

Scientific Curricula of Associated Investigators and main publication lists

Ilaria Catapano, Senior Researcher, Institute for Electromagnetic Sensing of the Environment (IREA), National Research Council of Italy (CNR)

EDUCATION, CAREER OUTLINE AND CURRENT POSITION

Ilaria Catapano received the M.S. degree in Telecommunication Engineering from University Federico II, Napoli, Italy, in 2002 and the Ph.D. degree in Electric and Information Engineering from University of Cassino, Italy in 2006. In 2002, in the framework of her PhD project, she started her research activities at the Institute for Electromagnetic Sensing of the Environment, National Research Council of Italy (IREA-CNR), where she became full-time Researcher in 2009 and First Researcher in 2020. From October 2006 to April 2007, she was a Post- doc at the Research Institute Fresnel Marseille - Centre National de la Recherche Scientifique working in Electromagnetic characterization of buried targets in random media.

RESEARCH ACTIVITIES

The research interests of Ilaria Catapano concern applied electromagnetism as well as data processing and image interpretation; hence, her skills are about electromagnetic modelling, forward and inverse scattering problems, remote and in situ microwave and TeraHertz (THz) sensing techniques. Specifically, since 2002 her research activities are carried out in the framework of non-invasive electromagnetic diagnostics and mainly regards:

- a) radar imaging with focus on processing of experimental data gathered by means of ground based, airborne and drone radar systems for surface and sub-surface surveys and image interpretation;
- b) THz spectroscopy and imaging, involving design of measurement protocols, development and performance assessment of advanced data processing strategies for material characterization, with a main focus on artworks and composite materials analysis;
- c) cooperative use of different sensing technologies for a multi-resolution and multi-parameteric non-invasive characterization of objects;
- d) planning and execution of measurement campaigns carried out by means of microwave and THz devices in several applicative contexts among which cultural heritage and archaeology.

Further research activities concern with:

- development of a high frequency radar systems and data processing strategies for target detection and tracking in order to support the navigation of Autonomous Surface Vehicles (ASVs);
- development and assessment of strategies for indoor radar detection of human presence, movement and vital sign (breathing and heartbeat) monitoring;
- use of microwaves and THz in the frame of food inspections and medical imaging.

PUBLICATIONS AND BIBLIOMETRIC INDICATORS

The scientific production of Ilaria Catapano consists of about 200 published articles, with more than 100 papers in refereed international journals, 11 book chapters and about 100 articles in national and international conference proceedings. At January 2024, the total number of citations is 2866 and the H-index is 29 (Scopus database), while according to Google Scholar database the total number of citations is 3850 and the h-index is 35. In August 2021, Ilaria Catapano was in the World's Top Scientists list published by Plos Biology - Stanford University.

AWARDS

2020: Best scientific contribution of DiSBA-CNR department: A Brook et al "A smart multiple spatial and temporal resolution system to support precision agriculture from satellite images: Proof of concept on Aglianico vineyard", Napoli, 21, December 2020;

2013: Best Poster at IET International Radar Conference 2013, Xi'an, China, April 2013 assigned at the paper "Comparison Study Of Two Approaches for Bioradar Data Processing", by L.N. Anishchenko, S.I. Ivashov, F. Soldovieri, I. Catapano, L. Crocco;

2009: Outstanding Refereeing Performance for the period May 2008- May 2009, Inverse Problems;

2008: Young Scientist Awardees at the XXIX URSI General Assembly;

2004: G. Barzilai (Young Scientists) Award from the Italian Electromagnetic Society, SIEM.

PROJECTS

Since 2006, Ilaria Catapano is/was involved in international and national research projects funded by different institutions (European Union, Ministry of Research and Education, Ministry of the Economic Development, Campania Region, etc.). Moreover, she collaborates/has collaborated with research institutions, such as CO.R.I.S.T.A, CIRA and Italian Space Agency, as well as companies, such as Ingegneria dei Sistemi Spa, NAIS S.r.l., Top View s.r.l.

She participates/has participated to the following projects, often having a leading role:

- 2022 – present ITINERIS (Italian Integrated Environmental Research Infrastructures System) – PNRR Infrastructure
Role: CNR-IREA research unit responsible
Research activities: Coordination and execution of activities relating to airborne synthetic aperture radar (SAR) technology and geophysical techniques for imaging and monitoring the Soil-Subsoil System.
- 2022 – present STYX (STand-off detection of hYbrid threats containing eXplosives) – European Defence Agency project
Role: CNR-IREA research unit responsible
Research activities: radar imaging for suspicious target detection and THz sensing for bulk explosive characterization.
- 2020-2022: AMOR (Advanced Multimedia and Observation services for the Rome cultural heritage ecosystem) - European Space Agency project.
Role: CNR-IREA research unit responsible
Research activities: Microwave tomography enhanced GPR surveys for subsoil and vertical structure investigations aimed at increasing knowledge of historical sites (Terme di Caracalla and Mura Aureliane).
- 2018-2021: RIPA –PAUN (Rete Intelligente dei Parchi Archeologici- Parco Archeologico Urbano di Napoli) - POR CAMPANIA FESR 2014/2020
Role: CNR-IREA research unit member
Research activities: Development of strategies for the optimized use of georadar systems in urban archaeological parks and employment of THz technology for non-invasive stratigraphic analysis of artwork samples.
- 2018 - 2020: VESTA (Enhancement and protection of the cultural heritage through the use of innovative technologies) - POR FESR CAMPANIA 2014/2020
Role: CNR-IREA research unit responsible
Research activities: diagnostics of archaeological assets of the Paestum archaeological park by means of radar systems for sub-surface investigations (Georadar) and development of a drone mounted radar system for surface object imaging
- 2016 – 2019: HERACLES (HERitage Resilience Against CLimate Events on Site) - H2020 project
Role: leader of Work Package: “Design/development of methodologies for wide area surveillance and site diagnosis and monitoring”.
Research activities: Design, validation and promotion of systems and solutions for the effective resilience of cultural heritage against the effects of climate change, using a holistic and multidisciplinary approach. In particular, the project aims at the development of a system based on an ICT platform capable of collecting and integrating multi-source information in order to provide a complete and updated photograph of the state of danger of cultural heritage and to support decisions. Furthermore, the project includes the development of new solutions for the maintenance and conservation of cultural heritage
- 2014 – 2019: CLARA – (CLOUD plAtform and smart underground imaging for natural Risk Assessment) - MIUR project– Idee progettuali Smart Cities and Communities and Social Innovation
Role: CNR-IREA research unit member
Research activities: development and evolution of radar technologies for subsurface surveys and their use in complex, hybrid, pervasive and ubiquitous environments.

She also has /had a leading role in the following project

- 2019-present: ARES (Autonomous Robotics for the Extended Ship) - MIUR - PON “RICERCA E INNOVAZIONE” 2014 - 2020
Role: CNR-IREA research unit responsible
Research activities: development of a radar prototype and data processing strategies for target detection and tracking to support the navigation of an ASV.

- 2019-present: LAMPO (Leonardo Automated Manufacturing Processes for COMposites) – Ministero dello Sviluppo Economico
Role: CNR-IREA research unit responsible
Research activities: employment of radar and THz technologies for characterization of composite materials and their defect imaging.
- 2017 – 2022: MATRAKA (Environmental and territorial monitoring, based on radar technology integrated with an innovative satellite communication system, based on the development of KA band antennas)
Role: CNR-IREA research unit responsible of the Sounder activities
Research activities: development of L-band radar system operating in Sounder mode (Penetration Radar).

EDITORIAL ACTIVITIES

2020 - present: Associate Editor of IEEE Transactions on Computational Imaging

2020 & 2021: Guest Editor of Special Issues “Real-Time Radar Imaging and Sensing” and “Data Fusion, Integration and Advances of Non-destructive Testing Methods in Engineering and Geosciences” in Remote Sensing - MDPI

REFEREE ACTIVITIES

Main Scientific Journals (peer-review):

- MDPI (Sensors; Remote Sensing; Heritage)
- IEEE (TGRS; GRSL; JSTARS; TAP, APM, AWPL.)
- ELSEVIER (Remote Sensing of Environment; NDT&E international)
- HINDAWI (Journal of Sensors; International Journal of Antennas and Propagation)

She has also been reviewer for European Conference on Antennas and Propagation (EuCAP), IEEE International Geoscience and Remote Sensing Symposium (IGARSS) and for national scientific projects of Ministry of the Economic Development (MISE)

DIDACTIC ACTIVITIES

2020: National scientific qualification as ordinary Professor in Electromagnetic Fields (09/F1)

2019: Living labs during Clara project concerned the issue relating to the use of the Georadar for non-invasive surveys of infrastructures and historical assets

2019: Winter School in the frame of HERACLES project concerned the monitoring technologies for enhancing environmental and structural resilience of architectural heritage

2018: National scientific qualification as associate Professor in Electromagnetic Fields (09/F1)

2016: Invited Lecture at the I'Indian Institute of Technology, Kharagpur, Kharagpur-721 302, India

2014: Advanced training course in the frame of PON I-AMICA project (High Technology Infrastructure for Climate and Environment Monitoring)

2013: Invited Lecture during the 15th Summer School in Geophysics – Modelling and inversion of GPR data São Paulo University, Brazil - Instituto de Astronomia, Geofísica e Ciências Atmosféricas (IAG), Departamento de Geofísica. Rua do Matão, 1226, Cidade Universitária, 05508-090, São Paulo, Brazil

2010: Adjunct Professor of Electromagnetic Diagnostic - Mediterranea University of Reggio Calabria, Italy
2003 - :Co-advisor of several master thesis at the University Federico II of Napoly, Italy, and at the University Mediterranea di Reggio Calabria, Italy.

SELECTED PUBLICATIONS (max 20)

1. Esposito G, I. Catapano, G. Ludeno, F. Soldovieri and G. Gennarelli, "A Deep Learning Strategy for Multipath Ghosts Filtering via Microwave Tomography," in IEEE Transactions on Geoscience and Remote Sensing, vol. 62, pp. 1-14, 2024, Art no. 5100314, doi: 10.1109/TGRS.2023.3337893.
2. Catapano I, G. Gennarelli, G. Esposito, G. Ludeno, Y. Su, Z. Zhang, F. Soldovieri, "Contactless Microwave Tomography via MIMO GPR," in IEEE Geoscience and Remote Sensing Letters, vol. 20, pp. 1-5, 2023, Art no. 3502505, doi: 10.1109/LGRS.2023.3257540.
3. Gennarelli G, C. Noviello, G. Ludeno, G. Esposito, F. Soldovieri and I. Catapano, "Three-Dimensional Ray-Based Tomographic Approach for Contactless GPR Imaging," in IEEE Transactions on Geoscience and Remote Sensing, vol. 61, pp. 1-14, 2023, Art no. 2000614, doi: 10.1109/TGRS.2023.3250740

4. Noviello, C.; Gennarelli, G.; Esposito, G.; Ludeno, G.; Fasano, G.; Capozzoli, L.; Soldovieri, F.; Catapano, I. An Overview on Down-Looking UAV-Based GPR Systems. *Remote Sens.* 2022, 14, 3245. <https://doi.org/10.3390/rs14143245>
5. Catapano, I.; Gennarelli, G.; Ludeno, G.; Noviello, C.; Esposito, G.; Soldovieri, F. Contactless Ground Penetrating Radar Imaging: State of the Art, Challenges, and Microwave Tomography-Based Data Processing. *IEEE Geoscience and Remote Sensing Magazine* 2022, 10 (1), 251–273. <https://doi.org/10.1109/MGRS.2021.3082170>.
6. Noviello, C.; Esposito, G.; Catapano, I.; Soldovieri, F. Multilines Imaging Approach for Mini-UAV Radar Imaging System. *IEEE Geoscience and Remote Sensing Letters* 2022, 19. <https://doi.org/10.1109/LGRS.2021.3086890>.
7. Gennarelli, G.; Ludeno, G.; Carlo, N.; Catapano, I.; Soldovieri, F. The Role of Model Dimensionality in Linear Inverse Scattering from Dielectric Objects. *Remote Sensing* 2022, 14 (1). <https://doi.org/10.3390/rs14010222>
8. Catapano, I.; Noviello, C.; Soldovieri, F. Down-Looking Airborne Radar Imaging Performance: The Multi-Line and Multi-Frequency. *Remote Sensing* 2021, 13 (23). <https://doi.org/10.3390/rs13234897>.
9. Gennarelli, G.; Catapano, I.; Dérobert, X.; Soldovieri, F. A Ground Penetrating Radar Imaging Approach for a Heterogeneous Subsoil with a Vertical Permittivity Gradient. *IEEE Transactions on Geoscience and Remote Sensing* 2021, 59 (7), 5698–5710. <https://doi.org/10.1109/TGRS.2020.3024831>.
10. Gennarelli, G.; Ludeno, G.; Catapano, I.; Soldovieri, F. Full 3-D Imaging of Vertical Structures via Ground-Penetrating Radar. *IEEE Transactions on Geoscience and Remote Sensing* 2020, 58 (12), 8857–8873. <https://doi.org/10.1109/TGRS.2020.2991315>.
11. Noviello, C.; Esposito, G.; Fasano, G.; Renga, A.; Soldovieri, F.; Catapano, I. Small-uav Radar Imaging System Performance with Gps and Cdgps Based Motion Compensation. *Remote Sensing* 2020, 12 (20), 1–24. <https://doi.org/10.3390/rs12203463>.
12. Ludeno, G.; Gennarelli, G.; Lambot, S.; Soldovieri, F.; Catapano, I. A Comparison of Linear Inverse Scattering Models for Contactless GPR Imaging. *IEEE Transactions on Geoscience and Remote Sensing* 2020, 58 (10), 7305–7316. <https://doi.org/10.1109/TGRS.2020.2981884>.
13. Catapano, I.; Gennarelli, G.; Ludeno, G.; Noviello, C.; Esposito, G.; Renga, A.; Fasano, G.; Soldovieri, F. Small Multicopter-UAV-Based Radar Imaging: Performance Assessment for a Single Flight Track. *Remote Sensing* 2020, 12 (5). <https://doi.org/10.3390/rs12050774>.
14. Bellanova, J.; Calamita, G.; Catapano, I.; Ciucci, A.; Cornacchia, C.; Gennarelli, G.; Giocoli, A.; Fisangher, F.; Ludeno, G.; Morelli, G.; Perrone, A.; Piscitelli, S.; Soldovieri, F.; Lapenna, V. GPR and ERT Investigations in Urban Areas: The Case-Study of Matera (Southern Italy). *Remote Sensing* 2020, 12 (11). <https://doi.org/10.3390/rs12111879>.
15. Ludeno, G.; Cavalagli, N.; Ubertini, F.; Soldovieri, F.; Catapano, I. On the Combined Use of Ground Penetrating Radar and Crack Meter Sensors for Structural Monitoring: Application to the Historical Consoli Palace in Gubbio, Italy. *Surveys in Geophysics* 2020, 41 (3), 647–667. <https://doi.org/10.1007/s10712-019-09526-y>.
16. Ludeno, G.; Capozzoli, L.; Rizzo, E.; Soldovieri, F.; Catapano, I. A Microwave Tomography Strategy for Underwater Imaging via Ground Penetrating Radar. *Remote Sensing* 2018, 10 (9). <https://doi.org/10.3390/rs10091410>.
17. Catapano, I.; Ludeno, G.; Soldovieri, F.; Tosti, F.; Padeletti, G. Structural Assessment via Ground Penetrating Radar at the Consoli Palace of Gubbio (Italy). *Remote Sensing* 2018, 10 (1). <https://doi.org/10.3390/rs10010045>.
18. Ludeno, G.; Catapano, I.; Renga, A.; Vetrella, A. R.; Fasano, G.; Soldovieri, F. Assessment of a Micro-UAV System for Microwave Tomography Radar Imaging. *Remote Sensing of Environment* 2018, 212, 90–102. <https://doi.org/10.1016/j.rse.2018.04.040>
19. Soldovieri, F.; Gennarelli, G.; Catapano, I.; Liao, D.; Dogaru, T. Forward-Looking Radar Imaging: A Comparison of Two Data Processing Strategies. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* 2017, 10 (2), 562–571. <https://doi.org/10.1109/JSTARS.2016.2543840>.
20. Gennarelli, I. Catapano and F. Soldovieri, Reconstruction Capabilities of Down-Looking Airborne GPRs: The Single Frequency Case, in *IEEE Transactions on Computational Imaging*, vol. 3, no. 4, pp. 917–927, Dec. 2017, doi: 10.1109/TCI.2017.2669865