ALADDIN

NEWSLETTER #3

DECEMBER 2019

Harvest time for the project

ALADDIN

Advanced hoListic Adverse Drone Detection, Identification & Neutralization

European Commission

Horizon 2020
European Union funding
for Research & Innovation

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ALADDIN AT THE TURNING POINT

Dear Reader,

With the autumn season, it is harvest time for ALADDIN. After completion of the first development cycle (M18), marked by a successful demonstration of the Beta version of the ALADDIN platform, the project starts collecting the first fruits of its research and innovation efforts.

The consortium partners played a major role in enhancing scientific research in the field of drone detection, thanks to ALADDIN advances in sensor technologies, involving state-of-the art methodologies and innovative data processing algorithms. This materialized into:

• Organization of the **UAV4S workshop** within the ICVS 2019 conference in Thessaloniki (Greece),
• Participation in the **2nd WOSDETC workshop** within IEEE AVSS 2019 in Taipei (Taiwan) and to the **World of Drones Congress 2019** in Brisbane (Australia)
• Scientific **collaboration with the SafeShore project** for organizing the next Drone vs Bird Detection Challenge.

In July the **2nd ALADDIN End-User Workshop** in Lisbon triggered the **preparation** of the final version of the system. A further step forward was the recent **data capturing** session at the Markopoulo training facility in Athens (Greece).

Enjoy your reading and keep up to date with the project through the events published on the website.

The project coordinator

THE ALADDIN CONSORTIUM

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Members of the ALADDIN consortium

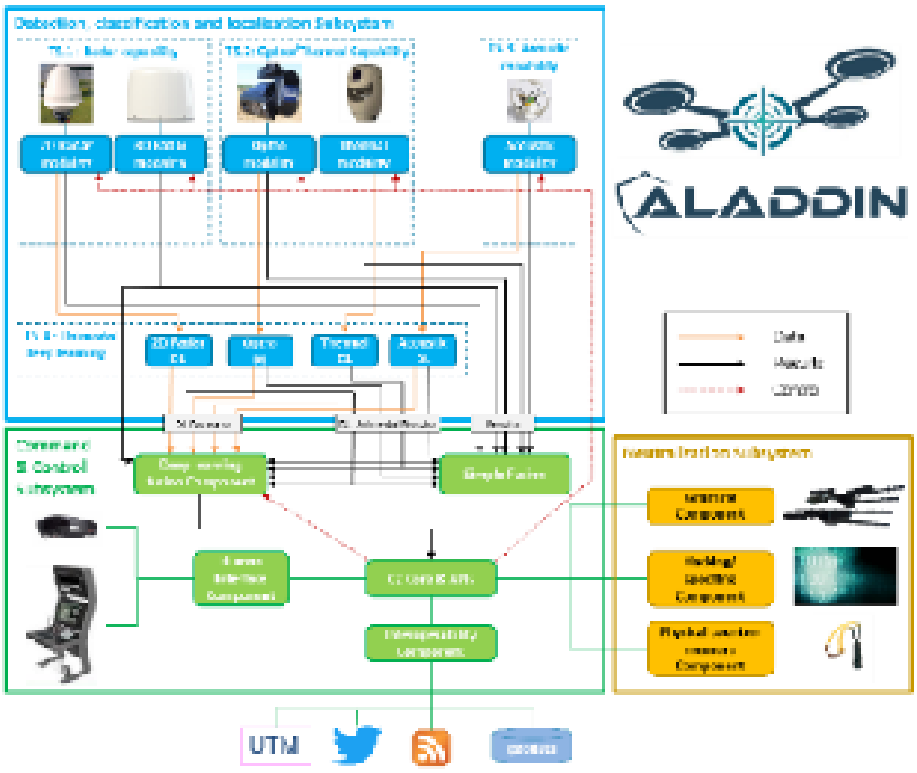
FRUITFUL END-USER WORKSHOP AND DATA CAPTURING SESSION

The consortium has started the development of the Final version of ALADDIN counter-drone system. Two events marked the start of this new cycle:

• the **2nd End-User Workshop (EUW**) in early July to inform the final system design and performance targets; and
• a **new data capturing session** in early October to train Deep Learning modules and for the preparation of the pilot experiments.

The EUW was the second of three workshops, organized in keeping with the ALADDIN user-centred approach to ensure that end-users are fully involved throughout the whole project lifecycle - from collection of requirements to training and demonstration.

It follows the 1st EUW organized in St Albans (UK) and hosted by CAST at the beginning of the project to drive the design of the ALADDIN Beta version.



Sketch of ALADDIN Final version

Hosted by Polícia Judiciária (PJ) in Lisbon (Portugal), this mid-project workshop gathered both end-users and technical partners to review the operational requirements and the functional specifications of the system.
Amongst other things, the consortium discussed the possibility of using e-identification (eID) to identify legal from malicious drones. The eID will be required for future Unmanned Traffic Management (UTM)/U-space services.

ALADDIN Consortium at Markopoulo Attiki, Athens (Greece)

DJI Phantom 4

DJI Matrice 210

DJI Mavic Pro

Target drones

2D radar

IR camera

Microphones

PTZ camera

3D radar

ALADDIN sensing arsenal

The third data capturing session took place in early October at the Markopoulo training facility of the Hellenic Police, near Athens (Greece). The test site will be the venue of the ALADDIN final demonstration in May 2020. Featuring both open and built-up areas, it is suitable for testing system performance in both 'open-field' and 'urban' scenarios.

The new dataset enriches the previous ones collected at the ATLAS test centre (Spain) in May 2018 and February 2019, by adding new challenges to the detection and classification algorithms for identifying drones flying in a more complex environment.

The new data will drive the improvement of Deep Learning and Data Fusion algorithms by forcing the networks to learn the complex examples and as a result learn to generalize better.

Recordings were captured by ALADDIN's sensing arsenal. Namely, a 2D long range radar developed by IDS, a 3D radar developed by SIRC, two Infrared cameras developed by HGH, one PTZ optical camera developed by PIAP as well as three eight channel microphone arrays developed by IDMT.

ALADDIN's sensors were deployed to capture multiple drone flights, utilizing a DJI Phantom 4, DJI Mavic Pro and a DJI Matrice 210. The flight plans were designed according to threat scenarios established by end users and included three main cases:
1. Drone coming from far away.
2. Drone standing nearby (on the ground), taking off and invading the protected area from the dark side of the buildings.
3. Swarm of drones flying in formation and performing a coordinated attack.

The resulting dataset includes 55 sessions performed from two distinct operation sites around the Markopoulo centre. The delivered dataset comprises five different modalities. Each modality has its own unique characteristics. Accordingly, several different file formats were utilized to store the captured data. The dataset represents approximately 9 hours of flying time.

UAV4S WORKSHOP AT ICVS 2019 CONFERENCE

CERTH organized the workshop on "Vision-enabled UAV and counter-UAV technologies for surveillance and security of critical infrastructures (**UAV4S**)", which was hosted by the 12th International Conference on Computer Vision Systems (**ICVS 2019**) in Thessaloniki, Greece, on 23-25 September 2019. The workshop aimed to stimulate research activities towards current technological advances and challenges – in particular, the development of UAV vision embedded technologies for surveillance and C-UAV detection, localization and identification algorithms, methods and tools, by utilizing enhanced computational vision, acoustic, radar and fusion methodologies. In addition, the objective of this workshop was to serve as an interdisciplinary forum for bringing together specialists from the scientific areas of Computer Vision, Surveillance, Data Science, Artificial Intelligence, and Security Research, promoting the formation of a community around the topic and disseminating the ALADDIN project to an increased number of researchers and practitioners.

Patrick Garnier, the coordinator of the H2020 ALADDIN Project, was the invited speaker at the workshop, presenting ALADDIN from the perspective of the use of counter-UAV technology to protect the security of critical national infrastructures. Other partners (CERTH, IDS, FADA-CATEC and HGH) presented the scientific results obtained during the development of the Beta release. ALADDIN major scientific outcomes are illustrated in the following papers accepted for publication by Springer in its "Lecture Notes in Computer Science" – a prestigious journal:

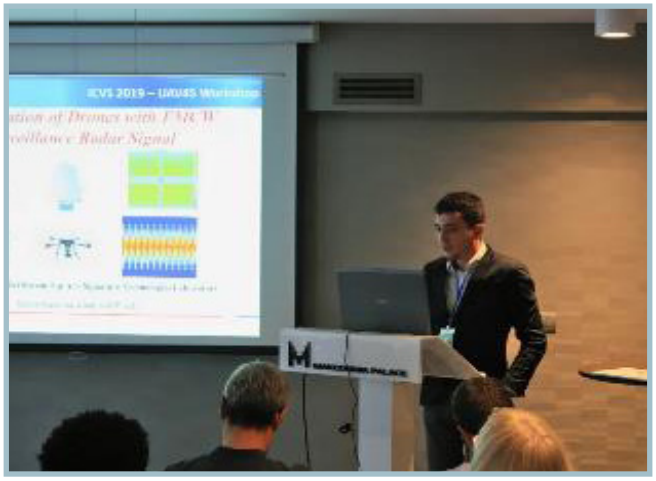
• *"Classification of Drones with a Surveillance Radar Signal" - Marco Messina and Gianpaolo Pinelli*

• *"Minimal-time trajectories for interception of malicious drones in constrained environments" - Manuel García, Antidio Viguria, Guillermo Heredia and Anibal Ollero*

• *"UAV classification with deep learning using surveillance radar data" - Stamatios Samaras, Vasileios Magoulianitis, Anastasios Dimou, Dimitrios Zarpalas and Petros Daras*

• *"UAV localization using panoramic thermal cameras" - Anthony Thomas, Vincent Leboucher, Antoine Cotinat, Pascal Finet, Mathilde Gilber*

• *«Multimodal Deep Learning Framework for Enhanced Accuracy of UAV Detection" - Eleni Diamantidou, Antonios Lalas, Konstantinos Votis and Dimitrios Tzovaras*

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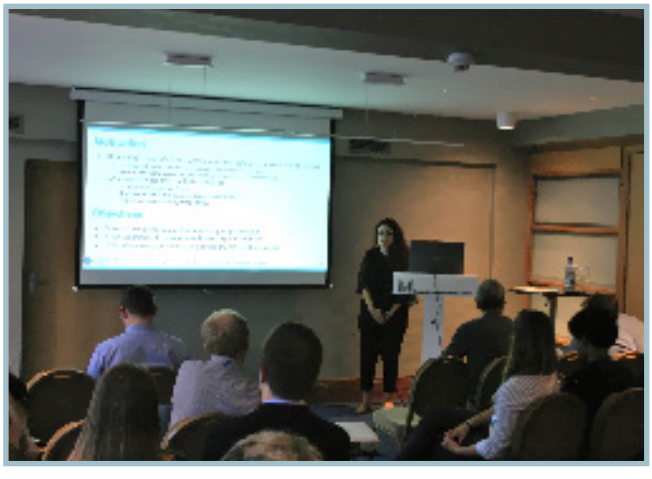


WORLDWIDE DISSEMINATION OF ALADDIN SCIENTIFIC RESULTS

September has been a busy month with partners engaged in disseminating ALADDIN scientific results and illustrating the project to scientific and professional communities outside the European borders.

KEMEA attended the World of Drones Congress 2019 **(WoDC 2019)**, held in Brisbane (Australia) from 26 to 27 September 2019.

The congress featured a fascinating Expo with over 30 exhibitors from Australia, China and Japan and attracted delegates from across Asia, the Pacific and beyond. With a focus on driving the drone industry through business and innovation, WoDC 2019 connects drone leaders, businesses and academia with the latest industry developments, applications and policies.

The session on Unmanned Traffic Management & Counter-Drone Capabilities was an opportunity for KEMEA to present to a world audience the EU funded project "ALADDIN" as a possible solution to the threat of malicious drones.

• "European Union's initiative to mitigate the threat of malicious drones and introduce a complete counter-drone solution via R&D" - George Kampas

CERTH attended the 2nd International Workshop on Small-Drone Surveillance, Detection and Counteraction Techniques **(WOSDETC 2019),** held in conjunction with the 16th IEEE International Conference on Advanced Video and Signal-based Surveillance (**AVSS 2019**) in Taipei (Taiwan) on 18-21 September 2019.

CERTH is working on Deep Learning methodologies to detect drones using optical sensors. In order to assess the capabilities of the developed solution and compare with the international research community, CERTH has participated in a scientific challenge organized in the framework of AVSS 2019. CERTH took 2nd place in the **Drone-vs-Bird Detection Challenge** and was invited to present a paper on the methodology used:
• "Does Deep Super-Resolution Enhance UAV Detection?" - V. Magoulianitis, D. Ataloglou, A. Dimou, D. Zarpalas and P. Daras

This participation in a prestigious conference such as AVSS and a highly specialized and targeted challenge (initiated by H2020 project SafeShore) will bring significant value to the project, increasing the visibility of the project's contribution to the counter-UAS field.

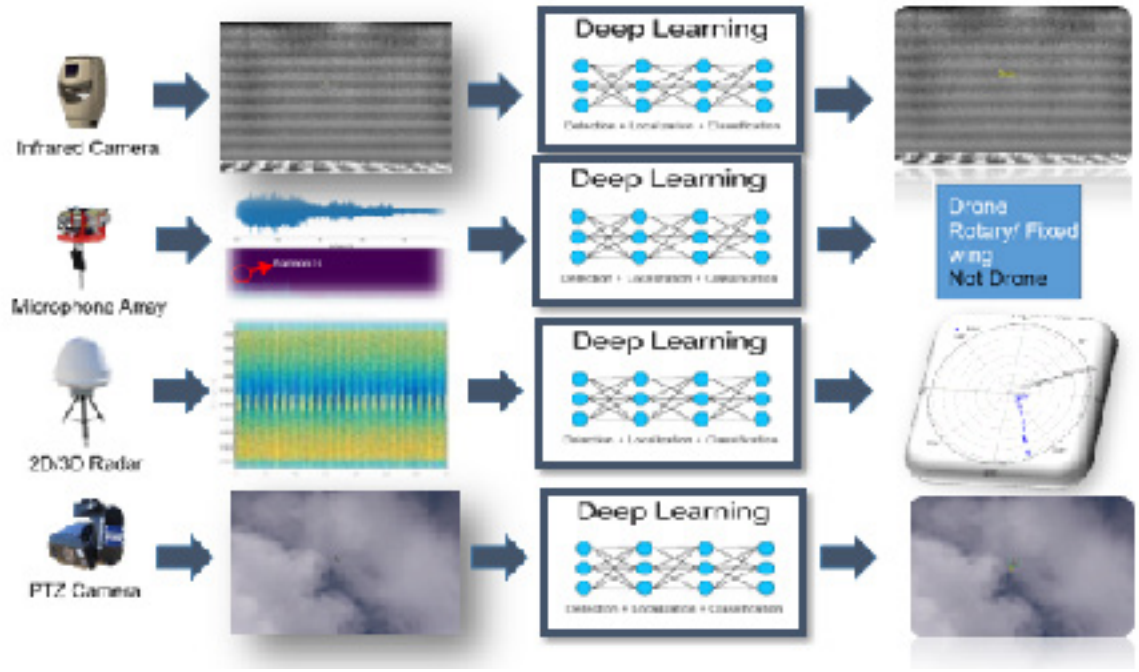
DRONE VS BIRD DETECTION CHALLENGE – DEEP LEARNING DEMYSTIFIED

Deep learning is a sub-field of machine learning that deals with algorithms inspired by the structure and function of the brain, known as neural networks. Those models learn directly from input data the features required for classification. Thus, after training on a large number of input samples, a deep learning model can discover the deep internal representations that are best for classifying the type of samples provided. These deep features are generic to object in question and can be used to classify other similar objects, which are unseen during the training phase of the model.

Evolution of Artificial Intelligence (AI) with deep learning

(Source: https://www.edureka.co/blog/what-is-deep-learning)

In ALADDIN, unimodal signals coming from the different sensor modalities are further processed and categorized by different deep learning models - for example, to deduce whether a radar sample or a thermal image signifies the presence of a UAV or some other airborne object. A summary of the unimodal deep learning processing utilised by ALADDIN is illustrated in the following figure.



Unimodal deep learning for the different ALADDIN sensing modalities

CERTH participated in the **Drone-vs-Bird Detection Challenge** at **WOSDETC 2019** and took 2nd place. CERTH presented a paper detailing the method used and providing a comparison with other methods:

• V. Magoulianitis, D. Ataloglou, A. Dimou, D. Zarpalas and P. Daras, "**Does Deep Super-Resolution Enhance UAV Detection?"**, 16th IEEE International Conference on Advanced Video and Signal-based Surveillance (AVSS), 18-21 September 2019, Taipei, Taiwan

The paper examines the problem of UAV detection through visual data - in particular, how to improve the recall capabilities of a UAV detection system that relies on visual sensors, without affecting detection performance. A weakness of such a system is that UAVs flying at some distance from the sensor may appear too small on the input image to be successfully detected. Super-resolution (SR) is meant to increase the initial size of an image as well as enhance its representation by depicting more detail of it.

To this end, this paper describes the application of a deep learning model to perform SR, before presenting the image to the deep UAV detector model, and optimizes both simultaneously, in the same training pipeline. Hence, the deep SR model learns to enlarge and enhance images that comprise UAVs, targeted for the task of UAV detection - and the deep UAV detection model benefits from the enhanced input, thus improving its recall performance. Experimental results show the effectiveness of the proposed method, where gains in recall performance can reach up to 32.4%

Award Ceremony of Drone-vs-Bird Detection Challenge at AVSS 2019

Participation in this challenge was a fruitful experience for the optical deep learning module team working on ALADDIN. The chance to compare performance against similar algorithms and to add new elements to improve the existing method is valuable for the project. One of the main differences between the 1st and 2nd place entries in the competition was in the utilization of the information that multiple frames across time contain.
The CERTH system detects UAVs looking at each frame separately, and does not utilize the motion information contained in successive multiple frames. The inclusion of the time element in the CERTH system will provide more distinct features for the successful detection and classification of UAVs. Notably, we are currently working on this aspect of our algorithms, to take into account the time factor and the prior information of detections in earlier frames to improve overall detection performance.

CERTH has also discussed with the challenge organizers of the possibility of jointly organising the next challenge (at the next AVSS), contributing with data collected during the ALADDIN data collection sessions. This would be an excellent opportunity to share ALADDIN data with the wider international scientific community.

NEXT ALADDIN MILESTONES AND EVENTS

The project is progressing to its second development cycle that will lead to the production of the final version of the system to be demonstrated in Athens, Greece in May 2020. Technical partners are engaged in finalizing the **development of individual components** and organizing **integration tests** in early 2020. Finally, during the **pilot experiments** in May 2020 the full capability of the system will be demonstrated.

RELATED EVENTS

Security Research Event 2019 (SRE 2019), 6-7 November 2019, Helsinki, Finland
https://www.sre2019.eu/

MILIPOL Paris 2019, 19-22 November 2019, Paris-Nord Villepinte, Paris, France
https://en.milipol.com/

Contact us:

For more information, please visit the **ALADDIN website**: https://aladdin2020.eu/

Send us an email to info@aladdin2020.eu

Join the LinkedIn group: Counter-Drone group managed by Aladdin

You may get involved in ALADDIN activities by joining the **External Advisory Board (EAB)** and the LinkedIn **Counter-Drone group managed by Aladdin (CDGMBA),** a professional group with participants only by invitation. Send us an email (to *info@aladdin2020.eu* or through the ALADDIN contact form *https://aladdin2020.eu/contact-us/* if you are interested in joining the EAB or CDGMBA.

Issue1 and **Issue 2** of the Newsletter are available at the webpage: *https://aladdin2020.eu/media/*

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