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EDA-ARTINDET (ARTIFICIAL INTELLIGENCE FOR AUTOMATIC DETECTION RECOGNITION, IDENTIFICATION (DRI) AND TRACKING)

This is a study funded from EDA Operational Budget. OB-Studies contracted by EDA are preparatory activities to catalyse pMS investments in related defence R&T.

Consortia/Organization

Aerospace and Defense everis

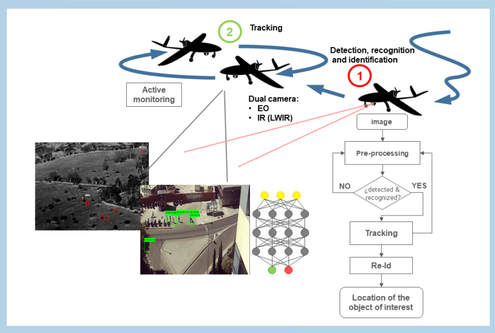
This project analyses new techniques of imagery-based systems relying on **Artificial Intelligence (AI)** including some techniques based on the Deep Learning paradigm.
Images captured by high-resolution cameras and operating with Wide Field of View (WFOV) feed the different algorithms that have been tested. The different implemented and tested techniques are aimed at composing a dedicated architecture for an Unmanned Aerial Vehicle (UAV). ARTINDET analyses all the required steps for the deployment of this kind of system.

Objectives

The general objective of this study is to analyse the most promising AI-based techniques for Automatic Detection Recognition Identification and Tracking (A-DRIT), at least in the following operative conditions:

» Spatially distributed small targets in strong background.
» High resolution imaging systems (passive or active) with wide Field of View (Wide region surveillance).
» Multidimensional imagery (multiband/multispectral/hyperspectral, multiresolution).
» Multiple cooperating platforms

The **scope of the project** is defined by the following figure, where the different devices included in the system and the workflow proposed for signal processing is established.



Project Workflow

Work Strands

The activities of the project are described below.

» The **first task** of the project has been dedicated to reviewing the scholar literature and the commercially available products.

» The **second task** of the project involved a workshop taking place at EDA premises in Brussels. Different stakeholders participated in a rich session where the attendees utilised their expertise to delimit the scope of the use cases that have been selected for the resolution of the project. The following table specifies the features considered for the selection of use cases.

	MISSION	SCENARIO	PLATFORM	SENSOR	FOV (m)	TARGET	
						Description	Pixels
UC 1	Situation awareness	ROAD/ URBAN	Small UAV	EO. IR	150	People	32x32
UC 2	Camp protection	ROAD/ RURAL	Small UAV	EO. IR	250	Car/Trucks/ Tanks	60x60

The **third task** has been devoted to analyse the different techniques and technologies selected in both the commercial and academic domains closer to the military domain. The lack of datasets available in the military domain has been compensated through the creation of custom datasets from public sources, specifically labelled for ARTINDET, and including other data collected by Everis ADS making use of the equipment mounted on an UAV as described by the hereunder figure.

UAV SETUP BY EVERIS ADS EMPLOYED FOR ARTINDET PERFORMANCE

» The **fourth task** has been oriented to determine the feasibility of a DRIT system by testing different AI technologies for the stages required. The most reliable tested techniques are expressed in the following table.

USE CASE	DETECTION	TRACKING	RE-IDENTIFICATION
UC 1	Faster RCNN	Embedded	Spatio-TemporalR
UC 2	SSD	Kernel-based (MOSSE)	Baseline (PCB)

» The **fifth task** proposes a roadmap to continue along the lines opened by this project. The corresponding roadmap fulfils the different areas to be covered and permits the exploitation of the results gathered in ARTINDET.

Conclusions

The study performed in this project has covered the different steps required to deploy a UAV system equipped with DRIT capabilities. The performance analysis has been concluded with the following assessments:

» There is a need to build specific datasets for the military domain since the scenarios and appearance of targets change drastically from the civil environment to the military environment.
» The deployment of complete DRIT systems should be complemented by an important integrational step to build a real-time embedded system.
» The performance of the AI algorithms is highly influenced by the appearance and size of the target objects.

Future Work

CHALLENGE	AIM
Dataset definition and classification in the military domain	Methodology to select relevant visual features for military datasets Real military dataset compliance Simulated and synthetic military data generation
Applying supervised AI for target detection and tracking in military scenarios	Deep Learning modelling for different use cases and automatic updating for new features in the operational scenario AI deployment in embedded systems for real-time inference in different operational scenarios
Human-machine interaction in the military domain	Human-machine interface development for DRIT applications and user-training Semi-automatic systems based on decision-making to manage operations
Real unmanned systems with AIDRIT capabilities	RPAS operative missions Integration of smart unmanned systems in the military scope with DRIT purposes

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