



SUMMARY (BIO)

María Jesús Ledesma Carbayo is a Full Professor in the Department of Electronic Engineering at the Universidad Politécnica de Madrid (UPM) and an affiliated scientist at the Centre for Biomedical Research Network (CIBER-BBN). A leading figure in Biomedical Engineering, her research focuses on developing advanced biomedical image processing and analysis techniques, with a strong emphasis on Artificial Intelligence (AI) and Machine Learning (ML) for healthcare applications. Her work aims to improve diagnostics, prognostics, and treatment guidance across various medical fields, including cardiology, oncology, and ophthalmology.

Professor Ledesma Carbayo has a distinguished international profile, including postdoctoral training at the US National Institutes of Health (NIH) supported by a prestigious Fulbright Fellowship. Her research has generated highly cited publications on topics like cardiac motion estimation, AI for glaucoma classification, lung disease analysis, and predicting cancer immunotherapy response.

Demonstrating significant leadership, she has coordinated UPM's participation in major international projects (e.g., EU FP7, EIT Health Catalyst Europe) and serves as an expert evaluator for top funding bodies like the European Research Council (ERC). Her innovative work translates into tangible impact through exploited international patents (licensed to companies like Imbio LLC and Leuko Labs Inc.) and the co-founding of the AI diagnostics spin-off, Spotlab SL.

Her contributions have been recognized with awards such as the highly competitive Leonardo Grant from the BBVA Foundation (2019). Professor Ledesma Carbayo actively mentors the next generation, having supervised numerous PhD theses, and contributes to global health initiatives through collaborations with NGOs. Her work consistently bridges cutting-edge engineering with real-world clinical needs and societal benefit.

MAIN 10-12 MILESTONES (Reseña)

1. **Exploited Patent (Pulmonary Embolism Prognosis):** Co-inventor of the internationally patented technology "Method and system for determining the prognosis of a patient suffering from pulmonary embolism" (US Patent 9,905,002 B2; WO/2015/078980 A2). Developed through a collaboration involving UPM, MIT, and Brigham & Women's Hospital, this invention was exclusively licensed to Imbio LLC (2015-2019) and forms the basis of a commercialized product, demonstrating significant technology transfer and potential clinical impact.
2. **Exploited Patent & Spin-off Link (Non-Invasive Hematology):** Co-inventor of "Systems, Devices and Methods for Non-Invasive Hematological Measurements" (US Patent 11,244,452 B2; EP3697294; granted JP, AU). This technology, developed with MIT, is exclusively licensed to Leuko Labs Inc. (Boston, MA) since 2019, underpinning their point-of-care device development. This represents major translational success with direct economic impact and potential to improve patient monitoring.
3. **Foundational Publication (Cardiac Motion):** Publication: M.J. Ledesma-Carbayo et al., "Spatio-Temporal Non-Rigid Registration for Ultrasound Cardiac Motion Estimation," IEEE Trans. Med. Imag., 2005 (DOI: 10.1109/TMI.2005.852051). As first author, Prof. Ledesma-Carbayo introduced a novel method for cardiac motion analysis. This highly influential work is widely recognized by leading researchers, cited in numerous reviews, and opened new avenues in quantitative cardiac image analysis.
4. **High-Impact AI Publication (Glaucoma):** Publication: J.J. Gómez-Valverde et al., "Automatic glaucoma classification of color fundus images based on convolutional neural networks and transfer learning," Biomed. Opt. Express, 2019 (DOI: 10.1364/BOE.10.000892). As senior author, she led the development of an AI system for automated glaucoma detection from fundus images. This work has significantly advanced the field of AI in ophthalmology and is frequently cited by researchers developing diagnostic tools.
5. **High-Impact AI Publication (Lung Disease):** Publication: D. Bermejo-Peláez et al., "Classification of Interstitial Lung Abnormality Patterns with an Ensemble of Deep Convolutional Neural Networks," Sci Rep, 2020 (DOI: 10.1038/s41598-019-56989-5). As a key author in collaboration with US researchers (BWH, Harvard), this work presented a novel deep learning ensemble for classifying lung abnormalities, contributing significantly to AI applications in pulmonary image analysis and improving diagnostic capabilities.

6. **Cutting-Edge AI Publication (Immunotherapy):** Publication: B. Farina et al., "Integration of longitudinal deep-radiomics and clinical data improves the prediction of durable benefits to anti-PD-1/PD-L1 immunotherapy in advanced NSCLC patients," J. Transl. Med., 2023 (DOI: 10.1186/s12967-023-04004-x). As senior author, she guided research showing improved prediction of immunotherapy response in lung cancer using AI with integrated data. This recent work is rapidly gaining attention, advancing personalized oncology.
7. **Prestigious Individual Grant (Leonardo Grant):** AWARD: Leonardo Grant for Researchers and Cultural Creators 2019 (BBVA Foundation). This highly competitive national award recognized the innovativeness of her individual project: "Models for predicting response to lung cancer immunotherapy treatment based on the integration of biomedical image data and molecular biomarkers," supporting cutting-edge research in AI for oncology.
8. **Prestigious Fellowship (Fulbright):** AWARD: Fulbright Ruth Lee Kennedy Fellowship 2006 (Fulbright Commission & International Institute). This prestigious fellowship enabled a research stay at the US National Institutes of Health (NIH), fostering crucial international experience and collaboration at a world-leading institution early in her career.
9. **EU Project Leadership (EIT Health Catalyst):** PROJECT: EIT Health Catalyst Europe PhD Fellowship Program (Ref. 20380). Coordinator of the Spanish Node and UPM PI (2020 onwards, €176k budget for 2020). Leads UPM's participation in this prestigious EIT Health initiative, collaborating with MIT, FAU, GE Healthcare, etc., to train PhDs in healthcare innovation, demonstrating leadership in international educational networks.
10. **EU Project Leadership (FP7 BIOPSYPEN):** PROJECT: BIOPSYPEN (FP7-ICT-2013-10, #611132). UPM PI and Leader of WP5 (Image and Signal Processing) for this €2.5M+ FP7 STREP project (UPM budget €298k, 2013-2017). Guided UPM's contribution to developing a novel, low-cost OCT-based diagnostic tool for dermatology, demonstrating leadership in competitive, large-scale EU collaborative research.
11. **International Evaluation Leadership (ERC):** COMMITTEE/EVALUATION: Expert Evaluator for the European Research Council (ERC) Consolidator Grants (2024). Selection based on scientific merit to evaluate proposals for Europe's most prestigious research funding body. This role, along with prior evaluation for Horizon Europe (2022) and H2020 (2014), signifies high-level international peer recognition and contribution to maintaining scientific excellence.

12. **Spin-off Co-founding & Tech Transfer (Spotlab):** OTHER R&D MERIT: Co-founder and shareholder of Spotlab SL. This spin-off directly translates AI research from her group (e.g., AI for hematology, parasite detection using smartphone microscopy) into diagnostic tools. This demonstrates a strong commitment to research translation, entrepreneurship, and achieving socio-economic impact from R&D activities, linking academic innovation to real-world applications.

Profile of Professor María Jesús Ledesma Carbayo

1. Professional and Academic Career

Professor María Jesús Ledesma Carbayo has established a distinguished academic and professional career centered at the Universidad Politécnica de Madrid (UPM), complemented by significant international experience and affiliations with national research networks. Her career trajectory demonstrates consistent advancement based on scientific achievement and contributions to the field of Biomedical Engineering.

The progression through academic ranks underscores a path marked by excellence in research, teaching, and service. Following doctoral studies at UPM¹ and valuable postdoctoral training at the U.S. National Institutes of Health (NIH) in Bethesda, MD¹, Professor Ledesma Carbayo returned to UPM. She secured a permanent, tenured position as Profesora Titular de Universidad (Tenured Associate Professor) in 2010¹, a significant milestone achieved through competitive processes evaluating research output and teaching capabilities. This role was held within the Departamento de Ingeniería Electrónica at the Escuela Técnica Superior de Ingenieros de Telecomunicación (ETSI Telecomunicación).⁴

Further recognition of her sustained scientific contributions and leadership came in September 2020, when she was promoted to Catedrático de Universidad (University Professor) within the same department at UPM.⁵ This position represents the highest academic rank attainable in the Spanish university system and is awarded based on rigorous evaluation of scientific merit, impact, and leadership. Holding this rank typically involves significant responsibilities, including leading major research lines, managing substantial research grants, supervising numerous postgraduate students and research staff, and undertaking key teaching and administrative duties within the department and university.⁵

Professor Ledesma Carbayo's integration within UPM's research structure is deep and long-standing. Since June 2005, she has been a member of the Grupo de investigación Tecnología de imágenes biomédicas (Biomedical Image Technologies - BIT)⁵, a group central to her research activities.⁴ Since January 2016, she has also been a member of UPM's Centro de I+D+I en Procesado de la Información y Telecomunicaciones (Information Processing and Telecommunications Center - ITP), highlighting her connection to the broader information and communication technology research landscape at the university.⁵

Beyond her departmental roles, Professor Ledesma Carbayo has held positions of institutional responsibility, serving as Coordinador De Titulación (Degree Coordinator) at UPM since April 2018.⁵ This role involves significant administrative

oversight for a specific academic degree program, demonstrating institutional trust in her capabilities alongside her primary research and teaching functions.

Complementing her UPM roles, Professor Ledesma Carbayo is an affiliated scientist with the Centro de Investigación Biomédica en Red – Bioingeniería, Biomateriales y Nanomedicina (CIBER-BBN).¹ This affiliation, active since at least 2013² and ongoing⁷, connects her work to a prestigious national network of excellence funded by the Instituto de Salud Carlos III. It underscores the national relevance of her research and facilitates collaboration and access to wider resources within Spain's biomedical research landscape.

This career path, characterized by advancement through merit-based evaluations to the highest academic rank, significant international experience at a leading institution like the NIH, and deep, long-term integration within UPM and national research networks like CIBER-BBN, establishes Professor Ledesma Carbayo as a leading figure in her field. Her stability within UPM since her tenure in 2010 has likely fostered the development of sustained research programs, robust collaborations, and the capacity to undertake significant institutional leadership roles.

Chronological Positions (Most Recent First):

- **Catedrático de Universidad (University Professor):** Departamento de Ingeniería Electrónica, ETSI Telecomunicación, Universidad Politécnica de Madrid (UPM), Madrid, Spain. (September 2020 – Present).⁵
 - *Description & Relevance:* Highest academic rank in the Spanish system, signifying national recognition of sustained scientific contributions and leadership, achieved via competitive merit-based evaluation. Involves leading research, teaching senior courses, supervising students/staff, and managing grants.
- **Coordinador De Titulación (Degree Coordinator):** Universidad Politécnica de Madrid (UPM). (April 2018 – Present).⁵
 - *Description & Relevance:* Institutional administrative role responsible for coordinating aspects of a specific academic degree program, indicating significant trust and responsibility.
- **Member:** Centro de I+D+I en Procesado de la Información y Telecomunicaciones (Information Processing and Telecommunications Center - ITP), UPM. (January 2016 – Present).⁵
 - *Description & Relevance:* Membership in a key UPM R&D center focused on information and communication technologies, broadening her research context.

- **Researcher/Affiliated Scientist:** Centro de Investigación Biomédica en Red – Bioingeniería, Biomateriales y Nanomedicina (CIBER-BBN), Instituto de Salud Carlos III, Spain. (Active since at least 2013 – Present).¹
 - *Description & Relevance:* Affiliation with a national center of excellence, highlighting the national relevance of her biomedical engineering research and facilitating collaboration.
- **Profesora Titular de Universidad (Tenured Associate Professor):** Departamento de Ingeniería Electrónica, ETSI Telecomunicación, UPM, Madrid, Spain. (2010 – September 2020).¹
 - *Description & Relevance:* Permanent, tenured academic position obtained via competitive evaluation, marking a key consolidation of her academic career at UPM.
- **Member:** Grupo de investigación Tecnología de imágenes biomédicas (Biomedical Image Technologies - BIT), UPM. (June 2005 – Present).⁴
 - *Description & Relevance:* Long-term membership and current senior role within this core UPM research group, indicating foundational and ongoing contributions.
- **Postdoctoral Researcher:** U.S. National Institutes of Health (NIH), Bethesda, MD, USA. (Dates prior to 2010).¹
 - *Description & Relevance:* International postdoctoral training at a world-leading research institution, providing advanced skills and establishing international connections.
- **PhD:** Universidad Politécnica de Madrid (UPM), Madrid, Spain. (Dates prior to Postdoc).¹
 - *Description & Relevance:* Doctoral training at her current home institution.

2. Main Research Areas

Professor Ledesma Carbayo's research program is situated at the intersection of **Engineering and Medicine**, specifically within the field of **Biomedical Engineering**. Her work concentrates on the development and application of sophisticated **biomedical image processing and analysis techniques**, increasingly leveraging the power of **Artificial Intelligence (AI)** and **Machine Learning (ML)**.¹ The overarching goal is to extract quantitative, objective, and clinically relevant information from diverse medical imaging modalities. This information is then used to improve diagnostic accuracy, predict patient prognosis and treatment response, enhance treatment planning and guidance (particularly in surgery and radiotherapy), and enable more effective monitoring of disease progression and

therapeutic effects. Ultimately, her research endeavors aim to translate technological advancements in imaging into tangible improvements in healthcare delivery and patient outcomes.¹ The breadth of her expertise is reflected in the wide range of disciplinary keywords associated with her work, spanning engineering fields (Biomedical, Electrical & Electronic, Computer Science including AI, Computer Vision, Software Engineering) and numerous medical specialties (Radiology, Cardiology, Oncology, Neurology, Pathology, Ophthalmology, Public Health).⁵

Her research activities can be broadly categorized into several interconnected focus areas. A core component involves the creation and refinement of **advanced image analysis methodologies**. This includes developing novel algorithms for complex tasks such as image registration (aligning images acquired at different times or from different modalities), motion estimation and correction (critical for dynamic imaging scenarios like cardiac cycles or respiratory movement), image segmentation (identifying and delineating anatomical structures or pathological regions), and data fusion (integrating complementary information from multimodality imaging or combining imaging data with non-imaging sources like clinical or molecular biomarkers).⁵ A significant thrust within this area is the application and innovation within **AI and ML for medical imaging**. Professor Ledesma Carbayo's group develops and utilizes techniques like deep learning and radiomics (the high-throughput extraction of quantitative features from images) to build predictive models and automated systems for detection, classification, segmentation, and outcome prediction. Notable examples include work on predicting treatment response in glioblastoma using MRI/MRSI ⁸, developing AI algorithms to predict immunotherapy response in lung cancer by integrating imaging and molecular data ¹, applying AI to digital pathology images for analyzing hematological diseases ⁵, creating AI tools for detecting parasites like *Trypanosoma cruzi* in microscopy images for Chagas disease diagnosis ⁹, and addressing bias in AI models for breast cancer detection.²⁰ This focus clearly positions her work at the forefront of the AI transformation in healthcare.

These advanced methodologies are translated into specific **clinical applications**, demonstrating a strong commitment to addressing real-world medical challenges. Key application domains include **Cardiovascular Imaging**, where her group works on analyzing cardiac function, quantifying structures from ultrasound (e.g., CUSQ software), and potentially guiding interventions for conditions like ventricular tachycardia.⁵ Another major focus is **Oncology Imaging**, spanning various cancer types such as lung ¹, brain (glioma) ⁸, breast ⁵, and hematological malignancies.⁵ **Microscopy Image Analysis** constitutes another significant area, involving automated analysis of cellular structures, cell tracking⁷, digital pathology for cancer diagnosis ¹², and parasite detection for infectious diseases.⁵ Furthermore, her

research contributes to **Image-Guided Surgery and Therapy**, developing tools and techniques for planning and guiding procedures like radiotherapy, including intraoperative radiotherapy.⁴ This clinical translation is often facilitated by close collaborations with hospital departments and clinical researchers.¹¹ Finally, her work also extends to **High-Resolution Preclinical Imaging**, likely involving animal models to develop, validate, and refine new imaging biomarkers and analysis techniques before human application.⁴ This comprehensive research portfolio highlights an approach that bridges fundamental methodological development with impactful clinical translation across multiple disease areas.

3. Leadership, Management, and Institutional Service

Professor Ledesma Carbayo's contributions extend significantly beyond her individual research and teaching activities. She has consistently undertaken important leadership, management, and service roles that demonstrate her commitment to her institution, the broader research community, and societal well-being. These roles reflect leadership capabilities in academic administration, research program direction, international collaboration management, and non-profit governance.

Within UPM, her appointment as **Coordinator De Titulación (Degree Coordinator)** since April 2018 signifies substantial institutional responsibility for overseeing an academic program.⁵ This role requires administrative acumen and the ability to manage academic processes effectively. Within her research environment, she serves as **Director of several lines of research** within the Laboratorio de Tecnologías de Imágenes Biomédicas (BIT), guiding specific research directions and mentoring junior researchers and students within the group.⁵

Her leadership also extends to managing international and collaborative programs. She serves as the **Coordinator for the Spanish node of the Catalyst Europe PhD fellowship program**, an initiative under EIT-Health focused on fostering healthcare innovation by connecting PhD students with clinical and industry partners.⁵ This role involves managing the program's implementation in Spain and facilitating crucial links between academia and the healthcare innovation ecosystem. Furthermore, her active **participation in initiatives like the Consorcio MVision (2013-2016) and the MIT-linQ program (since 2016)** demonstrates engagement in high-level institutional efforts aimed at fostering medical technology innovation and strengthening international ties, particularly between the Madrid region and MIT.⁵

Notably, Professor Ledesma Carbayo's leadership activities demonstrate a strong commitment to societal impact beyond traditional academic boundaries. She served as **Presidenta del patronato (President of the Board of Trustees) for the Fundación EHAS (Engineering for Human Health Foundation)** from 2016 to 2020.⁵ EHAS focuses on leveraging appropriate technologies, particularly ICT, to improve

healthcare access and quality in low-income settings. Her presidency involved ultimate responsibility for the foundation's governance and strategic direction. This commitment to global health and development is further evidenced by her long-term involvement with the NGO **ONGAWA, Ingeniería para el Desarrollo Humano (Engineering for Human Development)**, where she has been a volunteer since 1998 and served on the **Board of Directors** during various periods.⁵ This sustained engagement with organizations applying engineering solutions to address global challenges showcases a leadership vision that integrates technical expertise with social responsibility. This perspective may also inform some of her research directions, such as the work on low-cost diagnostic tools for diseases prevalent in resource-limited settings.⁹

These diverse roles collectively paint a picture of a leader who operates effectively within academic structures, fosters innovation through collaborative programs, and actively contributes to applying engineering knowledge for broader societal benefit.

Chronological Roles (Most Recent First):

- **Coordinator De Titulación (Degree Coordinator):** Universidad Politécnica de Madrid (UPM). (April 2018 – Present).⁵
 - *Description:* Overseeing administrative and academic aspects of a specific degree program at UPM.
- **Coordinator:** Spanish node of the PhD fellowship program Catalyst Europe (EIT-Health). (Current as of April 2025).⁵
 - *Description:* Leading the Spanish component of an EIT-Health program training PhD students in healthcare innovation, bridging academia, clinics, and industry.
- **Presidenta del patronato (President of the Board of Trustees):** Fundación EHAS (Engineering for Human Health Foundation). (2016 – 2020).⁵
 - *Description:* Held the top leadership position, overseeing governance and strategy for a foundation focused on technology for healthcare in low-income countries.
- **Member of the Board of Directors:** ONG ONGAWA, Ingeniería para el Desarrollo Humano. (Various periods; volunteer since 1998).⁵
 - *Description:* Long-term engagement including board-level governance participation in an NGO focused on engineering for human development.
- **Director:** Several lines of research, Laboratorio de Tecnologías de Imágenes Biomédicas (Biomedical Imaging Technologies Lab - BIT), UPM. (Ongoing).⁵

- *Description:* Leading specific research themes and teams within the BIT group at UPM.
- **Participant:** MIT-linQ program (since 2016) and Consorcio MVision (2013-2016).⁵
- *Description:* Active involvement in major institutional initiatives fostering medical technology innovation and international collaboration (Madrid-MIT).

4. Relevant Works, Recognitions, Prestigious Awards and Honors

Professor Ledesma Carbayo's research contributions and standing in the field have been recognized through prestigious grants and the generation of tangible intellectual property. These recognitions highlight the innovative nature and potential impact of her work.

A significant individual honor was the award of a **Leonardo Grant for Researchers and Cultural Creators** by the Fundación BBVA in 2019, within the area of Information and Communication Technologies.¹ These grants are highly competitive and support "highly innovative personal projects".¹ Her successful proposal, titled "Models for predicting response to lung cancer immunotherapy treatment based on the integration of biomedical image data and molecular biomarkers," received funding to pursue cutting-edge research combining radiomics, AI, and multi-modal data integration to address a critical challenge in oncology.¹ Securing this grant serves as a strong external validation of the novelty, scientific merit, and potential impact of her research agenda in AI-driven predictive modeling for cancer treatment.

Beyond grant funding, Professor Ledesma Carbayo's research has led to the creation of registered intellectual property, demonstrating a focus on generating usable tools and outputs. She is a co-author/co-inventor of the **registered software CUSQ (CARDIO US/Quantification)**, with registration number M-003351/2008.²¹ This software, developed for cardiovascular ultrasound quantification, was registered jointly by the Fundación para la Investigación Biomédica del Hospital Gregorio Marañón (FIBHGM) and UPM, with Manuel Desco Menéndez, María Jesús Ledesma Carbayo, and Andrés Santos Lleó listed as authors/inventors.²¹ The development and registration of such tools, dating back to 2008, indicate an early and sustained focus on translating research findings into practical applications.

While not explicitly listed as an inventor on every item, her close collaboration with colleagues (such as Manuel Desco Menéndez, Juan José Vaquero López, Javier Pascau González-Garzón, Andrés Santos Lleó) who were inventors on other registered software like MANGOOSE (image-guided surgery planning, Reg. No. 02/2010/4412), FIRST (tomography reconstruction), and QuTIS (spectroscopy quantification)²¹, as well as related patent applications like PCT/ES2008/000240

("System and method for intraoperative radiotherapy planning") owned by GMV Aerospace and Defense S.A.²¹, suggests her active participation in a research environment strongly oriented towards innovation and intellectual property generation in biomedical imaging and image-guided therapies.

Chronological List (Most Recent First):

- **Leonardo Grant Recipient:** Fundación BBVA, Leonardo Grants for Researchers and Cultural Creators, Area: Information and Communication Technologies. (2019).¹
 - *Description:* Prestigious, competitive individual grant awarded for a highly innovative project on AI and radiomics for predicting lung cancer immunotherapy response. Represents significant recognition based on scientific merit.
- **Registered Software: CUSQ (CARDIO US/Quantification):** Registration Number M-003351/2008. (Registered by 2008/Published in reports 2012, 2013).²¹
 - *Description:* Co-author/co-inventor (with M. Desco, A. Santos) of registered software for cardiovascular ultrasound quantification. Owners: FIBHGM - UPM. Represents tangible research output.
- **Related Intellectual Property:** Involvement in a research ecosystem that produced other registered software (e.g., MANGOOSE) and patents (e.g., PCT/ES2008/000240) with close collaborators, indicating an environment focused on translation.²¹

5. Publications

Professor Ledesma Carbayo possesses a substantial and impactful publication record, reflecting sustained high-level research activity and significant contributions to the fields of biomedical engineering, medical image analysis, and artificial intelligence in healthcare. Her scholarly output is characterized by both considerable volume and high quality, as evidenced by publication metrics and placement in reputable venues.

Overall Impact:

- **Volume:** She has authored or co-authored over 250 publications in total, including journal articles and conference proceedings.⁵ Alternative counts based on specific databases indicate around 145-190 indexed journal articles.⁵ This volume signifies consistent research productivity over her career.

- **Citations and Visibility:** Her work has garnered significant attention from the research community, reflected in strong citation metrics. As of early 2025, her citation counts and h-index values were reported as:
 - Web of Science (WoS): 190 documents, 2901 citations, h-index 24.⁵
 - Scopus: 175 documents, 3643 citations, h-index 27.⁵ Her Scopus Author ID is 7801546083.¹⁴
 - Google Scholar: 5290 citations, h-index 33.²⁴
 - Europe PMC: 59 documents, 623 citations, h-index 13.⁵ These metrics, particularly the h-indices ranging from 24 to 33, indicate a substantial body of work that is both well-cited and influential within her field. Her ORCID identifier is 0000-0001-6846-3923.¹⁴
- **Quality:** A notable proportion of her publications appear in high-impact journals. According to WoS data (as of April 2025), 98 of her 190 indexed documents were published in Q1 journals (top 25% by impact factor in their category), and 54 were in D1 journals (top 10%).⁵ This corresponds to approximately 52% of her WoS-indexed output being in Q1 journals and 28% in D1 journals, demonstrating a consistent ability to publish in leading international venues.

Highlighted Career Publications:

While specific seminal works are not explicitly designated in the source materials, key research themes are consistently represented in her publications. Important contributions likely include her work on **cardiac imaging analysis**, particularly related to arrhythmia treatment guidance, often conducted in collaboration with clinical partners like the Hospital General Universitario Gregorio Marañón and published in relevant cardiology and biomedical engineering journals.¹¹ Foundational work on **image processing methodologies**, such as motion compensation, image registration, and reconstruction techniques, also forms a significant part of her publication portfolio.¹⁴ Publications associated with the development and validation of the **CUSQ software** for cardiac ultrasound quantification represent tangible outputs documented in her publication history.²¹

Prestigious Journal Publications (Last 5 Years: approx. 2020-2025):

Professor Ledesma Carbayo's recent publication activity demonstrates continued productivity and focus on her core research areas, particularly the application of AI and advanced image analysis techniques to pressing clinical problems. The following table presents a selection of publications in prestigious journals or conference proceedings from the last five years, illustrating the breadth and impact of her current work.

Table 1: Selected Prestigious Publications (2020-2025)

Title	Journal/Conference	Year	Key Authors (incl. Ledesma-Carbayo)	DOI/Reference
Interpreting response to TMZ therapy in murine GL261 glioblastoma by combining Radiomics , Convex-NMF and feature selection in MRI/MRSI data analysis	Proceedings of the International Joint Conference on Neural Networks (IJCNN)	2020	Nunez LM,..., Ledesma-Carbayo MJ,...	10.1109/IJCNN48605.2020.9207031 ⁸
Adaptive compound ing speckle-noise-reduction filter for optical coherence	Journal of Biomedical Optics	2021	Gomez - Valverde JJ, Sinz C, Rank EA, Chen Z, Santos	10.1117/1.JBO.26.6.065001 ²⁶

tomography images			A, Drexler W, Ledesma-Carbayo MJ	
A bias analysis on a breast cancer mammography dataset for deep learning applications	Submitted to MIDL 2022 (Medical Imaging with Deep Learning Conference)	2021 (submitted)	Zufiria Gerbolés B, López-Linares K, García González MJ,..., Ledesma-Carbayo MJ , Macía Oliver I	²⁰
Digital Microscopy Augmented by Artificial Intelligence to Interpret Bone Marrow Samples for Hematolog	Microscopy and Microanalysis	2024	Postigo-Camp S,..., Ledesma-Carbayo MJ , Linares M, Luengo-Oroz M, Martin	Link via ¹²

ical Diseases			ez- Lopez J	
Artificial Intelligence Models for Risk Stratification of Patients with Myelodysplastic Syndrome s based on Bone Marrow Cytology Images	Blood (ASH Meeting Abstract)	2024	Postigo Camp s M,..., Ledesma-Carbayo MJ , Linare s M, Lueng o-Oroz M, Martín ez- López J	Abstract 7509 ¹⁸
A Smartphone App for Real-Time Assessment of Malaria Prophylaxis Adverse Events	Telemedicine and e-Health	2024	Rodrig uez- Valero N, Ledesma-Carbayo MJ , Martí- Soler H, Cuadr ado Sanch ez D,..., Pinazo MJ,...	10.1089/tmj.2023.0200 ²⁷

Enhancing Soil-Transmitted Helminths Diagnosis Through AI: A Self-supervised Learning Approach with Smartphone-Based Digital Microscopy	Book Chapter (Springer, Lecture Notes in Computer Science)	2025	Lin L, Cuadrado D, Mancebo-Martín R, Kepha S,..., Ledesma-Carbayo MJ , Luengo-Oroz M,..., Bermejo-Peláez D	10.1007/978-3-031-79103-1_15 ¹⁹
Fetal Body Parts Segmentation Using Volumetric MRI Reconstructions	Book Chapter (Springer, Lecture Notes in Computer Science)	2025	Alarcón-Gil PP, Alfano F, Uus A, Ledesma-Carbayo MJ , Cordero-Grand e L	10.1007/978-3-031-73260-7_12 ²⁸
Artificial Intelligence algorithm	medRxiv (Preprint)	2025 (preprint)	Cuadrado D,..., Mancebo	⁹

for real-time detection and counting of <i>Trypanosoma cruzi</i> parasites using smartphone microscopy			bo-Martín R, Ledesma-Carbayo MJ , Luengo-Oroz M,...	
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This strong publication record, characterized by high volume, significant citation impact, and frequent placement in top-tier journals, firmly establishes Professor Ledesma Carbayo's scientific standing. Her recent publications clearly demonstrate continued activity at the cutting edge of AI applications in oncology, microscopy, global health diagnostics, and imaging methodology development, aligning closely with her stated research interests and funded projects.

6. Relevant Research Projects and Funding

Professor Ledesma Carbayo has demonstrated considerable success in securing research funding and leading complex research projects throughout her career. She possesses extensive experience participating in and directing projects funded through national competitive calls (e.g., Spanish Plan Nacional), international programs, and collaborations with industry.⁵ Her ability to obtain funding as Principal Investigator (PI) is particularly noteworthy, indicating leadership in defining research questions, designing methodologies, and managing research grants and teams.

Several projects highlight her leadership role. The prestigious **Leonardo Grant** awarded by Fundación BBVA in 2019 is an individual grant where she serves as the sole PI, focusing on developing predictive models for lung cancer immunotherapy response using AI and integrated data.¹ This project underscores her capacity to conceive and lead highly innovative, independent research. She is also listed as PI on several recent UPM projects funded through national sources (MICINN - Ministry of Science and Innovation) and institutional programs. These include a project on **multimodal data integration (clinical, imaging, histopathology) for predicting cancer immunotherapy response** (started 2022, Ref PMPTA22/00169?), which directly aligns with and likely builds upon the Leonardo Grant work.⁵ Another project

under her leadership focuses on **multimodal planning and guidance for breast cancer surgery and treatment** (started 2022).⁵ Furthermore, she leads the **ALMA project on Artificial Intelligence for diagnosis, treatment, and prognosis of hematological diseases** (Ref PMPTA22/00169?, started ~2018/ongoing), connecting directly to her recent publications and collaborations in digital hematopathology.⁵

Her project involvement also includes participation as a team member or collaborator in earlier initiatives, such as a project on **real-time multimodal medical imaging for complex treatment scenarios** (PI: A. Santos, started 2013) ⁵ and potentially earlier work related to distributed computing for image analysis.¹⁵ She has also participated in more recent multi-hospital studies, for instance, on simulation systems for optimizing intraoperative radiotherapy practice (started 2023).⁵ This history of participation and leadership across diverse projects demonstrates a sustained engagement with funded research activities.

The following table summarizes key research projects involving Professor Ledesma Carbayo within the last five years (approx. 2020-2025), emphasizing those where she holds a leadership role and those funded through prestigious mechanisms.

Table 2: Selected Research Projects (2020-2025)

Project Title/Acronym	Funding Source	Role	Budget	Intl Collab	Dates	Reference
Integración multimodal de datos clínicos, imágenes médicas e histopatología para la predicción de respuesta	MICINN / UPM / Otros nacional (Ref PMPTA22/00169?)	PI	N/A	N/A	2022 – Present	⁵

al tratamient o del cáncer por inmunoter apia						
Panificaci ón y guiado multimod al en cirugía y tratamient o de cáncer de mama	UPM	PI	N/A	N/A	2022 – Pres ent	⁵
Leonardo Grant Project: Modelos de predicción de respuesta al tratamient o de cáncer de pulmón con inmunoter apia...	Fundación BBVA	PI	Substa ntial individ ual grant (amou nt N/A)	General collabor ation with EU/US groups mention ed ¹	2019 – Ongo ing	¹
ALMA - Inteligenci a Artificial para	MICINN / UPM / Otros nacional	PI	N/A	N/A	~201 8 – Ongo ing	⁵

diagnóstico, tratamiento y pronóstico de enfermedades hematológicas	(Ref PMPTA22/0 0169?)					
Estudio multi- hospital de sistemas de simulación y entrenamiento en la optimización de la práctica clínica en radioterapia intraoperatoria	UPM	Participant	N/A	N/A	2023 – Present	⁵

Note: N/A indicates information not available in the provided source materials.

Professor Ledesma Carbayo's project portfolio clearly demonstrates her ability to secure competitive funding from diverse sources, including prestigious private foundations (Fundación BBVA) and national research agencies (MICINN), often in the demanding role of Principal Investigator. The thematic focus of her recent projects—leveraging AI and multimodal data integration for improved cancer treatment (immunotherapy, breast cancer guidance), diagnosis, and prognosis (hematological diseases)—is highly coherent with her core research areas and recent publication output. This alignment suggests a well-defined research strategy

where funded projects drive scientific discovery and technological innovation, leading to impactful publications and potential knowledge transfer opportunities.

7. Industry Collaboration and Knowledge Transfer

Professor Ledesma Carbayo demonstrates a strong commitment to translating research outcomes into practical applications, engaging actively in knowledge transfer activities that bridge academia, clinical practice, and industry. Her efforts encompass direct industry collaboration, intellectual property generation, participation in innovation-focused programs, and links to potential spin-off activities.

A prominent example of her knowledge transfer activity is her involvement with **Spotlab SL**, a company focused on developing AI-driven diagnostic tools. Professor Ledesma Carbayo is identified as a **shareholder and member** of Spotlab.¹⁸ This relationship is further evidenced by numerous recent co-authored publications and preprints detailing the development and validation of AI algorithms for applications such as interpreting bone marrow images for hematological diseases¹² and real-time detection of *Trypanosoma cruzi* parasites using smartphone microscopy for Chagas disease diagnosis.⁹ This close collaboration signifies a direct pathway for translating research expertise in AI and medical/microscopy image analysis, developed within her academic group, into potentially commercializable diagnostic solutions.

Her focus on generating tangible outputs is also reflected in the creation of **intellectual property**. As previously noted, she is a co-inventor of the registered software **CUSQ (Cardio US Quantification)**.²¹ Furthermore, her research group's environment fostered collaborations leading to patents with industry partners, such as the work on intraoperative radiotherapy planning technology with **GMV Aerospace and Defense S.A.** involving her close collaborators.²¹

Effective knowledge transfer in biomedical engineering often relies on close **collaboration with clinical partners** to validate technologies and ensure clinical relevance. Professor Ledesma Carbayo maintains strong links with hospitals, including collaborations with the Department of Cardiology at Hospital General Universitario Gregorio Marañón¹¹ and the Department of Hematology at Hospital Universitario 12 de Octubre.¹² These collaborations are essential for accessing clinical data, understanding clinical needs, and testing developed technologies in real-world settings.

Her commitment to fostering innovation extends to participation in programs designed to bridge academia and industry. Her role as **Coordinator of the Spanish node for the Catalyst Europe (EIT-Health) PhD program**⁵ directly involves training students in healthcare innovation and connecting them with industry. Her

participation in initiatives like **MIT-linQ** ⁵ further underscores her engagement in ecosystems designed to accelerate the translation of medical technologies.

The following table highlights key knowledge transfer activities involving Professor Ledesma Carbayo over the last five years (approx. 2020-2025).

Table 3: Selected Knowledge Transfer Activities (2020-2025)

Activity Type	Description/Title	Partners	Role	Date/Status	Reference
Industry Collaboration / Spin-off Link	Development & validation of AI models for hematological disease analysis (digital microscopy)	Spotlab SL, Hospital 12 de Octubre	Shareholder/ Member (Spotlab), Research Collaborator	Ongoing (Pubs. 2024)	¹²
Industry Collaboration / Product Development	Development of AI algorithm for real-time Chagas parasite detection (smartphone microscopy)	Spotlab SL	Research Collaborator	Ongoing (Preprint 2025, Book Chapter 2025)	⁹
Program Leadership	Coordination of Spanish	EIT-Health, various academic/i	Coordinator	Ongoing (as of	⁵

(Innovation Training)	node for Catalyst Europe (EIT-Health PhD program)	industry partners		Apr 2025)	
Potential Licensing / Development	Technologies from recent grants (e.g., AI for Immunotherapy - Leonardo Grant; AI for Hematology - ALMA project)	Potential clinical or industry partners	PI / Inventor	Ongoing Research	¹

Note: Status reflects information available in source materials.

Professor Ledesma Carbayo's engagement with Spotlab represents a particularly mature form of knowledge transfer, moving beyond traditional IP generation to active involvement in a commercial entity leveraging her group's research expertise. This direct industry link, combined with her broader activities in fostering innovation ecosystems through programs like Catalyst Europe, indicates a strategic and multi-faceted approach to ensuring her research has tangible real-world impact.

8. Post-degree Student Supervision

8.1. Introduction and Context

This section aims to provide a detailed analysis of the postgraduate student supervision activities carried out by Professor María Jesús Ledesma Carbayo, with a particular focus on doctoral theses. It seeks to address the specific need for information regarding the total number of supervised theses and a detailed list of those defended in the last five years (approximately 2020-2025).

The supervision of doctoral theses and other postgraduate work is a fundamental indicator of academic and research activity. It reflects not only the researcher's mentoring capacity but also the vitality of their research group and their contribution

to training new generations of scientists and professionals. Evaluating this activity is therefore crucial in academic and institutional assessment contexts.

To collect and verify information on doctoral theses in Spain, various data sources are used. Among the most important is TESEO, the official database of the Ministry of Science, Innovation and Universities, which collects information on doctoral theses defended in Spanish universities since 1976. TESEO includes key metadata such as title, author, university, defense date, abstract, and examination committee composition.²⁹ Another relevant source is Dialnet, a multidisciplinary database that also houses information on doctoral theses. Its advanced version, Dialnet Plus, accessible to users from collaborating entities such as universities, offers specific search filters for theses (by keyword, title, author, university) and even allows visualization of a researcher's "academic tree," including supervised theses and participation in examination committees.³¹ Finally, institutional repositories, such as the Archivo Digital UPM of the Universidad Politécnica de Madrid, contain the scientific and academic output generated by the university community, including doctoral theses.³² UPM also has specific library catalogs for consulting theses.³⁴

The existence of multiple platforms (national, multidisciplinary, and institutional) suggests that obtaining a complete and verified overview of supervisory activity may require cross-referencing several sources. No single source guarantees exhaustiveness or provides all desired details (e.g., access to full text or precise clarification of the supervisory role in all cases). TESEO is the official database ²⁹, but Dialnet may offer additional analysis functionalities ³¹, while institutional repositories are key for the specific output of a university.³²

Given that Professor Ledesma Carbayo's primary affiliation is the Universidad Politécnica de Madrid (UPM), where she has held a professorship since 2020 ⁵ and is a member of the Biomedical Image Technologies (BIT) Research Group ⁵, UPM's own resources (Archivo Digital UPM ³², UPM Scientific Portal ⁵, library catalogs ³⁴) are the most likely primary sources for detailed information on the theses she has supervised. National databases like TESEO ²⁹ and Dialnet ³¹ serve as important complementary tools for verification and identifying potential co-supervisions or activities at other institutions.

8.2. Overall Supervision Record

Available information indicates a significant record of supervisory activity by Professor Ledesma Carbayo at the postgraduate and undergraduate levels.

- **Doctoral Thesis Supervision:** According to data compiled in her official profile on the UPM Scientific Portal, Professor Ledesma Carbayo has supervised a total of **19 doctoral theses**.⁵

- **Other Supervisions:** In addition to directing doctoral theses, her mentoring work extends to other levels. She has supervised **2 Master's theses (TFM)** or equivalent and **10 Bachelor's theses (TFG)**.⁵

This volume of supervision, especially the 19 doctoral theses, should be contextualized within her academic career. Having obtained a tenured associate professor position at UPM in 2010 ¹ and achieved full professorship in 2020 ⁵, this number of supervised theses reflects a sustained and significant commitment to doctoral training over more than a decade.

Considering the high demands of effective doctoral supervision (methodological guidance, progress review, student support), directing 19 doctoral theses represents a considerable workload. This mentoring work has been carried out alongside intense research activity, evidenced by a high number of publications (>250 journal articles and conference proceedings, with notable h-indices in Scopus and WoS ⁵), participation and leadership in numerous national and international research projects ⁵, holding academic management roles (Degree Coordinator at UPM ⁵), and significant involvement in technology transfer activities and industry collaboration.⁵ The ability to simultaneously manage this significant supervision load along with other academic and research responsibilities suggests high organizational capacity and a dynamic and productive research environment within her group (Biomedical Image Technologies - BIT ⁴).

8.3. Theses Supervised and Defended in the Last 5 Years (Approx. 2020-2025)

An attempt was made to compile a specific list of doctoral theses supervised by Professor Ledesma Carbayo that were defended between 2020 and 2025 (inclusive), as requested. However, compiling a definitive and verified list solely from the information sources directly accessible for this report presents significant limitations.

Specific searches conducted or information extracted from the consulted profiles and databases did not allow for the generation of such a complete list.³⁴ For example, although one thesis where she is listed as director (TESEO ID 138116) is identified and available in the Archivo Digital UPM, the available information does not specify the defense date.⁵⁰ In another documented case from 2022, her participation was as President of the examination committee, not as supervisor.⁵¹

The proposed table structure to house this information is presented below, which ideally would contain the complete data if available.

Table 8.1: Doctoral Theses Supervised by Prof. María Jesús Ledesma Carbayo Defended between 2020 and 2025 (inclusive)

Student Name	Thesis Title	Defense Date	Supervisor Role	University	Link/Source (if available)
[Data not available]	[Data not available]	[yyyy-mm-dd]	**	[UPM or other]	**
...

Note: The table above represents the desired structure. Based strictly on the information contained in the sources consulted for this report, it was not possible to populate it with verified entries corresponding to theses supervised and defended in the 2020-2025 period.

To obtain a definitive and exhaustive list of doctoral theses supervised by Professor Ledesma Carbayo and defended in the last five years, it would be necessary to directly consult the official academic records of the Universidad Politécnica de Madrid, the professor's official and updated Curriculum Vitae, or perform specific and authenticated searches in databases such as TESEO ²⁹ and Dialnet (particularly Dialnet Plus ³¹).

8.4. Broader Academic Impact through Supervision and Evaluation

Professor Ledesma Carbayo's contribution to the postgraduate education ecosystem extends beyond the direct supervision of her own doctoral candidates. Her participation as a member of doctoral thesis examination committees is another relevant facet of this contribution.

Available documentation evidences her participation in such committees. Notably, she served as President of the examining committee for a doctoral thesis defended at the Universidad Carlos III de Madrid in 2022.⁵¹ She is also listed as a Member (Vocal) on another thesis committee ⁵², although specific details of date and university are not present in the consulted source. The Dialnet platform also specifically allows for the recording of participation in doctoral committees as part of a researcher's academic profile.³¹

Being invited to serve on doctoral thesis committees, especially assuming roles of responsibility such as president ⁵¹ and doing so at external institutions ⁵¹, constitutes explicit recognition of her expertise and reputation within the national academic community in her field of specialization (Biomedical Engineering, Biomedical Image Processing, Artificial Intelligence applied to medical imaging ⁵). This activity complements her direct supervision work, contributing to quality

assurance and scientific rigor in doctoral training at a broader level within the university system.

8.5. Data Verification and Limitations

The information presented in this section is based on sources considered reliable, such as the researcher's official profile on the UPM Scientific Portal ⁵, national thesis databases like TESEO ²⁹, academic aggregator platforms like Dialnet ³¹, and UPM institutional documentation.³²

However, it is important to note the main limitation encountered: the inability to extract a complete and verified list of doctoral theses supervised *and defended* specifically in the 2020-2025 period, based solely on the data accessible for preparing this report.³⁴ As mentioned, some relevant entries lacked dates ⁵⁰ or corresponded to examiner roles rather than supervisor roles.⁵¹ Furthermore, access to certain potentially key sources, such as detailed searches in the Archivo Digital UPM or the complete ORCID profile, was not possible or did not yield the specific required results within the scope of this analysis.⁴⁷

It is also pertinent to mention that occasionally, minor discrepancies or time lags in information updates may exist between different databases and academic profiles, reinforcing the advisability of cross-verification.

The difficulty in assembling this specific dataset (theses supervised in the last 5 years) from the consulted public sources highlights the inherent challenges in aggregating detailed and up-to-date academic information based exclusively on publicly accessible data. Often, internal institutional records or authenticated access to specialized databases ³¹ contain the most accurate and complete information, especially regarding the most recent activities.

8.6. Conclusion

In summary, Professor María Jesús Ledesma Carbayo possesses a substantial and consolidated track record in supervising postgraduate students, having directed a total of 19 doctoral theses, in addition to Master's and Bachelor's theses.⁵ This mentoring activity has been carried out consistently throughout her career at UPM, alongside outstanding scientific productivity and leadership.

Although it was not possible to compile an exhaustive list of theses defended under her supervision in the specific 2020-2025 period from the information available for this report, various indicators suggest continuity in this work. Her promotion to Full Professor in 2020 ⁵, the direction of active and recent research projects ⁵, her continuous scientific output ⁵, and her participation as an expert on thesis committees ⁵¹ indicate that her involvement in doctoral training remains an important part of her current academic activity.

To obtain detailed and complete information on the theses supervised and defended in the last five years, it is recommended to consult the official records of the Universidad Politécnica de Madrid or Professor Ledesma Carbayo's standardized and verified Curriculum Vitae.

Conclusion

Professor María Jesús Ledesma Carbayo emerges from this analysis as a highly accomplished and influential figure in the field of Biomedical Engineering, with specific expertise in biomedical image processing, analysis, and the application of Artificial Intelligence in healthcare. Her career exhibits a clear upward trajectory based on scientific merit, culminating in her appointment as Catedrático de Universidad at the Universidad Politécnica de Madrid, where she has established a stable and productive research base within the Biomedical Image Technologies (BIT) group and the broader university structure.

Her research program is characterized by its focus on developing advanced computational methodologies (including image registration, motion correction, segmentation, AI/ML, and radiomics) and translating them into impactful clinical applications across diverse areas such as cardiovascular disease, oncology (lung, brain, breast, hematological), microscopy-based diagnostics (including global health applications like Chagas disease), and image-guided therapies. The high volume and quality of her publication record, marked by numerous papers in leading international journals (significant percentages in Q1/D1 categories) and substantial citation impact (h-index up to 33), attest to the significance and visibility of her scientific contributions.

Professor Ledesma Carbayo has demonstrated consistent success in securing competitive research funding as a Principal Investigator, including a prestigious individual Leonardo Grant from Fundación BBVA and national grants from MICINN. Her project portfolio is strategically aligned with her core research interests and recent publications, indicating a coherent and forward-looking research agenda focused on leveraging AI and multimodal data integration to solve critical healthcare problems.

Beyond traditional academic metrics, her profile is distinguished by significant leadership roles and a strong commitment to knowledge transfer and societal impact. Her leadership extends from academic program coordination (Degree Coordinator, Catalyst Europe node) to non-profit governance (Presidency of Fundación EHAS, board membership at ONGAWA), reflecting a dedication to applying engineering expertise for broader benefit. Her knowledge transfer activities are robust, highlighted by the generation of intellectual property (e.g., CUSQ software) and, notably, a deep and ongoing collaboration with the AI diagnostics company Spotlab SL, where she is a shareholder. This demonstrates a clear

pathway from academic research to potential commercial application and real-world impact.

Finally, she plays an active and significant role in training the next generation of researchers through substantial PhD supervision (19 theses directed) and leadership in specialized innovation training programs.⁵ While a comprehensive list of doctoral graduates defended specifically in the last five years was not available from the consulted sources, her overall record and continued activity confirm her dedication to research capacity building. Her expertise is further recognized through her participation in doctoral examination committees, including at external institutions.⁵¹

In conclusion, Professor María Jesús Ledesma Carbayo presents a profile of an established academic leader with a strong international reputation, significant scientific achievements, a proven ability to lead funded research, a clear focus on translational impact through innovation and industry collaboration, and a commitment to both institutional service and broader societal contributions.

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