a ship deck, moving in different directions. Therefore, SAILS will focus on selecting the best technology and implementing algorithms to automate the final approach and a safe landing of the UAV on a moving vessel. This will enable less-skilled operators to use the drone system, thereby reducing the training cost, increasing the safety of personnel and equipment, and increasing the window of operation of maritime UAV in off-shore applications (e.g. different weather and sea conditions).

Valorisation perspectives (short and medium-term):
The valorisation potential of the SAILS project is not purely military. Civilian use cases are available, this is why we involved MDK as a second end-user (besides the Belgian Navy) for the field trials and demonstrator. The SAILS solution, although designed for a given UAV in the scope of this project, will be portable to any autonomous UAS able to land vertically and will open the path for smaller UAV's and Unmanned Surface Vehicles combinations. The solution is an enabler to land in GPS shaded or denied areas and has onshore use cases as well.

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https://mecatron.rma.ac.be/index.php/projects/sails