2019

Annual report

cnit

consorzio nazionale
interuniversitario
per le telecomunicazioni

National Lab
RaSS
Radar and Surveillance Systems

Director's Introduction

This is our first official edition of the Radar and Surveillance Systems (RaSS) Laboratory's annual report, namely the 2019 RaSS Annual Report.
This annual report has been edited with the aim of showcasing the research activities that have been conducted and the major results obtained during this financial year.
In general, 2019 has been a very positive year that has seen:

- a consolidation of the personnel at RaSS with three new permanent research positions and five new temporary research positions
- 25 active projects been carried out
- 25 publications published
- 15 participating members in 30 conferences, workshops and specialist meetings
- RaSS personnel leading the three NATO activities and participating in three additional NATO activities
- five project proposal granted that will see new projects starting at the very beginning of 2020
- RaSS been certified ISO 9001/2015 for an additional three-year term (2020-2022)

This report has been kept concise and simple in order to give a brief breath of what RaSS has been concentrating its effort in the last year. For any additional information, please feel free to contact me at rass@cnit.it.

Sincerely,
Marco Martorella
Director of RaSS

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National Lab
RaSS
Radar and Surveillance Systems

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THE RADAR AND SURVEILLANCE SYSTEMS LABORATORY IN A NUTSHELL

The Radar and Surveillance Systems (RaSS) is a National Laboratory of the National Interuniversity Consortium for Telecommunications (CNIT). CNIT is a no-profit consortium composed of 44 Research Units (37 Italian Universities, 7 Departments of the National Research Council (CNR)) and 5 National Laboratories (CNIT web address).
The RaSS Lab was founded in 2010 with the purpose of creating a critical mass to face research challenges in the field of radar and applied electromagnetics. Today, RaSS counts 45 people among researchers, technical and administration staff.

The RaSS Lab has participated in several national and international research projects (often as leader), funded by the Italian MoD (Ministry of defence), EDA (European Defence Agency), MIUR (Ministry of Education), MISE (Ministry of Economic Development), EU FP7, EU H2020, ESA (European Space Agency), EOARD (European Office of Aerospace Research and Development), NATO SPS (Science for Peace and Security), NCIA (NATO Communications and Intelligence Agency), ARMASUISSE, ASI (Italian Space Agency), Tuscany Region, Industries like LEONARDO, MBDA, VITROCISET, INTERMARINE, GEM, E-GEOS, TELEDYNE.
RaSS strives to maintain, and when possible to increase, the quality and excellence of the research activities and the results achieved. At the same time, it seeks to strengthen and consolidate its structure and to invest in basic research in new promising areas.
RaSS places itself between classic academia and industry with the aim to fill the gap existing between them. Many research projects that have been carried out at RaSS have led to the development of fully integrated demonstrators with TRLs between 5 and 6.
RaSS also focuses its effort on dissemination activities, including journal and book publications, presentations at international conferences, training activities under the form of short courses, tutorials, seminars and lectures for industry, government and various research institutions.
RaSS values all its collaborations nationally and internationally, counting today more than 50 partners across, industry, academia and both government and non-government research institutions.
RaSS has a strong participation in both NATO and EDA contexts, where its personnel holds key roles within Panels and Captechs.
RaSS has spun off two companies, namely ECHOES and FREESPACE. The former focuses on the design and development of radar systems whereas the latter deals with the design and production of advanced antenna concepts and electromagnetic compatibility. Both ECHOES AND FREESPACE improve the ability of RaSS to produce effective technological transfer.

FINANCIAL STATS

The RaSS Laboratory budget comes from several sourcing of financing. The following figure outlines the lab's financial trend from FY 2017 through FY 2019.

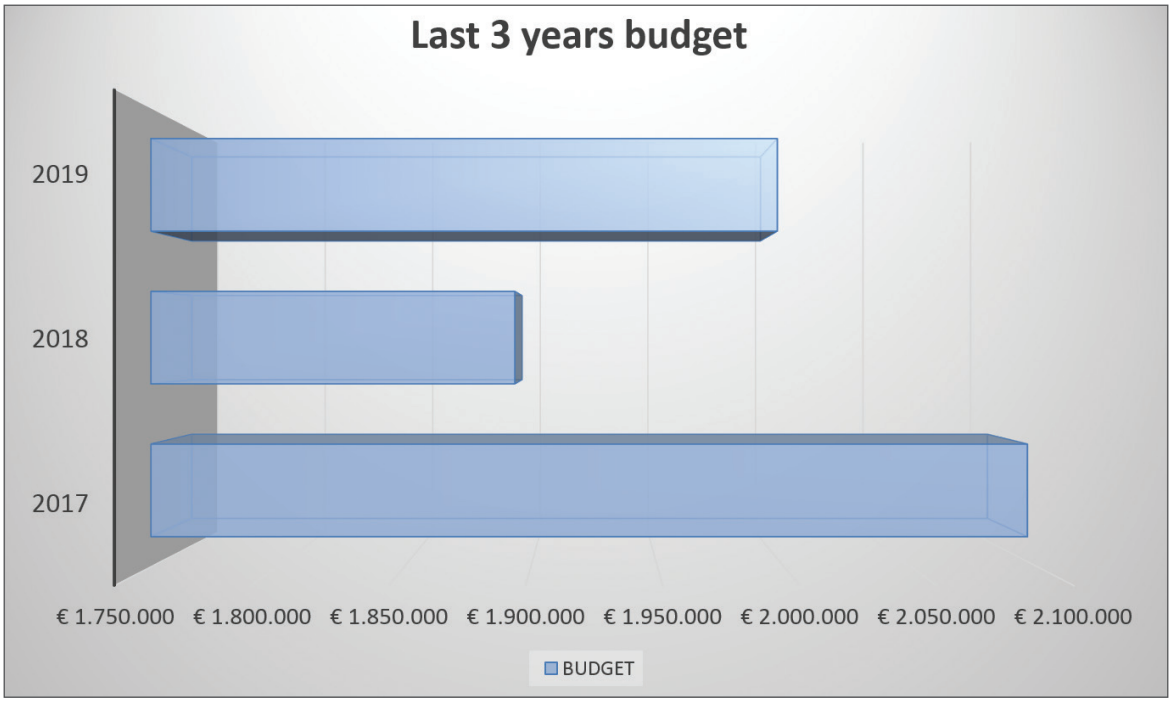


Figure 1 – RaSS Lab financial trend from FY 2017 through FY 2019

ORGANISATION CHART

Figure 2 shows the organisational chart of the RaSS Lab as on 31 December 2019.
This diagram illustrates the structure of the organisation and the relationships of its governing bodies and positions.
The RaSS Lab is organized in five research areas, namely radar systems, radar signal/image processing, remote sensing, antenna, electromagnetic modelling & materials. RaSS also has an explorative research area, where promising basic research is internally funded, an instrumental laboratory and a security office to handle classified information. On the administration side, RaSS is composed of a secretariat office, a quality control office and a public relation office. RaSS governance is directed by the Steering Committee, which is chaired directly by the Director.

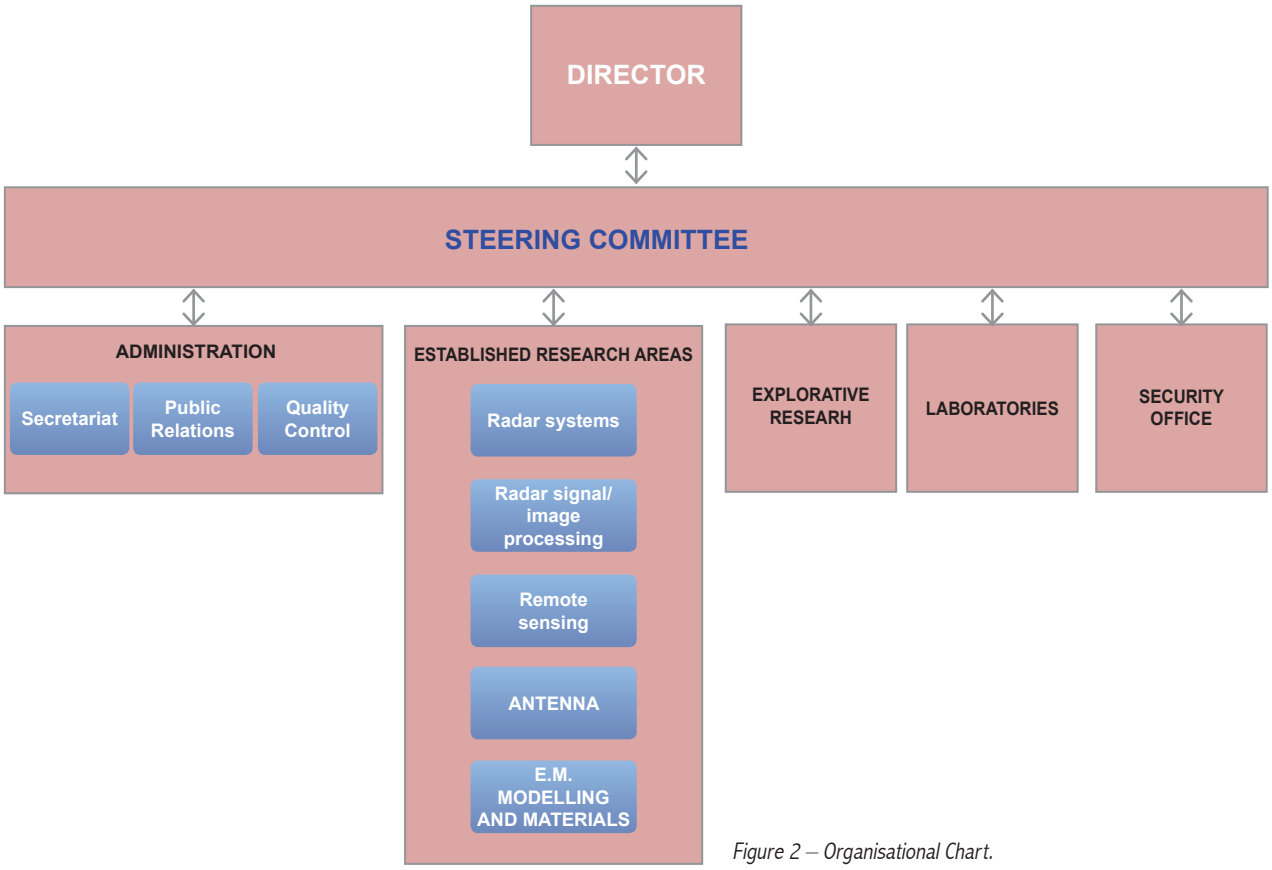


Figure 2 – Organisational Chart.

DIRECTOR

Prof. Marco Martorella received his Laurea degree (Bachelor+Masters) in Telecommunication Engineering in 1999 (cum laude) and his PhD in Remote Sensing in 2003, both at the University of Pisa. He is now an Associate Professor at the Department of Information Engineering of the University of Pisa and an external Professor at the University of Cape Town where he lectures within the Masters in Radar and Electronic Defence. Prof. Martorella is also Director of the CNIT's National Radar and Surveillance Systems Laboratory. He is author of more than 200 international journal and conference papers, 13 book chapters, a book entitled Inverse Synthetic Aperture Radar Imaging: Principles, Algorithms and Applications and another book entitled Radar Imaging for Maritime Observation. He has presented several tutorials at international radar conferences, has lectured at NATO Lecture Series and organised international journal special issues on radar imaging topics. He is a member of the IET Radar Sonar and Navigation Editorial Board and a member of AFCEA. He is also a member of the IEEE AES Radar Systems Panel, a member of the NATO SET Panel, where he sits as co-chair of the Radio Frequency Focus Group, and a member of the EDA Radar Captech. He has chaired five NATO research activities, including three Research Task Groups, one Exploratory Team and two Specialist Meetings. He has been recipient of the 2008 Italy-Australia Award for young researchers, the 2010 Best Reviewer for the IEEE GRSL, the IEEE 2013 Fred Nathanson Memorial Radar Award, the 2016 Outstanding Information Research Foundation Book publication award for the book Radar Imaging for Maritime Observation and the 2017 NATO Set Panel Excellence Award. In 2019 he was elevated to IEEE Fellow for his contributions to multi-static inverse synthetic aperture radars. He is co-founder of a radar systems-related spin-off company, namely ECHOES. His research interests are mainly in the field of radar.

Active Projects

PROJECT ANTI-DRONES

Project Anti-Drones - Innovative concept to detect, recognize and track "killer-drones"

The project is focalized on the development of a new concept of anti-drone system able to detect, recognize and track the killer-drones – mini/micro UAVs - in order to facilitate the neutralization of them minimizing the risk for people and assets.
This needs the integration of different competences, such as system design and integration, design of antennas and transceiver, development of advanced signal processing algorithms, as well as development of software and firmware. The ambitions will be achieved through the use of software defined technologies and the backbone of development will be focused on software engineering techniques relevant to the success of the project.
The final scope of the project is to progress the state of the art of the anti-drone systems through the use of mini-radar technology and signal processing, improving the performance of the system and eliminate completely the environmental impact (e.g. ECM pollution) in urban environment.

Technical Sheet
Funding institution:
NATO – ESCD – SPS Programme
Project partners
CNIT-RASS, Mother Teresa University (MTU), North Kazakhstan State University (NKSU)
Project duration
September 2019 - March 2022
Involved countries
Italy, North Macedonia, Kazakistan

(a) - Realistic scenario: Assassination Attempt on Head of State in Venezuela via a Drone

(b) - Anti-Drones project Conceptual Diagram

PROJECT ARIMOTA

(Airborne Radar Imaging of Moving Targets)"

The surveillance of land and sea segments from airborne platforms both "manned" and "unmanned" is of fundamental interest both in civil and military applications. In particular, both in the Mediterranean region and in the state of Singapore, airborne sensors that can monitor large areas with controllable and flexible missions, can be seen as a viable solution. The ARIMOTA project is the result of a bilateral research collaboration that has been established between the Italian (MoD) and the Singaporean (MInDef) ministries of defence.

The aim of ARIMOTA is to study and develop airborne Multi-channel Synthetic Aperture Radar (M-SAR) for imaging of ground and maritime targets that are embedded in strong clutter.

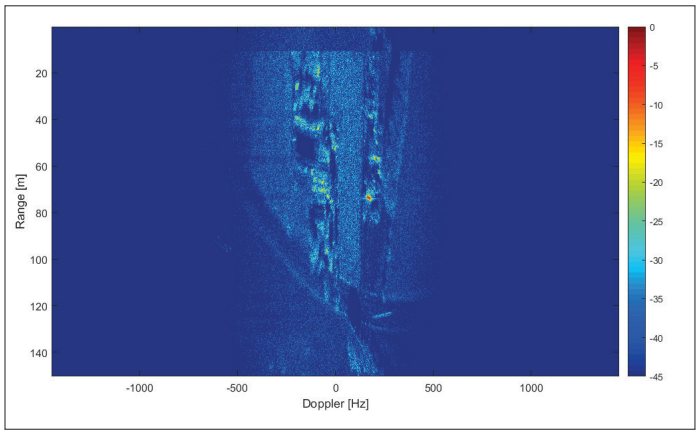
More specifically:

- Develop signal processing algorithms for an airborne SAR system with high performance in non-cooperative moving targets detection and imaging.
- Development of multichannel radar system demonstrator for airborne platform.
- Organization and conduct of trials for the acquisition of multichannel airborne radar data on both terrestrial and maritime scenarios.
- Data analysis for system validation.

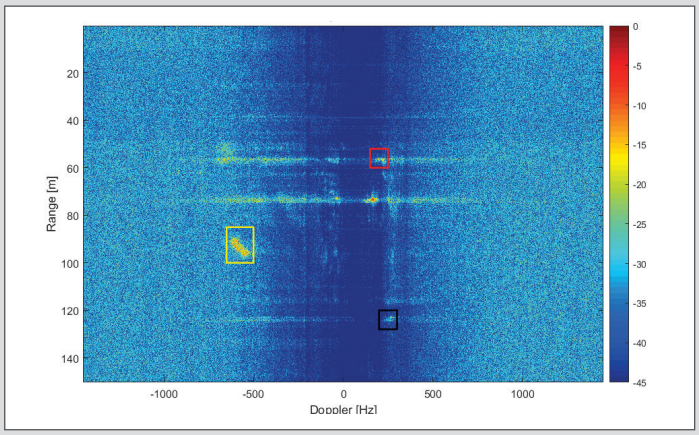
The proposed activity matches the national needs for a complete airborne monitoring system. The system will be developed to interface with various airborne platforms. The demonstrator of the system will be developed and constructed with the criteria of low emission, compact and light in order to be used in a high number of types of missions and scenarios. The algorithms that will be developed and tested with the technological demonstrator will go in the direction of increasing the capabilities of intelligence in the military environment and of homeland security.

Technical Sheet
Funding institution:
Italian Ministry of Defence (MoD)
Project partners
NANYAGH Technological University (NTU), CNIT
Project duration
November 2017 – November 2020
Involved countries
Italy, Singapore

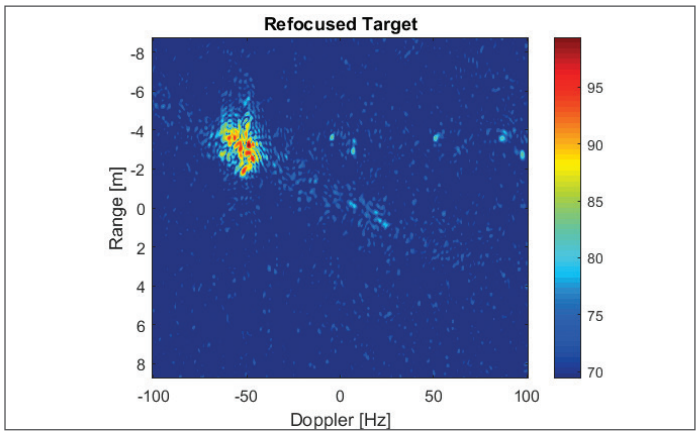
(a) - SAR image of the area of interest



(b) - Observed Range-Doppler SAR image before STAP processing



(c) - SAR image after STAP processing SAR image after STAP processing



(d) - Non-cooperative moving target after ISAR processing

PROJECT ARTESIAN

(updAte Radar capTEch StrategIc reseArch ageNda)

This technical proposal is a response to EDA's call for tenders 18.ESI.OP.005 titled "Service Contract for the Provision of Services Related to the Study CapTech Radar SRA Update".

The aim of the study is to update the Scientific Research Agenda (SRA) of the CapTech RADAR using the recent EDA Overarching Strategic Research Agenda (OSRA) methodology.

A series of workshops will be organized with the most important research centers and companies working in the defence sector in order to highlight current technology gaps in RF technology, design a roadmap toward the filling of these gaps end set the research priorities for European Defence in the RF Capthech for the upcoming years.

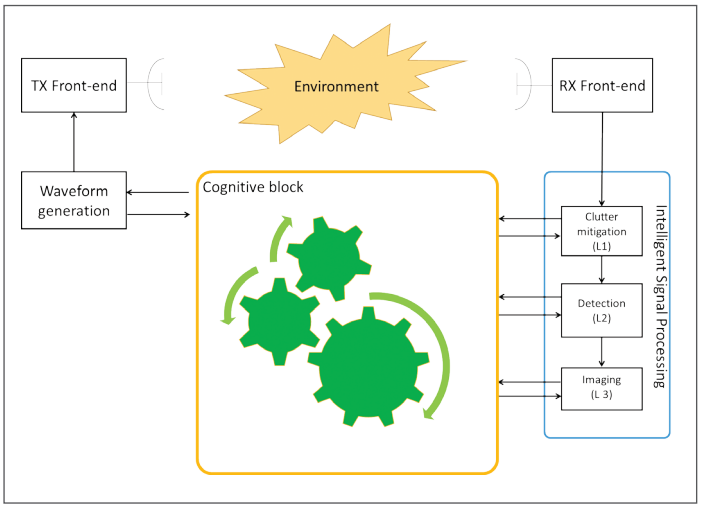
Technical Sheet
Funding institution:
European Defence Agency
Project partners
CNIT, Fraunhofer FHR, TNO, Onera
Project duration
June 2018 – June 2019
Involved countries
Italy, Germany, Netherlands, France

PROJECT COGITO

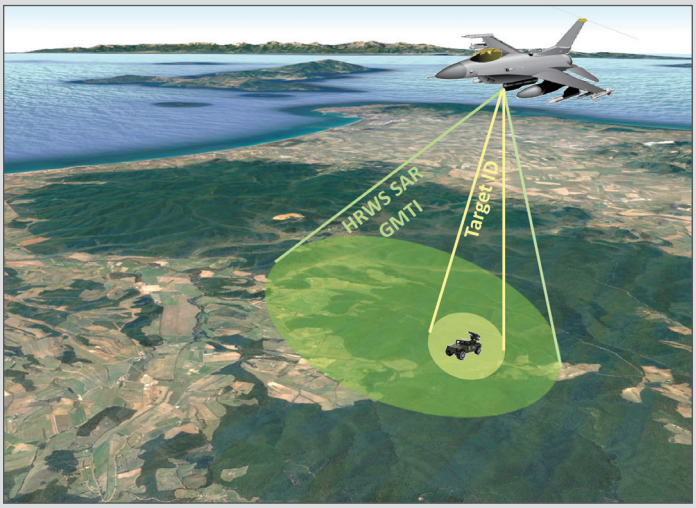
(COGnitive Radar for Enhanced Target RecognITiOn)

The COGITO project is the first attempt to apply the cognitive architecture to the problem of target recognition.
Today, in fact, most of the "Cognitive Radar", either existing or under study, are focused on the radar capability to automatically select the regions of the spectrum of frequencies that are free of other intentional or not radio frequency sources. It should be noticed that such a way of working resembles that of a cognitive radio system more than a cognitive radar system.
The concept of cognitive radar for target recognition is based on the system's ability to understand the environment and to autonomously manage both the radar degrees of freedom (transmitted waveform and processing on receive) and the recognition algorithms in order to maximize the identification performances, also exploiting a priori knowledge of the radar environment.
The aim of this project is to develop and test, both on simulated and real radar data, different cognitive radar architectures for automatic target recognition. The project will also assess the performance comparison between the classical HRR/ISAR classifiers and the new cognitive architectures. Here below follow a pictorial representation of the cognitive architecture that will be developed inside the project and of the operative scenario in which the system is asked to operate. The performance will be evaluated with simulations, synthetic and real experimental data.

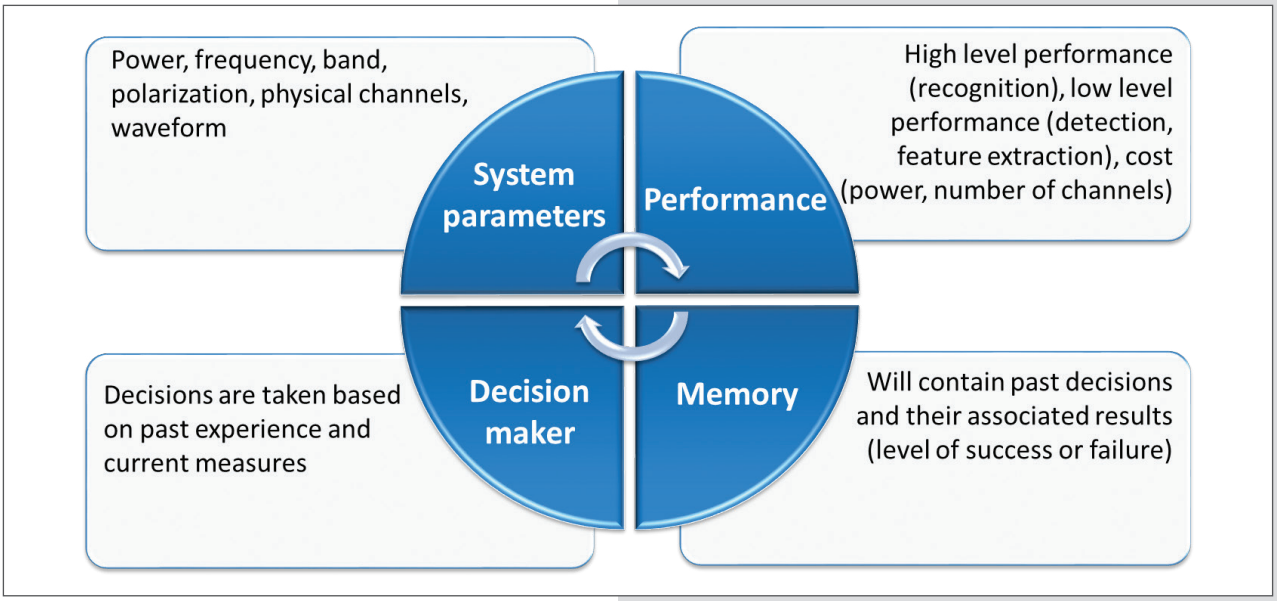
Technical Sheet
Funding institution:
European Defence Agency (EDA)
Project partners
CNIT - RaSS Lab, IDS, FHR, MBDA
Project duration
January 2019 – January 2022
Involved countries
Italy, Germany



(a) - Cognitive radar high level architecture



(b) - Operative scenario example



(c) - Cognitive imaging radar learning criteria

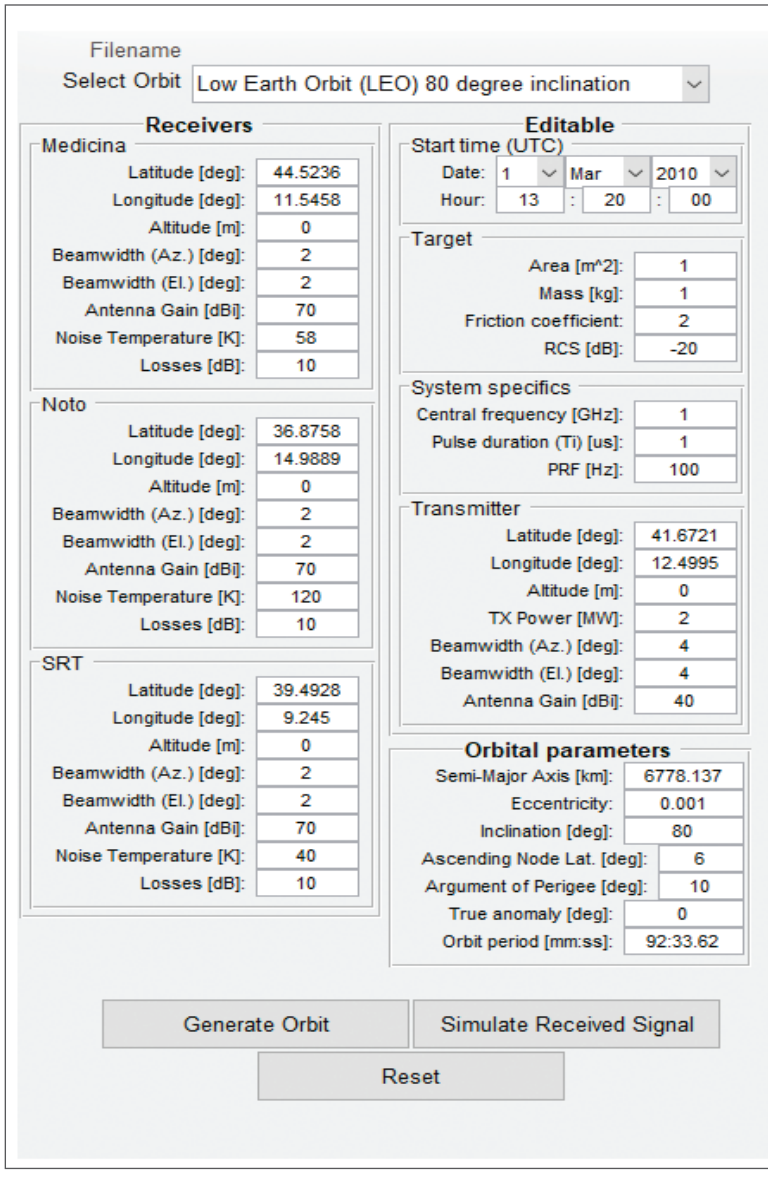
PROJECT DEA-SSA

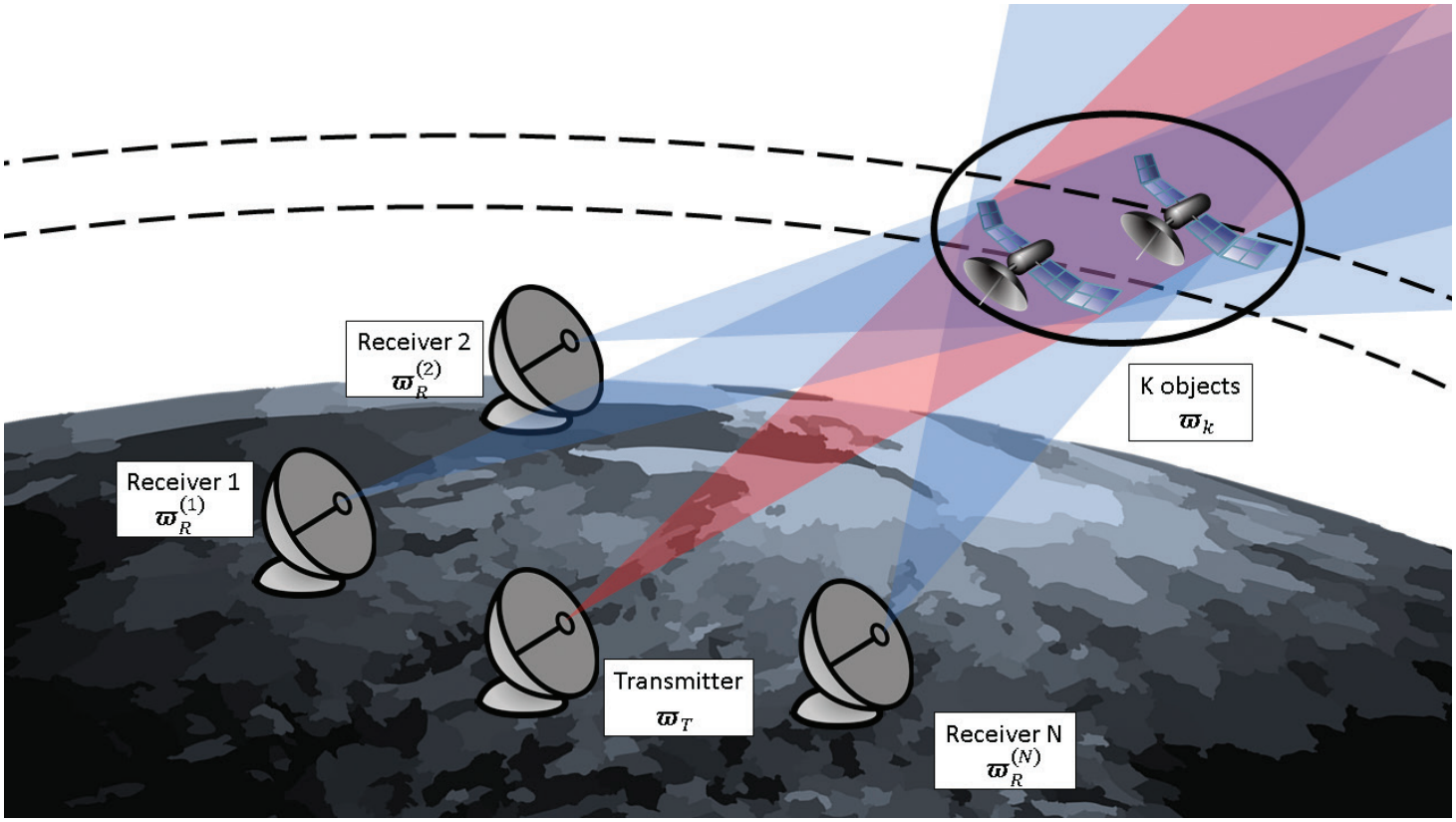
(Data Exchange Agreement (DEA) "Space Situational Awareness")

The aim of this joint project is develop the necessary capability to perform Space Surveillance and Tracking with a nationally implementable radar system. More specifically, in order to leverage on the existence of powerful radio-telescopes to be used as receivers, the configuration is a multi-bistatic one. Detection, tracking and ultimately initial orbit determination are the necessary steps to be performed to enable the creation and maintenance of a RSO catalogue. The collaboration with the US counterpart is intended for combining radar and optical data collected possibly from different sites of the world. The joint use of such assets should improve RSO orbital parameter estimation accuracy and robustness. This project is linked to the Project Agreement with US NO. US-IT-AF-14-0001 on "Space Situational Awareness of Resident Space Objects".
The objectives of this project are:

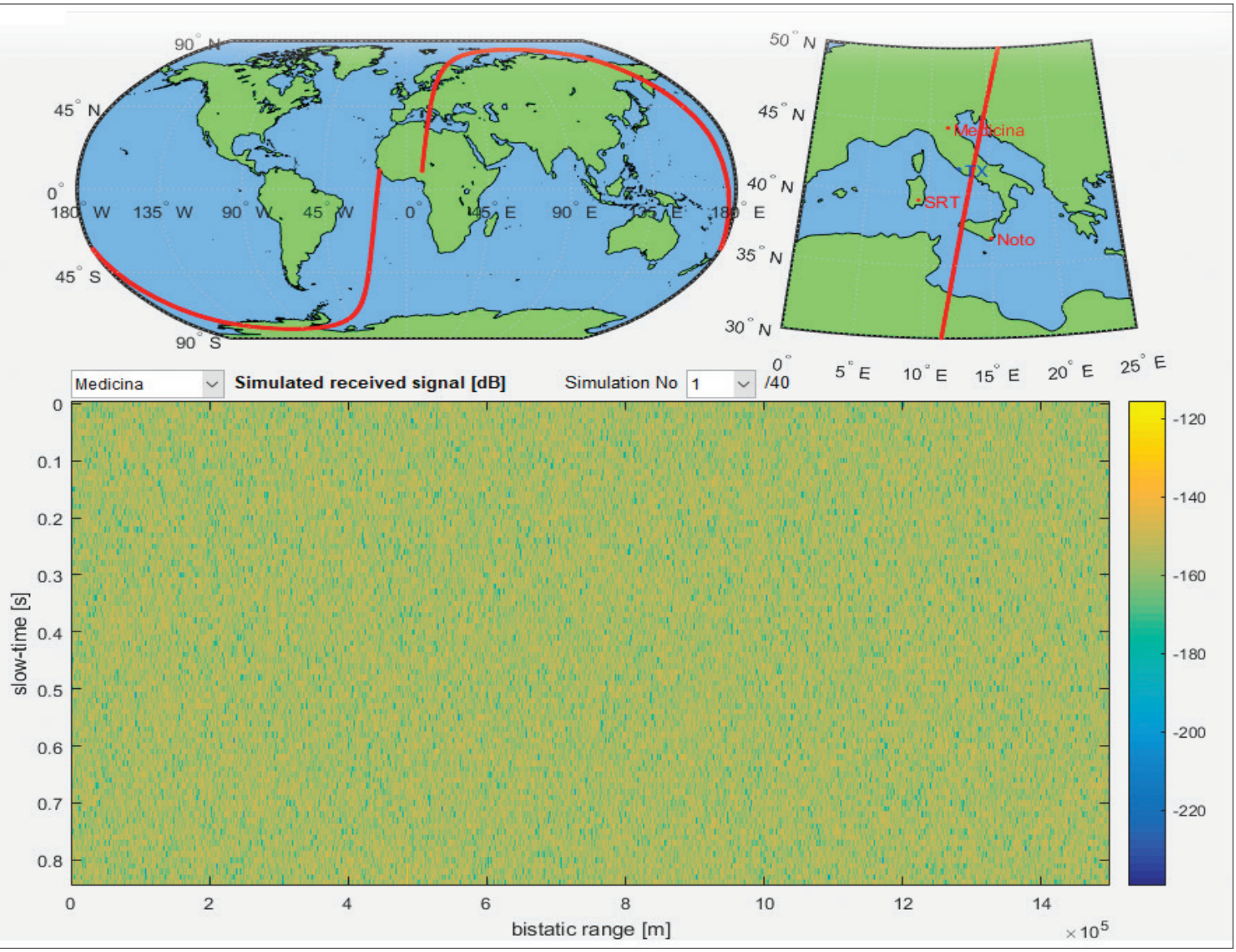
- Development of algorithms for the detection and tracking of RSO with multi-bistatic radar.
- Orbital parameter estimation with bistatic radar observables.
- Development of RSO classification and recognition algorithms based on bistatic radar data.
- Experimental data analysis.

Technical Sheet
Funding institution:
Ministry of Defence
Project partners
AFRL
Project duration
February 2017 – June 2020
Involved countries
Italy, USA





(b) - Multi-bistatic radar configuration for RSO orbit determination



(a) - Radar signal simulator GUI - screenshot

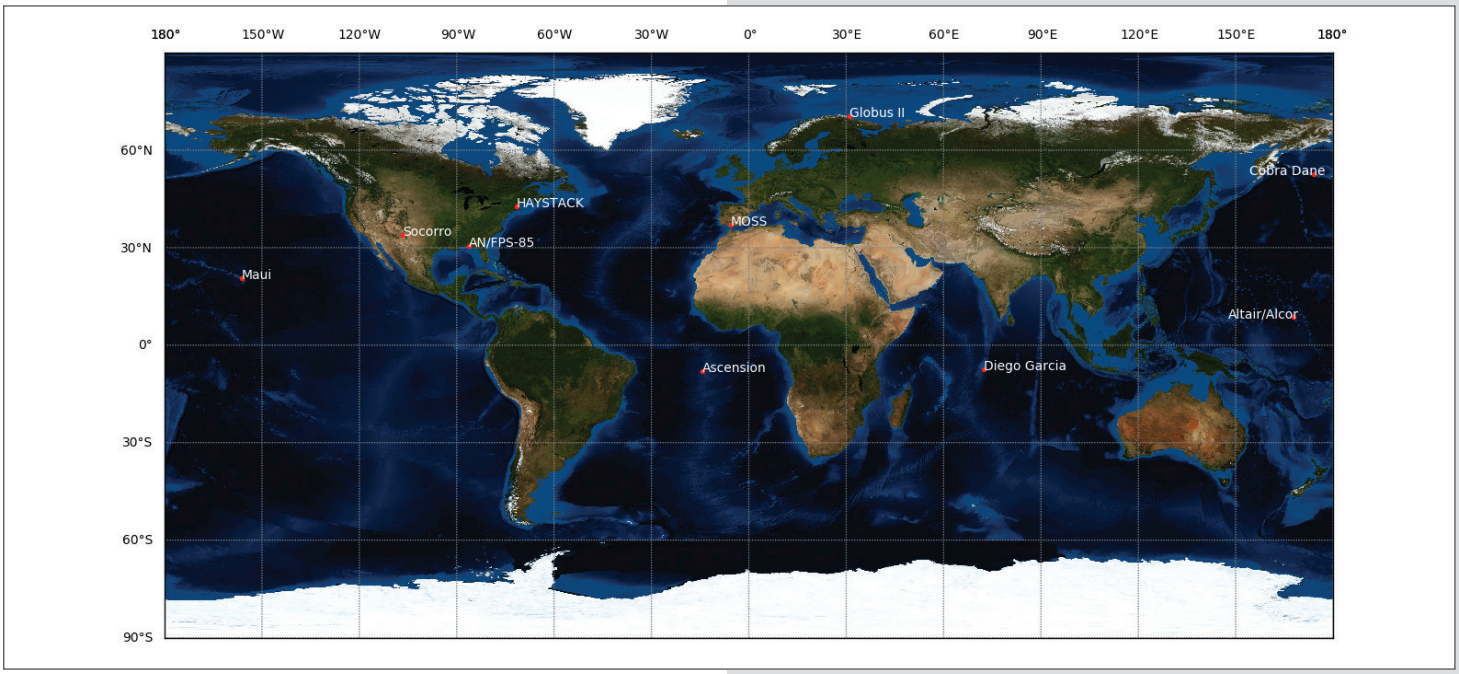
PROJECT EOARD 2

(Optimized Tracking of Low Thrust Orbit Raising Manoeuvres)

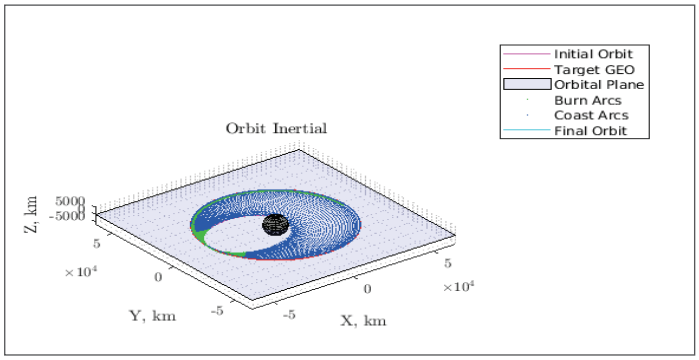
The primary goal of this project is to develop novel algorithms for improvements in low thrust maneuver (LTM) sensor tasking and orbit determination by jointly using angle (optical) and range/range-rate (radar) measurements. Radar and optical measurements will be combined to improve tracking and to estimate object parameters that will better characterize the physical and dynamic attributes that are assumed in force models. This will include the use of radar cross section (RCS) and optical photometry to better characterize the attitude dynamics, which affect drag and solar pressure acceleration. The proposed sensor network is shown in Fig. 1, while Fig. 2 shows an example of xenon ion propulsion system, which will be considered in this project. Models and algorithms will be developed to improve the error characterization, which affects tracking of manoeuvring satellites.

The algorithms that will be developed will make use of Unscented Kalman Filter (UKF), smoothing filters and data fusion algorithms. Particularly, consecutive pass update estimations will be used to better estimate satellite's state vectors (including manoeuvre model parameters) and to reduce the uncertainty by increasing the accuracy, so that a minimum consumption of tasking resources will be needed to perform asset corrections. The performance impact to follow-up acquisitions and data to track associations for all observation combination cases will be assessed. Satellite parameter estimation (physical and dynamic attributes) that will be derived from both optical and radar measurements will be integrated into force models to improve the system dynamic model. The developed algorithms will be tested and validated using simulated data to demonstrate an effective precise LTM determination improvement and tasking optimization.

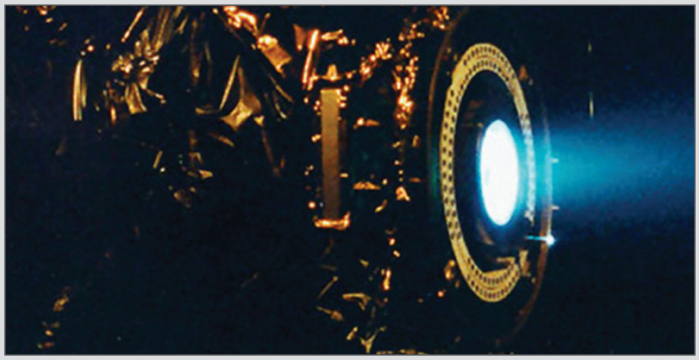
Technical Sheet
Funding institution:
EOARD, AFOSR
Project partners
Applied Defense Solutions
Project duration
September 2018 – August 2019
Involved countries
ITA, USA



(a) - Sensor network scenario considered in the simulations;



(b) - DS1's ion propulsion system, Image credit: NASA/JPL-Caltech



(c) - Transfer orbit and manoeuvring plan of the considered scenario

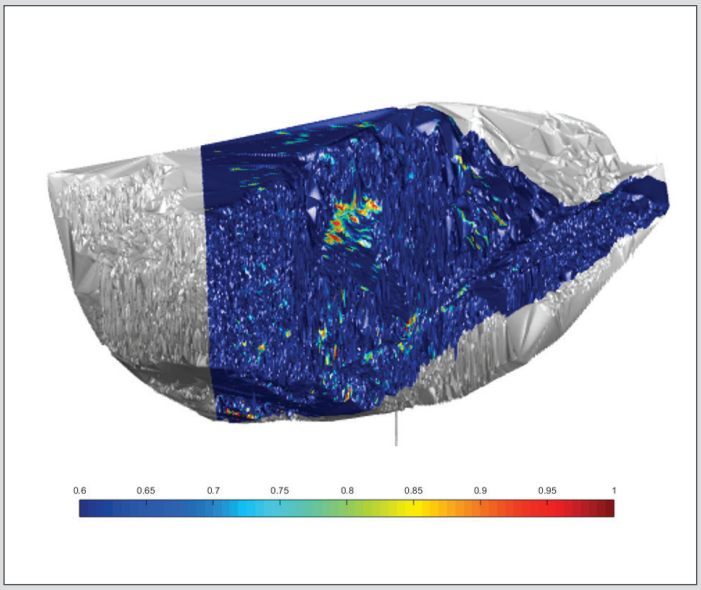
PROJECT GLIDE

(HiGhLy SensItive Radar Change Detection)

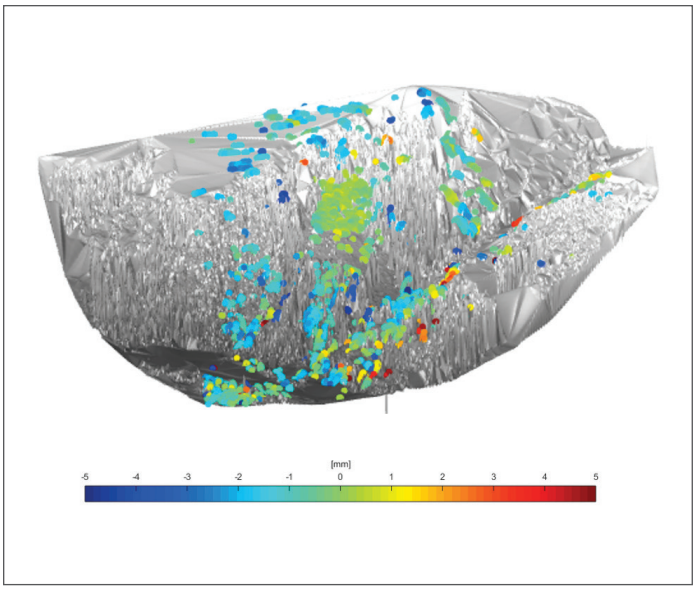
The goal of this Program Agreement (PA) is to significantly improve radar change detection by accurately studying the phenomenology associated with radar interferometry and by developing improved algorithms that are based on such an understanding. The main objectives to be achieved within this project are:

- Study the phenomenology associated with repeat pass interferometry, such as atmospheric interference, temperature and humidity variations at various frequencies. For this purpose, one or more measurement campaigns will be run to collect real data by using a multi-frequency ground-based SAR system.
- Develop effective change detection and structure deformation estimation algorithms that are based on the results of the phenomenological study in order to outperform classic algorithms and significantly improve state-of-the-art radar coherent change detection.
- Real data acquisition with a multi-frequency ground-based SAR system for phenomenological study and algorithm validation.
- Study spaceborne distributed and Unmanned Aerial Systems (UAS)-based Synthetic Aperture Radar (SAR) formations and optimise them based on the mission goals and on the phenomenological scenarios.

Technical Sheet
Funding institution:
Ministry of Defence
Project partners
University of Naples, ELTA Systems, ECHOES s.r.l
Project duration
February 2019 – November 2020
Involved countries
Program Agreement



(a) - Coherence map after fine Co-Registration (ECHOES s.r.l.);



(b) - Displacement map (ECHOES s.r.l.)

PROJECT ITS-ITALY 2020

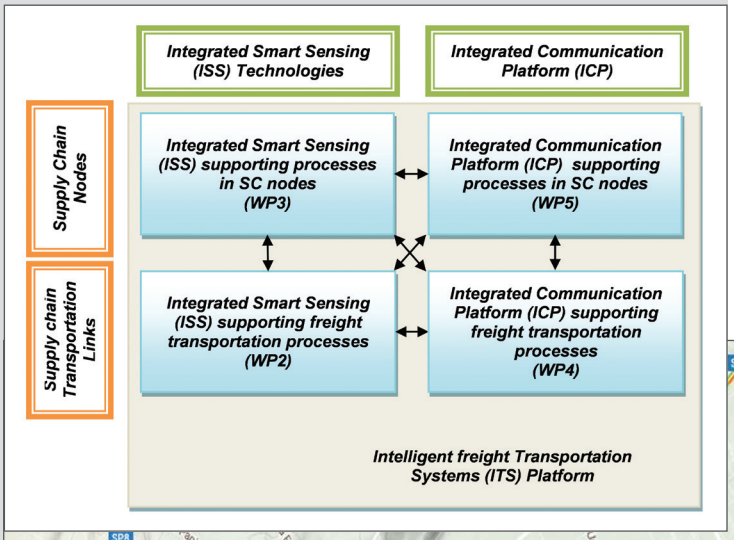
(Intelligent Transportation System – ITALY 2020)

The project aims to research, design and tuning innovative ICT based solutions to support logistics and transportation processes, with special attention to the inter-modal freight transportation, in order to improve their effectiveness and efficiency. In this context, it is very important to apply technologies based on sensors (Integrated Smart Sensing) and systems supporting the information exchange among the supply chain players (Integrated Communication Platform) for enhancing the logistics process in its base components, namely 'nodes' (e.g. ports and inter-ports) of the supply chain and transportation 'arches'. To this aim, the project has been structured into seven work packages (WPs) whose main research areas are:

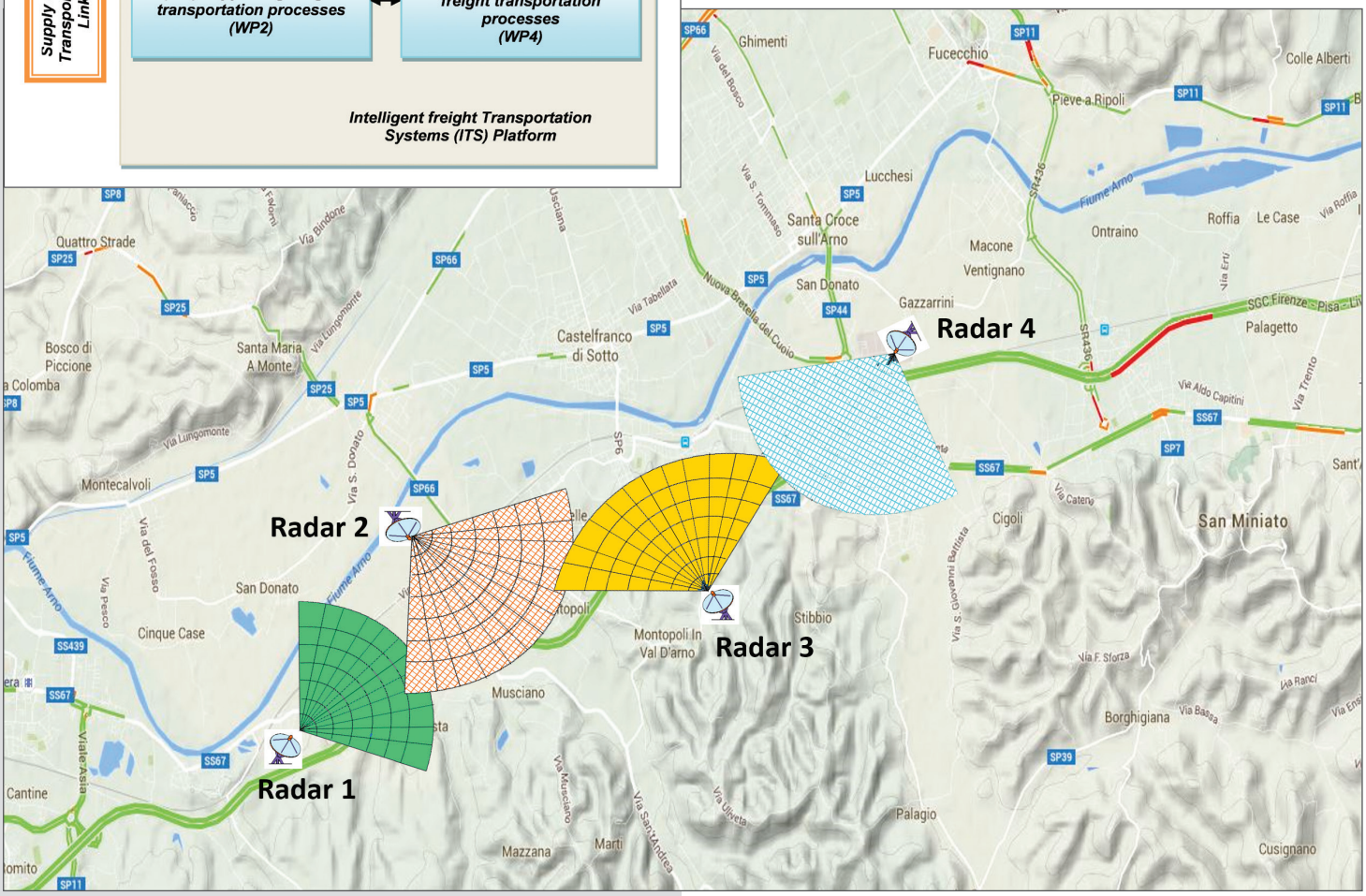
- Development of integrated smart sensing solutions to support both transport and node processes
- Development of data communication system solutions to support both transport and node processes

The main result of the project will be the development of effective tools able to integrate traditional services, i.e. transportation and warehousing, with information-based services, such as information transfer, route planning, monitoring (i.e. tracking and localization). In the framework of ITS-ITALY project, CNIT-RaSS proposes a radar systems network for vehicle monitoring and classification based on radar images. The processing architecture and the proposed algorithms have been validated through real data acquired during the experimental phase.

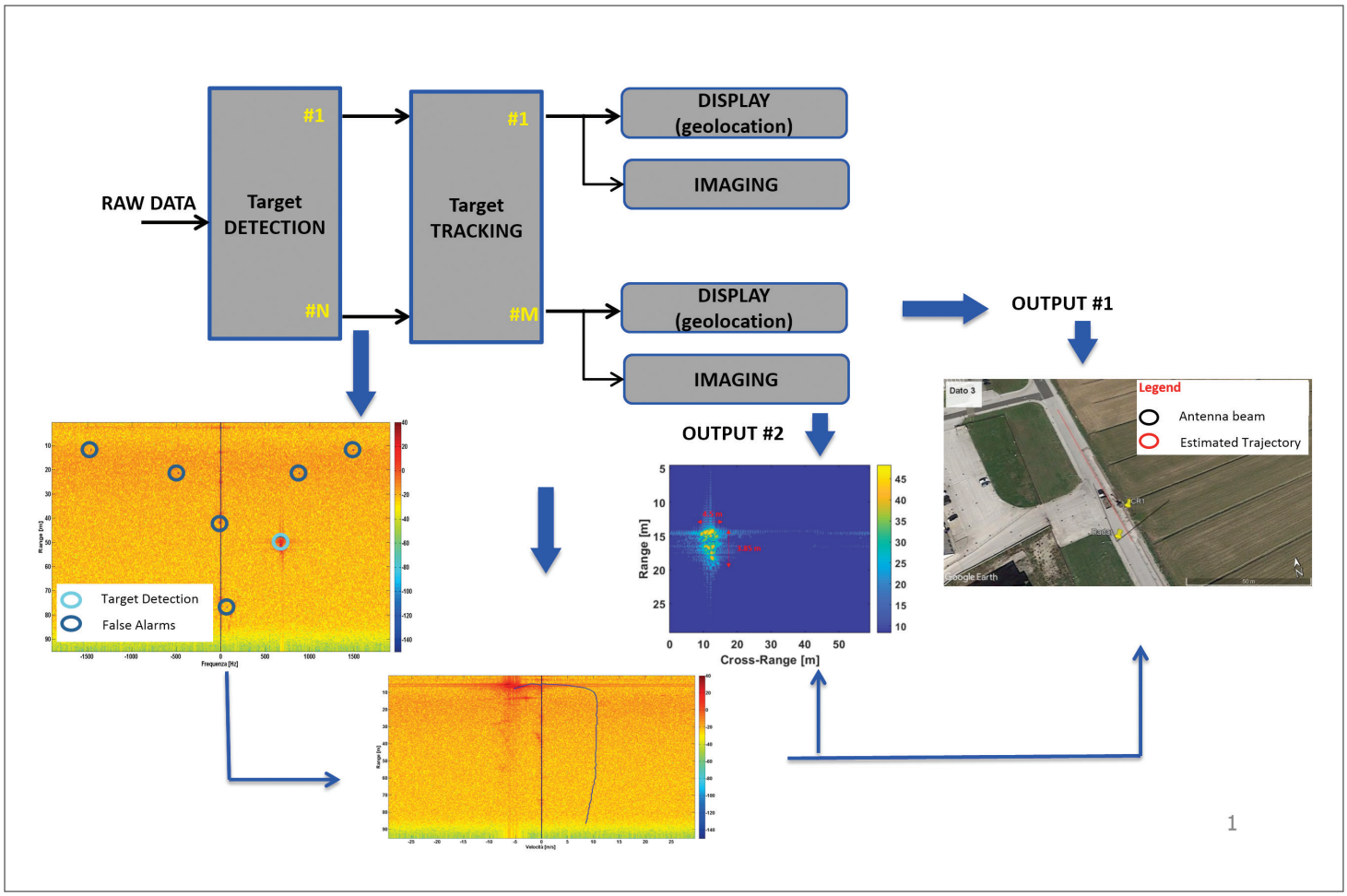
Technical Sheet
Funding institution:
MIUR
Project partners
POLIMI, POLITO, Softeco Sismart, TESI, Mobysys, Gruppo SIGLA S.r.l., Almaviva, RDW, Rotas Italia S.r.l., IVECO S.p.A., IDNOVA S.r.l., IB S.r.l., Aitek, TELECOM, Exprivia, Gianetti Ruote, IDS, STAR, VITROCISET, OPTISOFT, ART S.p.A., HUPAC
Project duration
February 2014 – February 2021
Involved countries
ITALY



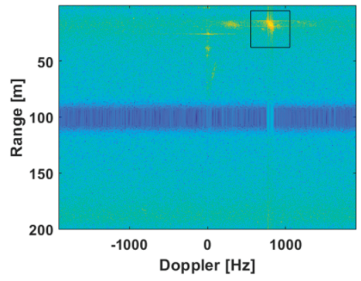
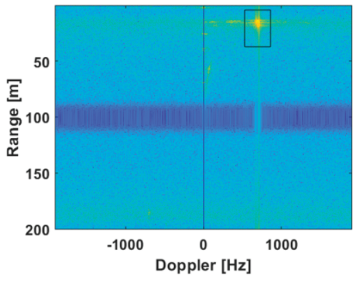
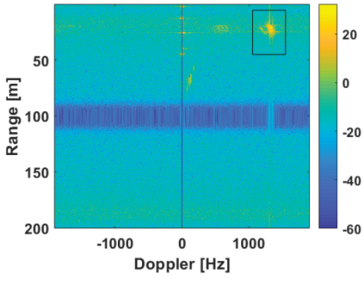
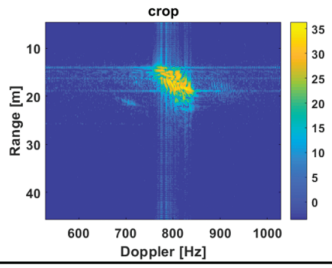
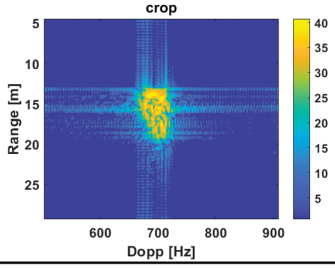
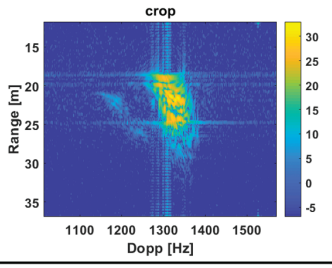
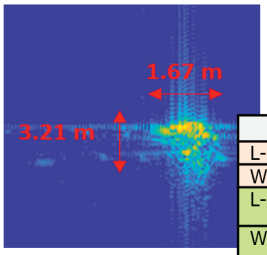
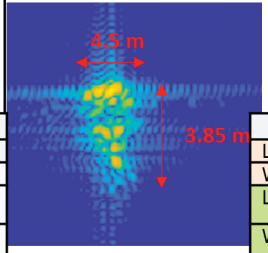
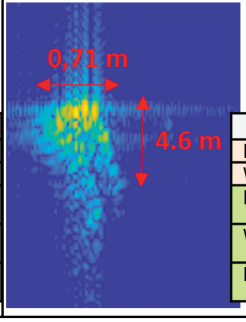
(a) - ITS concept architecture



(b) - Network of sensors for the surveillance of wide areas and the localization of freight transports



(c) - Processing Block Diagram and relative output

	Lancia Y	Ford Transit	Renault Megane
Range-Doppler image			
Range-Doppler crop			
R-D zoom-dim estimation			
	Dim Comparison: L-real 3,84m; Wi-real 1,67m; L-estimated 3,21m; W-estimated 1,67m; Extension 3,62m	Dim Comparison: L-real 5,57m; Wi-real 1,78m; L-estimated 4,5m; W-estimated 3,85m; Extension 5,92m	Dim Comparison: L-real 4,36m; Wi-real 1,8m; L-estimated 4,6m; W-estimated 0,71m; Extension 4,65m

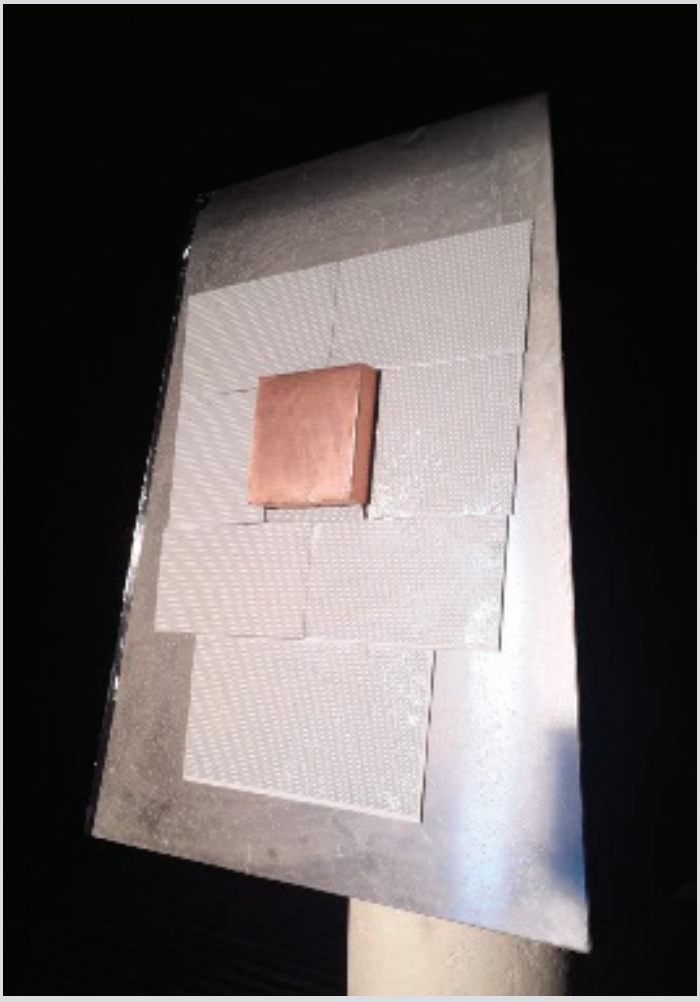
(d) - Results of vehicle classification based on radar images

PROJECT LOREN

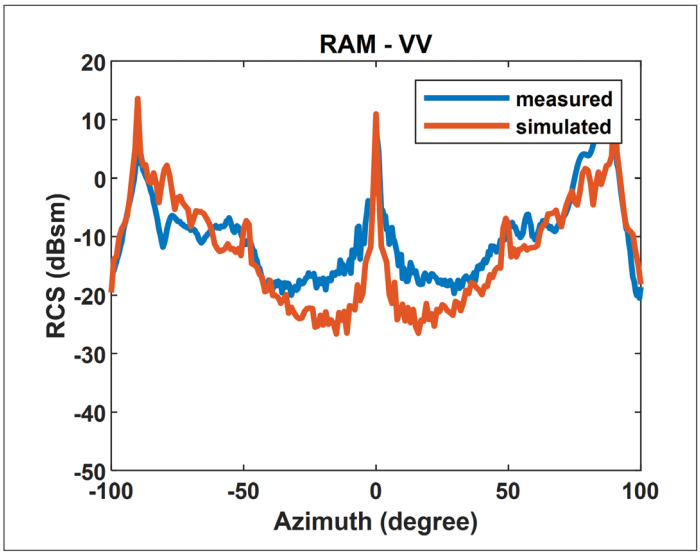
(Low Reflecting, Ultra Thin, Conformal Frequency Selective Metamaterial for Radar Camouflage and Cloaking)

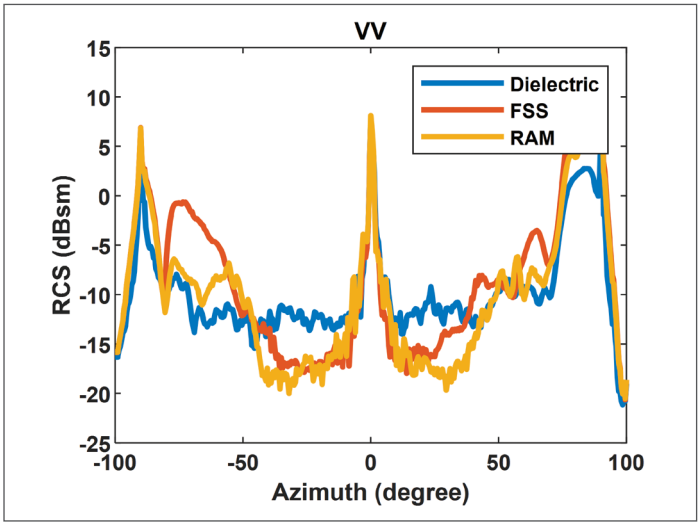
LOREN project was focused on the design and implementation of a technological demonstrator aimed at reduction of the radar signature of mobile units by exploiting innovative metamaterials realized with periodic resistive surfaces. These radar absorbing materials have been specifically designed to be integrated in the most critical parts of the mobile unit in terms of backscattered fields, such as antennas and corners. The successful implementation and realization of resistive materials, achieved by using processes and technologies available in the national industry, was one of the most challenging task accomplished. Guidelines for the design of future units have been provided on the basis of the gained physical insight, which has also to take into account the feasibility, cost-efficiency and required form factor of the designed materials.

Technical Sheet
Funding institution:
NAVARM
Project partners
CNIT, CSSN-ITE, NAVARM
Project duration
September 2018 – June 2019
Involved countries
Italy

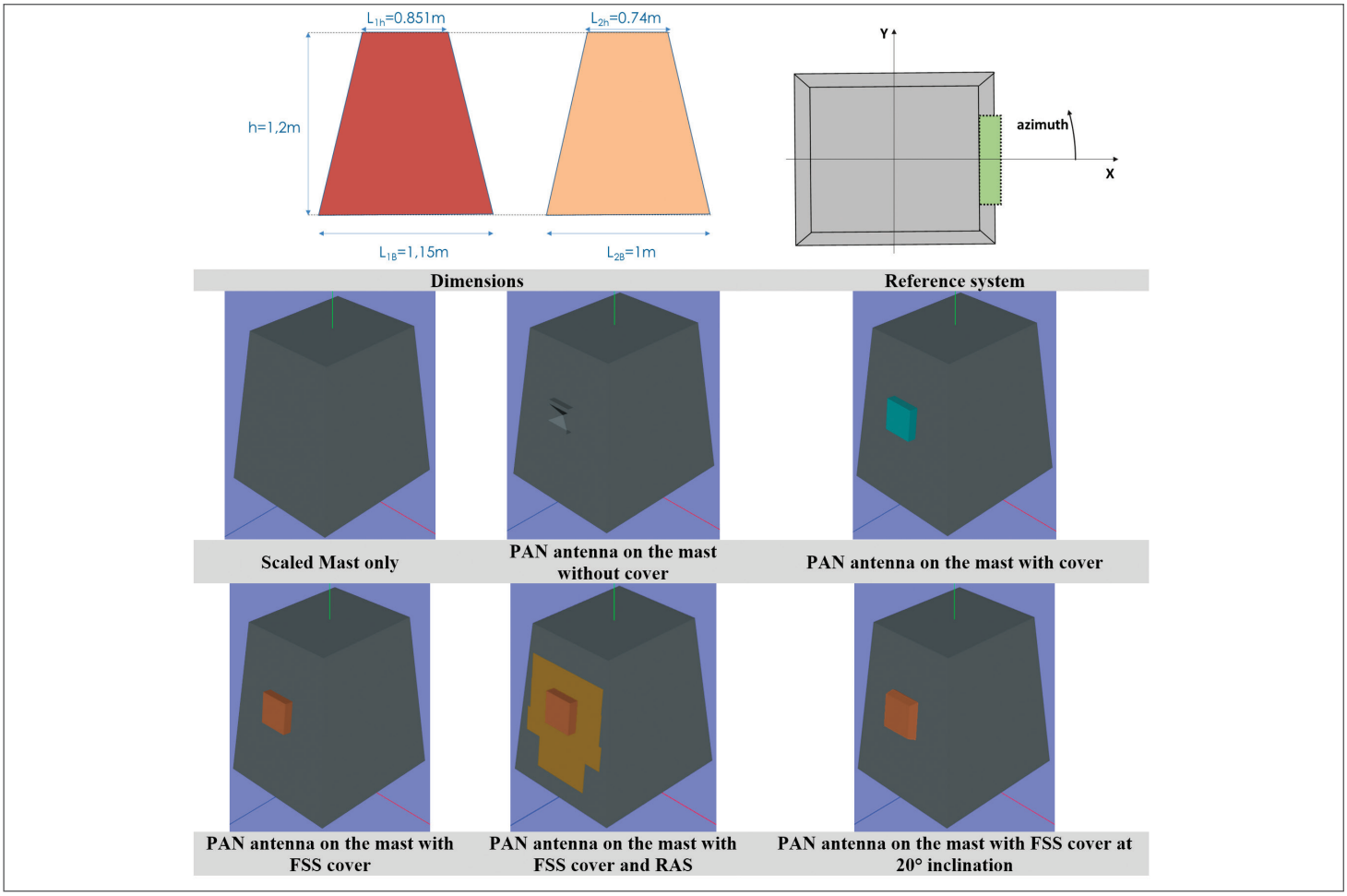


(a) - Simplified mockup for countermeasure radar performance assessment

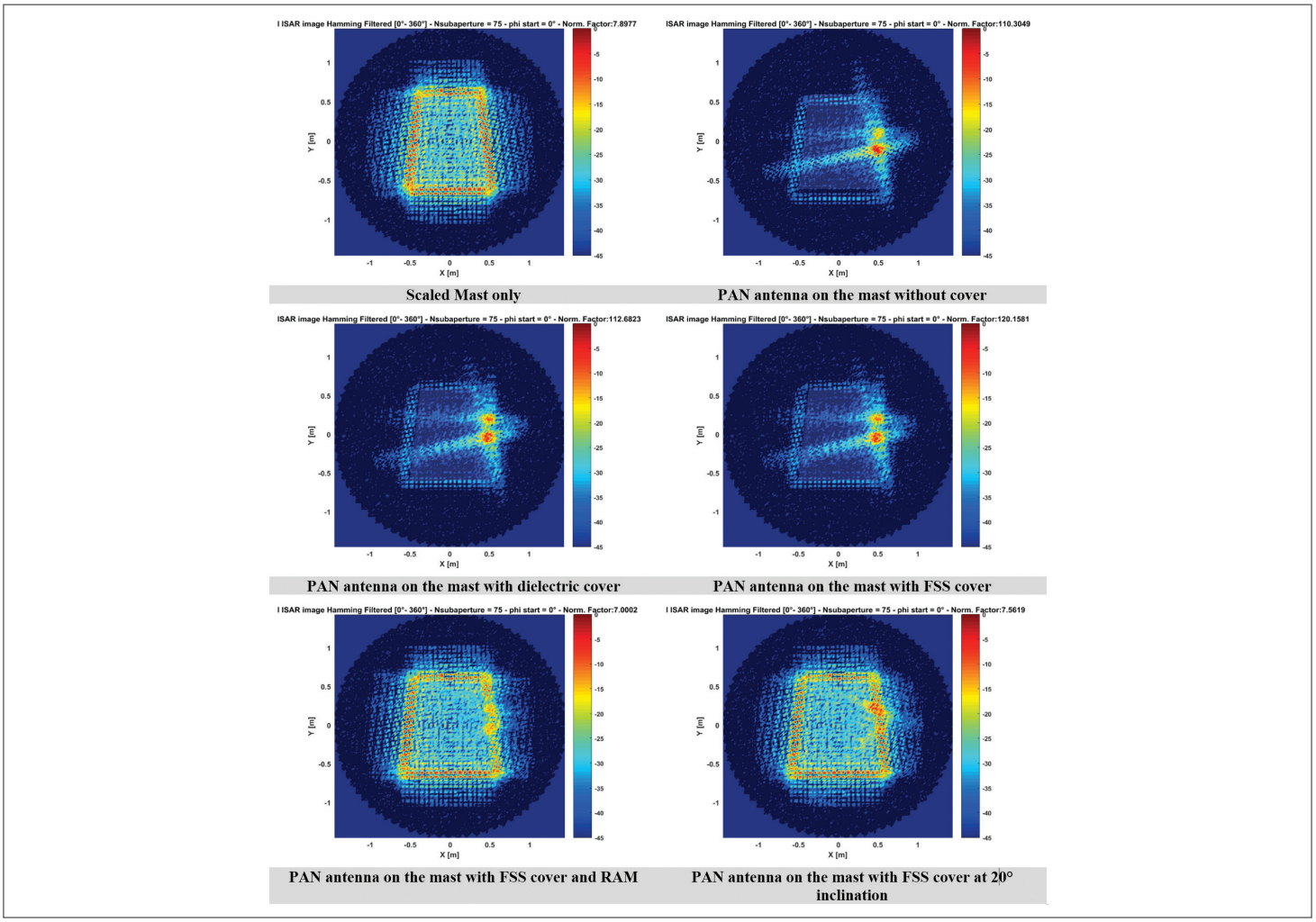




(b) - Comparison of simulated measurements of the measured RCS averaged on the 18-26 GHz band. Measured RCS averaged on the 18-26 GHz band: comparison of the countermeasures using FSS and RAM compared to the dielectric cover only



(c) - Geometry of the simulated configurations: the metal is shown in gray, the dielectric with εr of 3.5 is in light blue, the FSS film in orange and the RAM structure in mustard



(d) - Final ISAR images of all configurations on the plane φ = 0 ° in polarization V. The images have the same dynamic range but are normalized to a different maximum value identified as NF (Normalization Factor)

PROJECT MIRACLE II

(Micro-Satellite Clusters II)

In background surveillance there is a need for near-global coverage at medium temporal and spatial resolution. In targeted operations, there are similar needs for localized coverage at a very high temporal and spatial resolution. The objective of this project is to cover both needs through:

- Virtual SAR constellations
- Cluster of real SAR satellites

in combination with new SAR technology both on the instrument and processing side.

The application scenarios for the project will be maritime security and defence applications in the Mediterranean and High-North areas. In surveillance and security, our assets should maximise the following operational performance characteristics:

- Spatial coverage
- Temporal coverage
- Spatial resolution
- Low vulnerability
- Timeliness

Current assets, including the way they are used, are not able to meet user needs and requirements in an optimal manner. During this project, we will analyse new and forthcoming technologies to provide increased performance of future assets and optimal use of existing assets at an affordable cost.

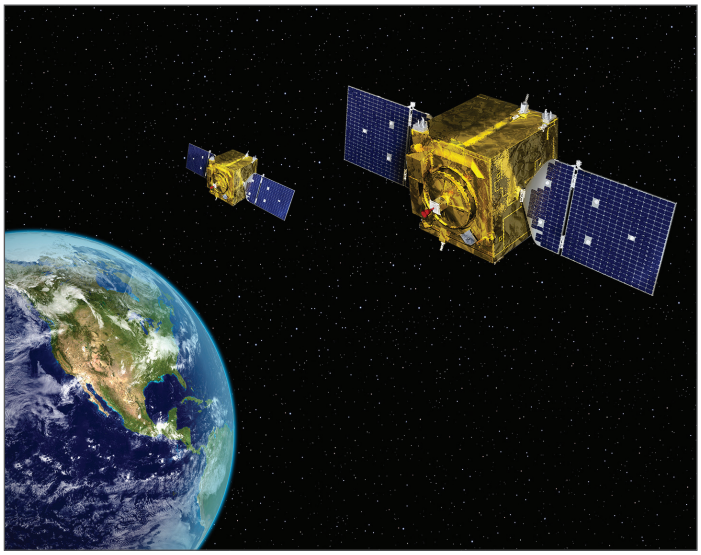
The following key elements will be analysed:

- SAR Cluster of small, relatively inexpensive satellites
- New SAR technologies
- Virtual SAR cluster utilizing existing and future SAR missions
- Maritime modes, including optimal ship detection and imaging

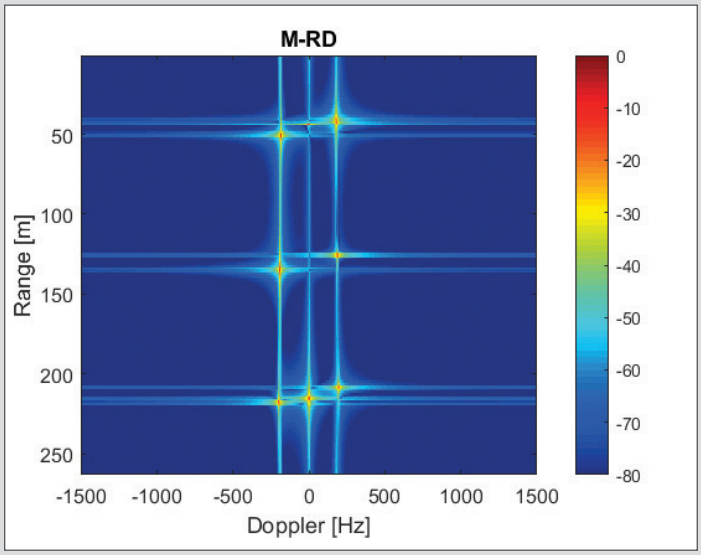
In this project we:

- Propose an architecture for such constellations
- Demonstrate technical solutions and key technologies
- Demonstrate the value for military users.

Technical Sheet
Funding institution:
European Defence Agency (EDA)
Project partners
Kongsberg, FFI (Norwegian Research and Defence Establishment), CNIT-Lab RaSS, Università La Sapienza
Project duration
January 2018 – December 2020
Involved countries
Italy, Norway



(a) - Satellite cluster concept



(b) - Multichannel image formation with baseline length equal to 1.5 cm

PROJECT NORMA

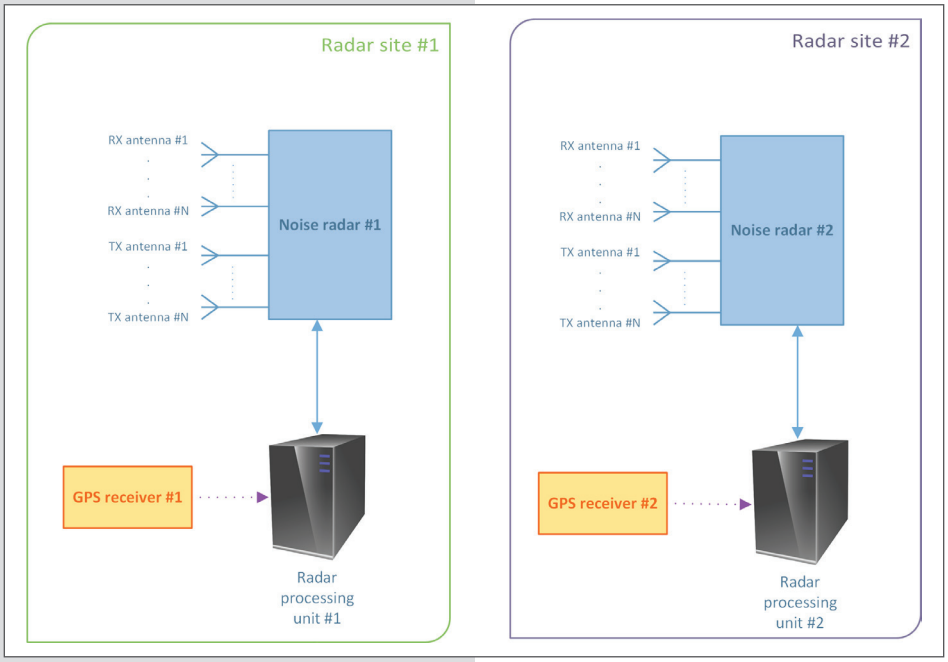
(NOise imaging Radar network for covert air and MAritime borders Security)

The project proposes the study, design, analysis and demonstrator realization of the wideband noise imaging radar network for air and sea border surveillance. The single radar sensor will be designed to work in three different modes: target RCS measurement, high range resolution profiling (HRRP or 1D imaging) and 2D-SAR and ISAR imaging. The main novelties of the NORMA system are:

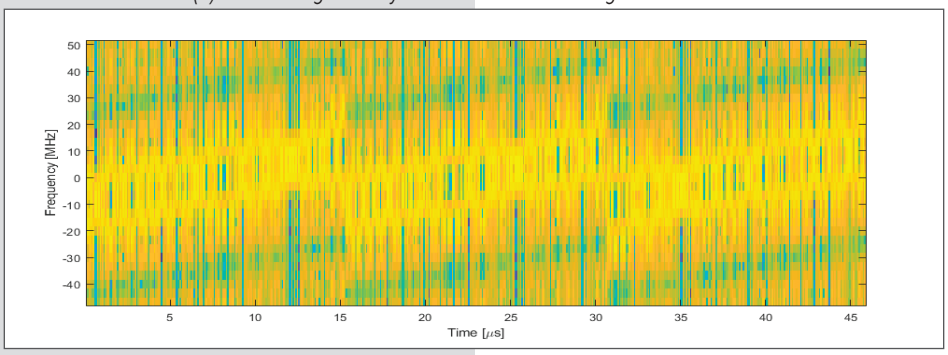
- The use of random/noise and noise-like waveform that enables Low Probability of Intercept (LPI) characteristic and, hence, covert surveillance operational mode,
- The radar imaging capability with noise waveform that provides high resolution range profiles and
- 2D- images of targets facilitating their recognition and classification.
- The radar is also enabled to transmit stepped frequency continuous waveform aso facilitating detection of slow aerial (especially drones) and sea target in strong clutter environment.
- The radar imaging with capability of MTI and Doppler frequency estimate provides possibilities to detect targets floating in the sea clutter environment.
- The use of the radars in network configuration enabling bistatic, multistatic and Multiple Input Multiple Output (MIMO) RCS and 1D-2D imaging for better target characterization and identification.

A technological demonstrator composed of two noise imaging radar network will be designed and developed.
The demonstrator will be designed to make monostatic and bistatic, RCS measurements, high range profiling and 2D ISAR imaging. Test and validation will be performed in two scenarios: 1) The surveillance of the Russian-Ukraine Airborder around the area of Kharkov, as a practical real problem; 2) The surveillance of the sea area around the Livorno harbour (Italy) for preventing and monitoring illegal and threating activities. Special attention will be paid to detection of floating small size objects in sea clutter.

Technical Sheet
Funding institution:
NATO Emerging Security Challenges Division, SPS Programme
Project partners
CNIT-Lab RaSS, IRE NASU with the participation of Echoes s.r.l
Project duration
May 2018 – May 2021
Involved countries
Italy, Ucraine



(a) - NORMA high level system architecture including two noise radars



(b) PRBS (pseudorandom binary sequences) modulated FMCW waveform, 30MHz noise bandwidth. The typical "ramp" of FMCW signal is completely masked by the noise, leading to psudo random noise like waveforms and, hence, LPI operations

PROJECT OCEAN 2020

(Open Cooperation for European mAritime awareNess)

OCEAN2020 project has been conceived in the framework of the Preparatory Action on Defence Research (PADR), in the Research Action call on Unmanned Systems, focusing on the topic of Technological demonstrator for enhanced situational awareness in a naval environment.

The OCEAN2020 project will allow the enhancement and the integration of various types of unmanned platforms (fixed wing, rotary wing, surface and underwater) with the command and control centre of the naval units, providing for the data exchange via satellite with command and control centres on the ground. The joint and cooperative use of both pilot and unmanned platforms will also be demonstrated during the project. These innovative capabilities will be used for surveillance missions and maritime interdiction.

OCEAN2020 put together the specialists of technologies relevant to the sea domain for observing, orienting, deciding and acting naval operational tasks in maritime scenarios (from major Research Institutes, through Large and SME industries till the NATO Center of Excellence for Maritime Research and Experimentation) and fourteen countries representative of European northern and southern seas along with their relevant defense and security needs.

In very few words, all above represents the inclusive strength that OCEAN2020 intends to leverage to pave the way towards the future EU Defence Research Window and Capability Window, by integrating legacy with new technologies concerning unmanned systems, ISTAR payloads, lethal and non-lethal effectors and by exploiting data from multiple sources, including satellite assets, into a Standardized Maritime Picture, to secure a naval/maritime dominance.

Technical Sheet

Funding institution:

EU

Project partners

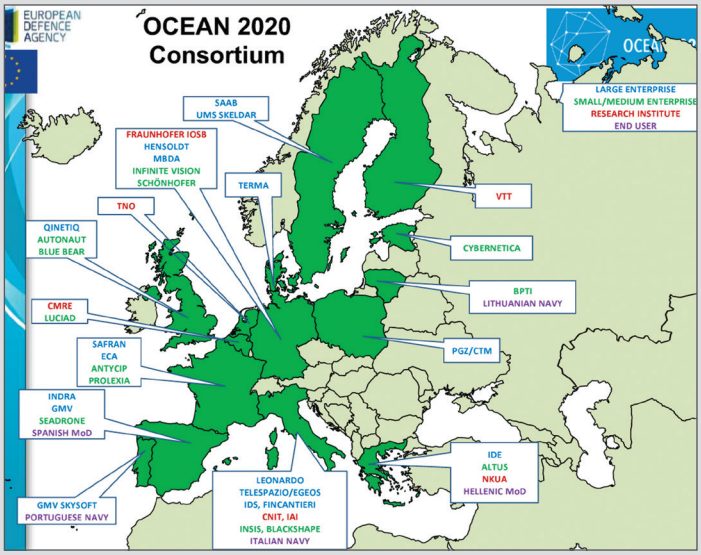
Leonardo S.p.A, Sistemi Dinamici, Swidnik Spolka Akcyjna, NATO Centre for Maritime Research and Experimentation, Indra, Fraunhofer IOSB, Saab Akitebolag, Saab Kockums, Saab Dynamic, Docksta Shipyard, Osrodek Badawczo-Rozwojowj Centrum Techniki Morskiej S.A., Safran Electronics & Defense, Intracom, Defense Electronics, TNO Defence Research, QinetiQ Ltd., Baltijos Pazangiu Technologiju Institutas, GMV IS Skysoft, MBDA Deutschland GmbH, MBDA Italy, IDS Ingegneria dei Sistemi, GMV Aerospace and Defence, Terma A/S, ECA Robotics, Fincantieri S.p.A., CETENA, e-GEOS S.p.A., Telespazio, VTT Technical Research Centre, Cybernetica AS, UMS Skeldar Sweden AB, Seadrone, AutoNaut Ltd, Blue Bear Systems Research Ltd, National and Kapodistrian University of Athens, Prolexia, Schönhofer Sales and Engineering GmbH, Antycip Simulation SaS, Infinite Vision GmbH & Co. KG., Insis SpA, Altus LSA, Luciad NV, Istituto Affari Internazionali, Hensoldt Sensors GmbH, Blackshape S.p.A., Marina Militare Italiana, Lithuanian Navy, Hellenic Ministry of Defence, Portuguese Navy, Spanish Ministry of Defence

Project duration

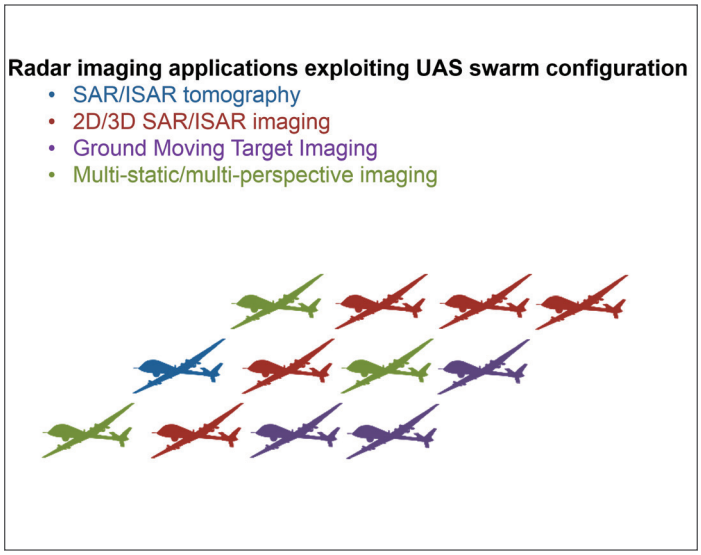
January 2018 – March 2021

Involved countries

Italy, NATO, Spain, Germany, Sweden, Poland, France, Greece, Netherlands, UK, Lithuania, Portugal, Denmark, Finland, Estonia, Belgium



(a) - OCEAN2020 project consortium



(b) - OCEAN2020 – Sketch of radar imaging applications on UAS swarm

PROJECT POSEIDON

(A compact combined UaV Polarimetric Ku band radar and EO/IR sensor system for oil spill and sea debris detection)

This project is funded by the Italian Ministry of Education, University and Research (MIUR), the Spanish Centre for the Development of Industrial Technology (CDTI) and co-funded by European Union's Horizon 2020 research and innovation programme under the framework of ERA-NET Cofund MarTERA (Maritime and Marine Technologies for a new Era).

POSEIDON aims to protect the sea life by designing an efficient response for the alarming rise of maritime pollution and its consequences making use of a compact multi-sensor system carried on UaVs and radar sensors jointly operating with EO/IR cameras to detect sea debris and oil spill.

Sea pollution is an issue that has attracted the attention of researchers worldwide in the last decades. The amount of pollution is increasing in the last few years, posing a serious threat for marine life as well as affecting boats and the coastal ecosystem. Deliberate or accidental disposal of man-made waste, such as fishing nets and plastic bags among others, as well as oil spills from large vessels, are two of the main sources of marine pollution.

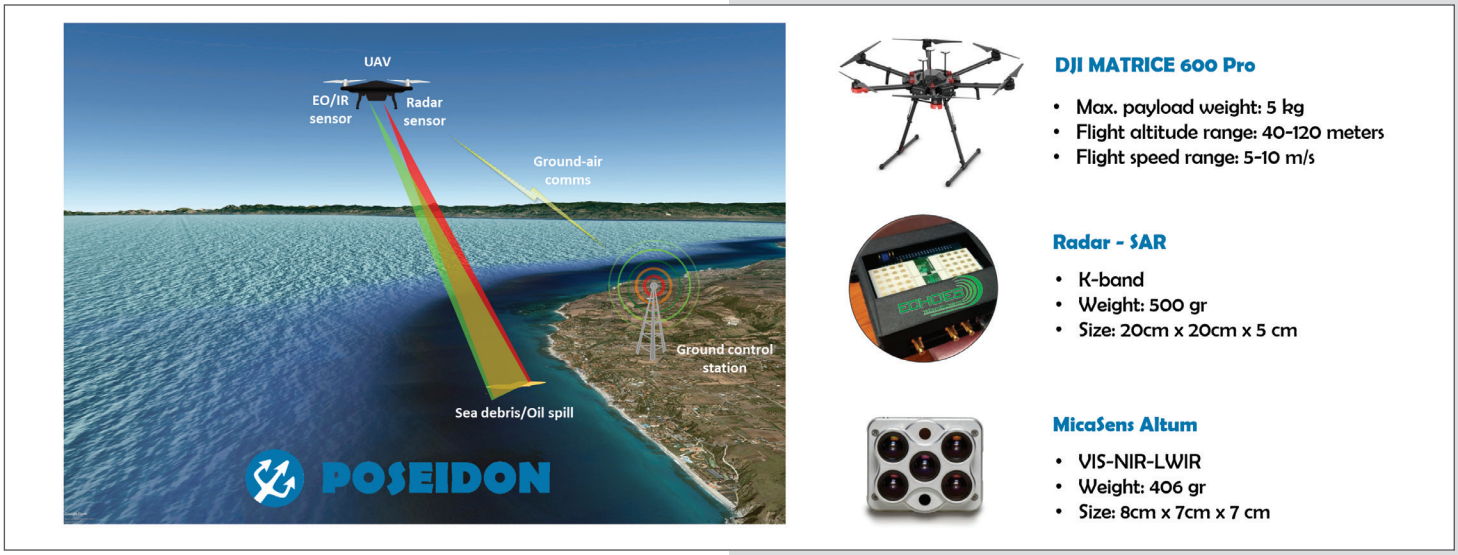
POSEIDON aims to contribute with the provision of an efficient, innovative and expertly designed response for the alarming rise of marine pollution and its consequences. The POSEIDON solution is a compact multisensor system carried on small UAVs that integrates radar sensors jointly operating with EO/IR cameras to monitor marine areas and detect sea debris and oil spills. The main novelties of the proposed system are:

- Design of a compact, light and fully polarimetric radar with SAR imaging capabilities. The radar system is a 24/7, all weather surveillance sensor with enhanced capability of detecting floating debris and oil spills thanks to polarimetry and high spatial resolution.
- Use of EO/IR sensors for a better identification of the type of debris and the extension of the oil spill to help the coordination of a prompt response for the mitigation of the problem. To this end, recent advances in deep neural networks for object detection, segmentation, and classification will be explored.
- Application and development of ad-hoc fusion techniques for the two sensors to jointly operate in the same platform.

Project web-site: http://poseidon.cnit.it/

Technical Sheet
Funding institution:
MarTERA ERA-NET COFUND (EU) MIUR (IT) *Ministerio de Economia Y Empresa (SP)*
Project partners
CNIT-RaSS Lab, CARTOGALICIA
Project duration
May 2018 – October 2021
Involved countries
Italy, Spain

POSEIDON



(a) - POSEIDON system and its main components

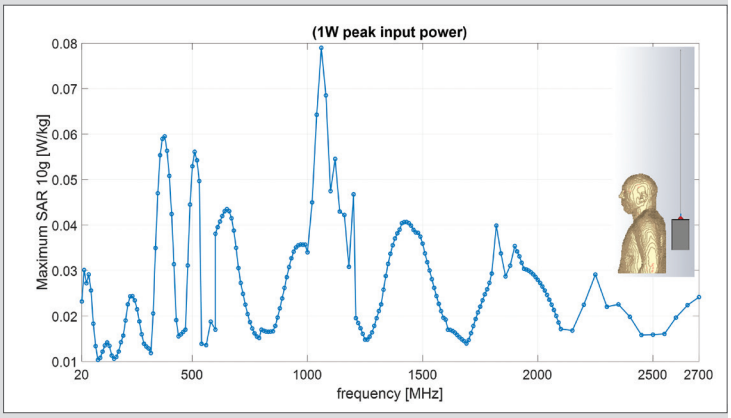
PROJECT SAFE-LAB

(Laboratory for the Evaluation of the Safety of Portable Intentional Electromagnetic Sources)

The potential effects of radio frequency (RF) electromagnetic fields (EMF) on human body are currently not sufficiently known and results presented in literature are often conflicting each other. The continuous development of new technologies and the increasing diffusion of several transmitting devices simultaneously operating on different frequencies and in proximity of the operators poses a safety problem on exposure to electromagnetic fields both in civil and military world. Instruments/capabilities, able to guarantee an increasingly complete and correct assessment of the exposure scenario are becoming a priority. The guidelines on workers exposure at the EMF are based on civilian applications and they are therefore not suitable for signals typically used in the military scenario. Since civil research is not focused on specific signals used in military applications, the SAFE-LAB Project specifically aims to accurately investigate the levels of EMF exposure and the Specific Absorption Rate (Specific Absorption Rate - SAR), using representative schemes of systems and radio protection commonly implemented in operational scenarios. The results of the study will lead to:

- guidelines definition for use of portable systems;
- proposing innovative solutions for shielding the operators;
- proposing technical solutions on minimizing systems exposure, by maintaining operational efficiency;
- carrying out a test set for measurement and qualification of all the portable devices used in military applications.

Technical Sheet
Funding institution:
Ministero della Difesa (Ministry of Defense)
Project partners
Università di Pisa, Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT), Free-Space SRL
Project duration
February 2019 – February 2020 (Currently, Phase 1)
Involved countries
Italy



Safelab

Fig. 1 –Specific Absorption Rate numerical estimation vs. operating frequency

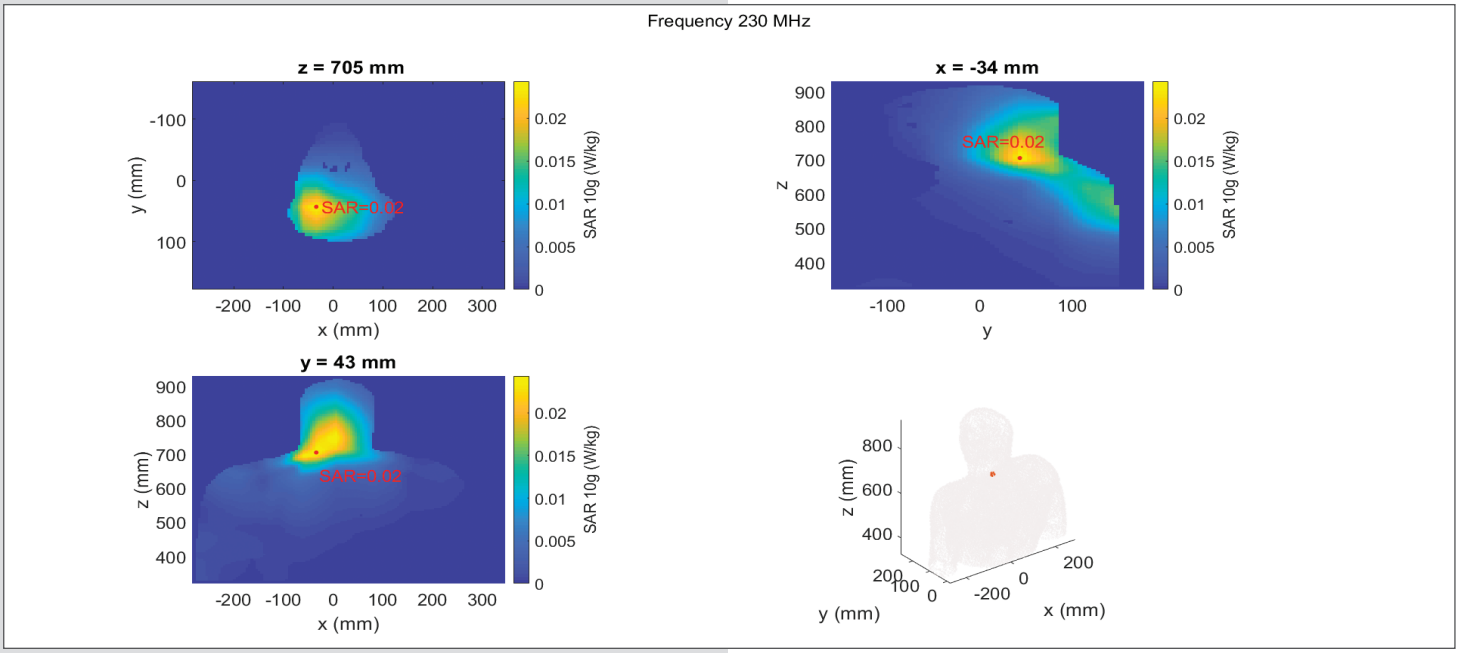


Fig. 2 – Specific Absorption Rate numerically obtained at 230MHz

PROJECT SURFACE

(Sviluppo di un sistema di previsione, monitoraggio e classificazione di eventi meteorologici intensi ed estremi su scala urbana ed extra-urbana, basato su una rete di miniradar innovativi a bassa potenza di uscita)

The purpose of the SURFACE project is to create a monitoring and classification system for intense and extreme precipitations that can occur on urban areas or on small rural basins, based on a network of innovative miniradars with low output power. The idea behind the project is to create a system capable of monitoring, classifying and predicting precipitative events in the very short term (nowcasting), with particular reference to intense or extreme events that can occur on urban areas or on small basins.

These events are hardly detected by the traditional monitoring networks based on rain gauges or meteorological radars that operate at long range. The rain gauge networks provide punctual measurements in defined points and are often not sufficiently dense to be representative of the events in progress.

The nationwide weather radar networks are designed to ensure maximum coverage with the least number of systems. In a territory with complex orography like Italy, radar systems are sometimes positioned in a sub-optimal way for observation, causing the presence of large sectors obscured by the presence of reliefs.

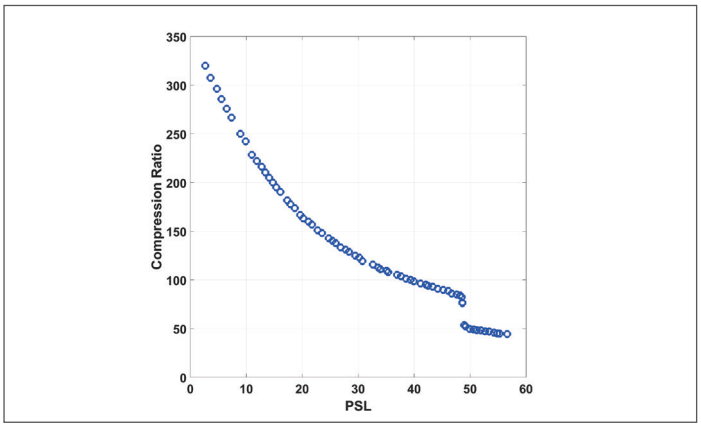
As part of this project, the design and construction of a weather radar prototype is planned, suitable for this application, in line with the requirements of Industry 4.0, which combines a series of system-level and technological project innovations with the development of "ad hoc" components.

The realization of such an innovative radar is linked to the integration of a series of technological innovations that concern:

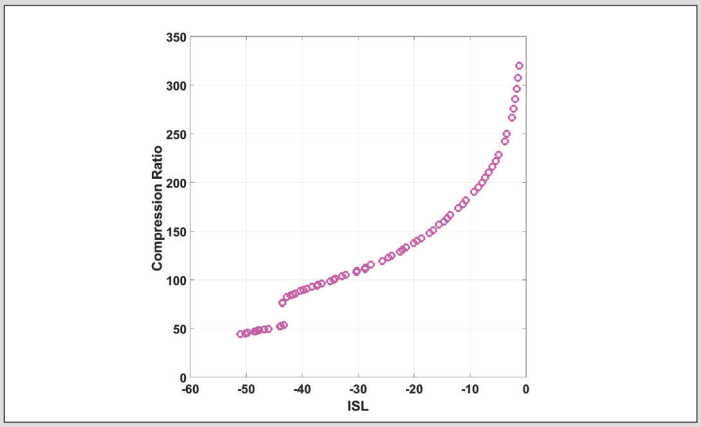
1. the use of solid-state, low-power components that generate electromagnetic emissions within the permitted limits for use in areas with a high density of inhabitants;
2. the ad hoc design of signal transmission and reception systems, so as to reduce the overall dimensions, costs and energy consumption, while maintaining high performance;
3. The development of a remote control system, using "SMART" type remote terminals that use Web browsers, to monitor radar operation, which can guarantee the full efficiency of the instrument at any time; this remote control system will be designed to also provide useful information for the possible modification and optimization of the system, at the firmware and software level, even from a remote location, in line with the requirements of Industry 4.0;

As regards the definition of the low-power radar solid state weather radars, one of the most important objectives is the definition of transmission waveforms and reception filters that present low energy of the side lobes compared to the main and highly Doppler-tolerant.

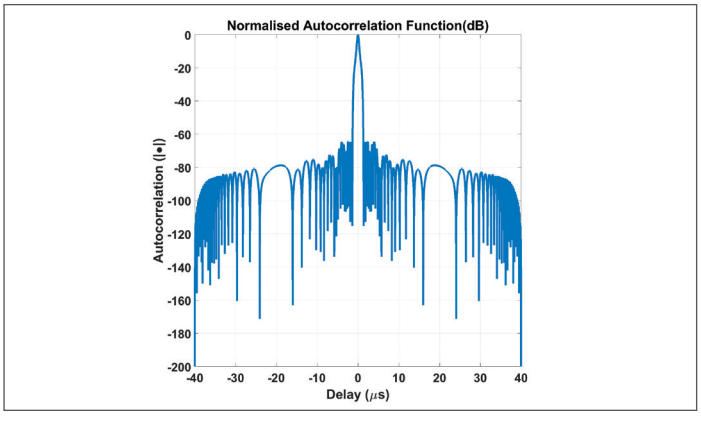
Technical Sheet
Funding institution:
Regione Toscana
Project partners
Eldes srl, Pasquali srl, Netfarm, Lamma
Project duration
June 2018-March 2020
Involved countries
Italy



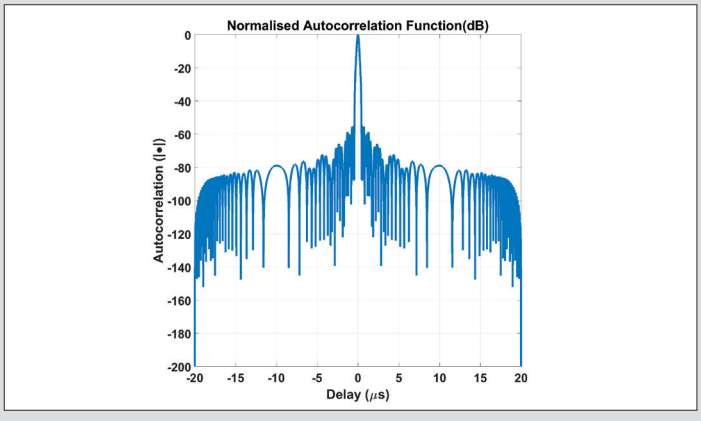
(a) - Pareto fronts of the compression ratio of the compressed waveform versus PSL (Peak to Sidelobe Level) for a Bandwidth-Duration product BT=200. Raised cosine weight at the receiver with roll-off factor 0.1 and a number of sinusoidal components of the ACF spectrum N=5;



(b) - Pareto fronts of the compression ratio of the compressed waveform versus ISL (Integrated Sidelobe Level) for a Bandwidth-Duration product BT=200. Raised cosine weight at the receiver with roll-off factor 0.1 and N=5



(c) - Normalized ACF for T=40ms, B=5MHz



(d) - Normalized ACF for T=20ms, B=10MHz

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2019

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From January 2017 the RaSS Lab has been certified ISO 9001/2015 by the international and independent body DNV GL. The certification refers to the "Design and development of technology systems and services in telecommunications, radar and electromagnetism and related computer aids and the design and manufacture of RF and microwave equipment and subsystems" (Figure 3).

DNV·GL

MANAGEMENT SYSTEM CERTIFICATE

Certificate No:
211274-2016-AQ-ITA-ACCREDIA

Initial certification date:
19 January 2017

Valid:
20 January 2020 - 19 January 2023

This is to certify that the management system of

Consorzio Nazionale Interuniversitario per le Telecomunicazioni - Laboratorio Nazionale RaSS - Radar e Sistemi di Sorveglianza
Galleria G.B. Gerace, 18 - 56024 Pisa (PI) - Italy

has been found to conform to the Quality Management System standard:
ISO 9001:2015

This certificate is valid for the following scope:
Design and development of technology systems and services in telecommunications, radar and electromagnetics and related computer aids. Design and manufacturing of radiofrequency and microwaves equipments and subsystems (IAF 34, 19, 33)

Place and date:
Vimercate (MB), 07 January 2020

ACCREDIA
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Via Energy Park, 14, - 20871 Vimercate (MB) - Italy

Zeno Beltrami
Management Representative

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Figure 3 - Lab RaSS ISO 9001/2015 DNV certificate.

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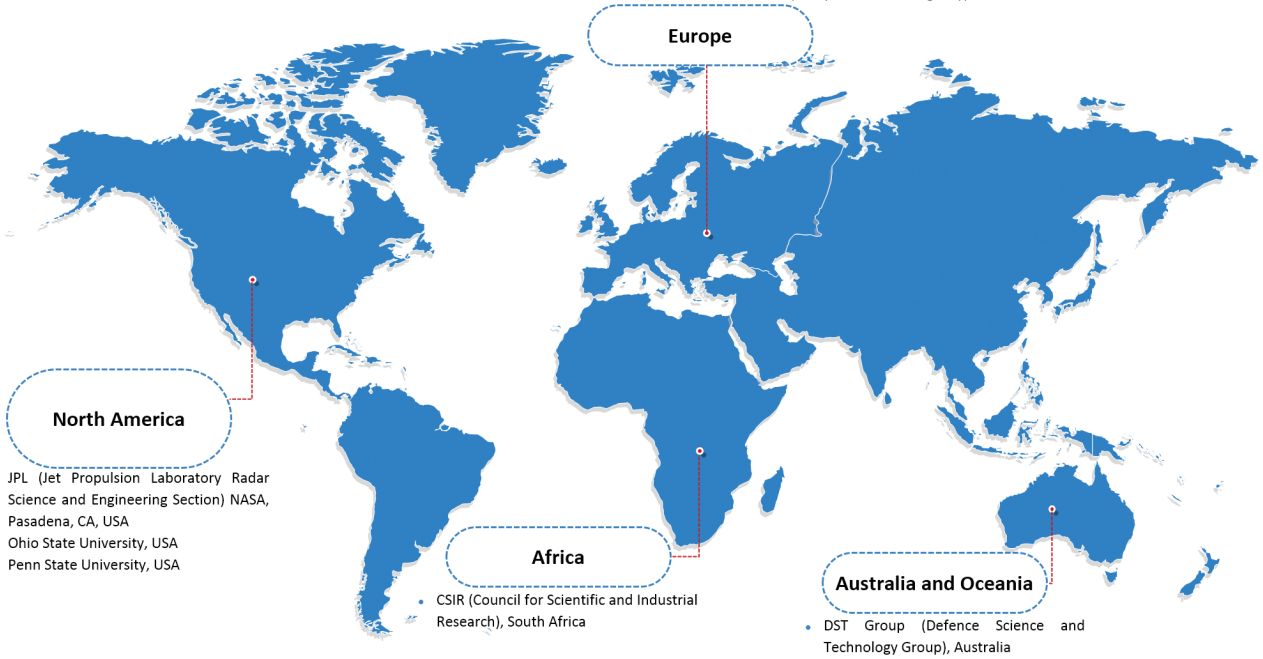

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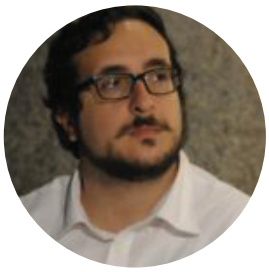

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