

SONDRA

LABORATOIRE SONDRA - CENTRALESUPÉLEC ONERA NUS DSO RESEARCH ALLIANCE



SONDRA (CentraleSupélec ONERA DSO Research Alliance) was officially launched on 28 April 2004 in Supelec. The mission of SONDRRA is to conduct unclassified basic research in advanced Electromagnetics and Radar domains.

Catching the invisible with new radar and surveillance concepts

As part of its missions, SONDRRA contributes also to a better assessment of new technologies that are of interest to overcome various problems related to maritime surveillance in congested water areas, ground and air surveillance, homeland security especially in urban areas. The characterization of the environment, whether "natural" or anthropogenic is more and more complicated as we aim at augmenting the sensitivity and performances of the surveillance systems in the current context of the new connected world and of increased maritime, air and ground traffics. Radar and EM detection technologies remain of great interest to catch "invisible targets", i.e. target either masked by cloud cover, urban infrastructures, foliage or simply blocked by the horizon line of sight.

The alliance between the 4 parties offers a unique opportunity of development. NUS and CentraleSupélec provide an academic environment, effective at generating new collaborations with academic partners. On the other hand, DSO and ONERA are very attentive to experimental validation and transition to applications. The success of SONDRRA is probably due to its capability to carry physics and signal processing research and to systematically register the research projects in a consistent framework

leading to concrete actions and real validation, hence taking all attention from overseas stakeholder.

By the association of four high level research establishments in the rich research environment which represents the University of Paris-Saclay, SONDRRA represents a world class laboratory for graduate education and research which produces innovative research outcomes for ONERA and DSO.

SONDRRA contributes to research through 3 scientific areas, Physics and Modeling, New Concepts and Signal Processing and New Generation Hardware.

- **Physics and Modeling:** to predict the propagation of electromagnetic waves in complex media as forested or urban environments; radar is known to propagate through the foliage and inside urban canyons, hence providing unique capabilities for tracking vehicles that are not visible by optical sensors. Skywave propagation through the ionosphere is also studied to monitor the effects that can affect the medium.
- **New Concepts and Signal Processing:** to maximize the performances of existing or future radar by applying processes based on Artificial Intelligence.
- **New Generation Hardware:** activity focusing on a system approach, applied to the field of electromagnetism by studying new concepts of antennas and specific hardware components for signal conversion.

The two first scientific themes are those more developed in SONDRRA lab considered a large contribution of Artificial Intelligence for the modeling, analyzing, and processing, whereas the third concerns National University of Singapore, NUS.

HIGHLIGHTS 2023

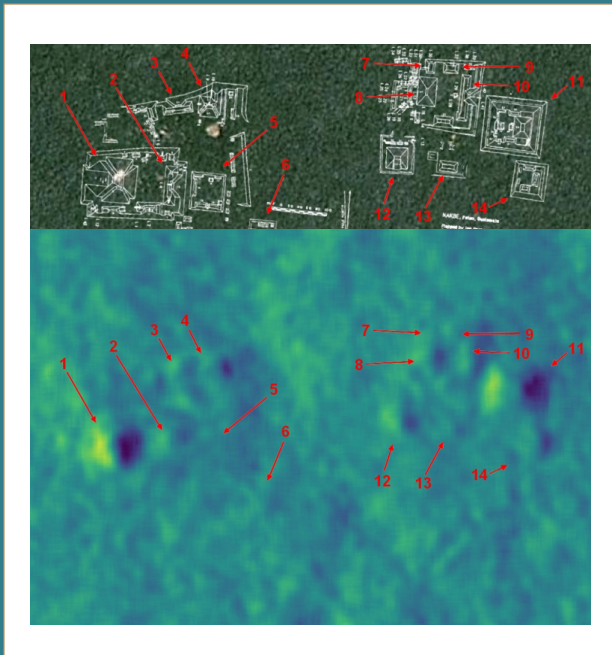


Visit of Singapore Ministry of Defense, Chief Defense Scientist (CDS) Mr. Peng Yam TAN – 22 February 2023.

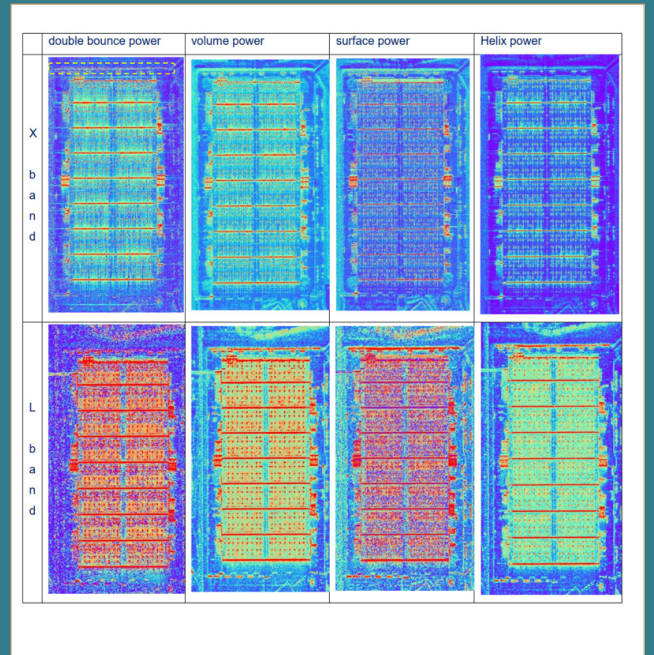


Visit of Singapore Ambassador, H.E. Mrs Lee Foo TEOW 10 March 2023.

EXAMPLES OF STUDIES



Optical image with map overlaid and markers added (top)
Satellite output SAR image with markers added (bottom).
The large pyramids and several smaller buildings are detected.

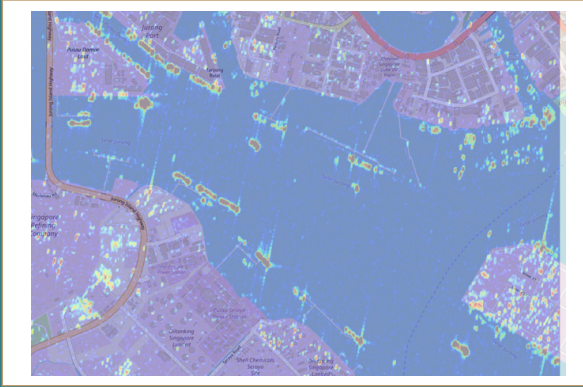


Multiband SAR imaging of one warehouse

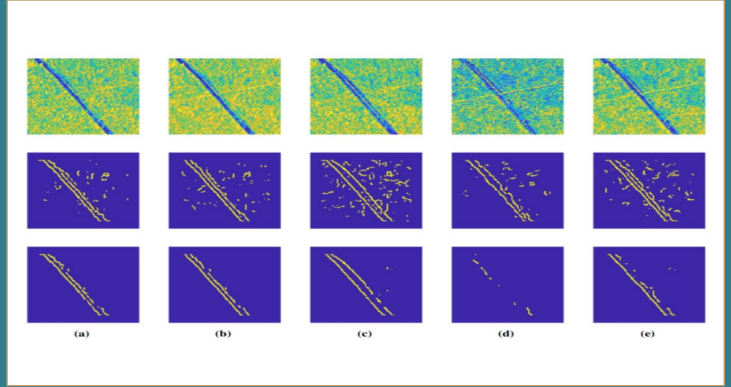


SIERA project (SONDRA Innovative Embedded RAdar Aircraft)

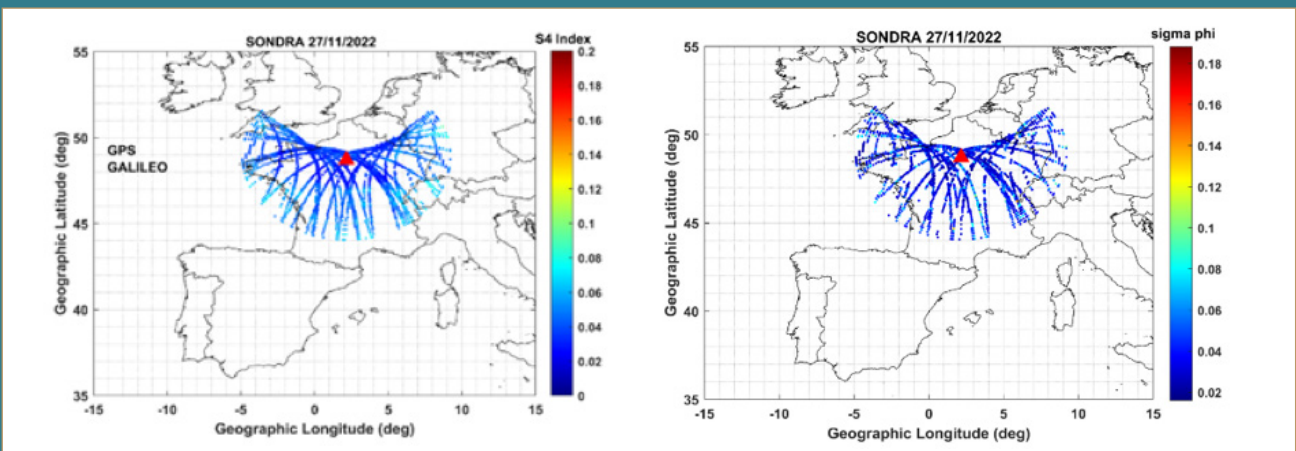




Ships detection results, overlaid on optical imagery using FBR (Frozen Background Reference) technique



Roads detection from TerraSAR-X and SENTINEL-1 satellite imaging



Day-wise scintillation variation deduced from GALILEO constellation: Right: amplitude scintillation index - Left: Phase scintillation index

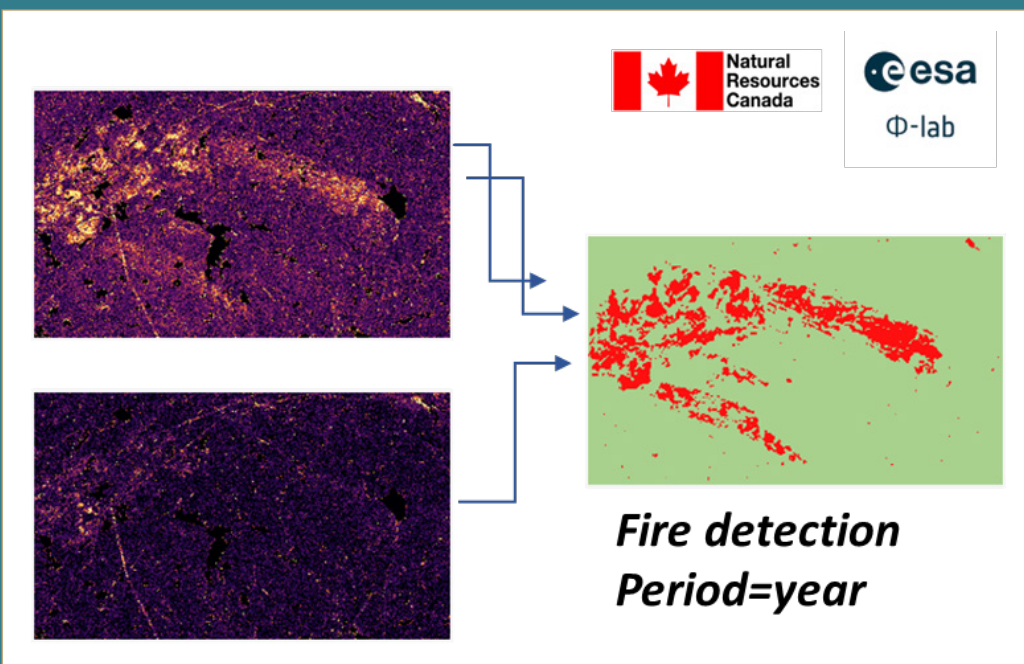


Illustration of the Detection of Forest Fires through Deep Unsupervised Learning Modeling of Sentinel-1 Time Series, ISPRS International Journal of Geo-Information, T. Di Martino, B. Le Saux, R. Guinvarc'h, L. Thirion-Lefevre, and E. Colin

Industrial Partners

- DSO
- ESA
- THALES
- ONERA

Academic Partners

NUS (National University of Singapore), NTU (Nanyang Technological University Singapore), UNIVPM (Università Politecnica Delle Marche, Ancona, Italie), Colorado School of Mines (USA), SATIE (ENS Paris-Saclay), GIPSA (Grenoble), IETR (Rennes).

Key figures

- Professors, Associate Professors & Researchers 8
- Engineers & Administrative staff 2
- PhD Students 9
- Postdoc 1
- Publications of the year (WoS) 16

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