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Doctoral positions with scholarships according to the Ministerial Decree no. 352/2022, within the Italian National Recovery and Resilience Plan (NRRP), in the frame of Mission 4, component 1 “From Research to Business”; Investment 3.3 “Introduction of innovative doctorates that respond to the innovation needs of businesses and promote the recruitment of researchers by the companies”

A.Y.2022/2023 – Cycle 38

RESEARCH TOPIC DESCRIPTION

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Doctoral Programme in PHYSICS

Proposed research/Scholarship title	Development of optical diagnostic techniques for the characterization of an H ₂ /N ₂ plasma in EUV lithography devices.
Scientific contact person	Prof. Luca Matteo Martini
Brief description of the proposed research	<p>Training activities.</p> <p>The training plan of the Ph.D. student will be in line with the "Manifesto of Studies" of the Doctoral Program in Physics. The student will attend courses for 12 credits (ECTS). The training activity for the Ph.D. students will consist of compulsory activities (e.g., "Joint Colloquia"), technological/scientific courses, and international schools. The student will be trained on advanced experimental techniques in physics (mainly spectroscopy) and in advanced topics in plasma physics/plasma chemistry. The Ph.D. students will attend courses offered by the Doctoral School in Physics (e.g., "Advanced techniques in experimental physics," Baldi/Brusa; "Optical and spectroscopic diagnostic of materials for photonics", Chiasera, etc.). The Ph.D. student will attend international schools on topics related to the research activity (e.g., "International School on Low Temperature Plasma Physics: Basics and Applications – Bad Honnef, Germany") and international conferences.</p> <p>Research Activities.</p> <p>Non-thermal plasmas are ionized gases characterized by an electron temperature much higher than the heavier species' temperature (e.g., molecules). Non-thermal plasmas can excite the strong chemical bond of N₂, easily split H₂, and promote the production of stable species like NH₃ and N₂H₄. Gaining better insight into the fundamental mechanisms triggered by the plasma requires knowing the time evolution of physical parameters (e.g., temperature) and the local gas composition. Inferring these observables in a plasma environment is challenging because strong spatial and temporal gradients are present. Thus, dedicated non-invasive optical diagnostic techniques are needed. The Ph.D. candidate will develop and employ optical diagnostic methods to investigate such a complex environment. He/she will evaluate the possible strategy for quantitatively detecting atomic species. The Ph.D. candidate will realize dedicated experiments in a test bed reactor in UniTrento and at the R&D department of ASML where a production device is available. The Ph.D. student will collect and analyze data regarding the temporal and spatial evolution of transient species in the pulsed H₂/N₂ plasma under different experimental conditions to reveal the underlying relevant physical/chemical processes that lead to the formation of stable species. The development of a strategy for process optimization is foreseen.</p>
Name of the company	<p>ASML Netherlands B.V.</p> <p>De Run 6501, 5504 DR Veldhoven, The Netherlands</p>



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<p>Brief presentation of the company</p>	<p>ASML develops and manufactures lithography machines which are used to fabricate the microchips which power virtually all modern technology. ASML is the world's leading provider of such systems for the semiconductor industry with more than 28,000 employees, offices and customers in the Netherlands and around the world, and more than \$13bn in annual revenue. The extremely complex machines ASML develops are continually evolving and improving to keep up with the increased demands from the semiconductor industry. Light is the central tool used in our products, from the photolithography process itself to precision metrology and characterization devices. In collaboration with its partners, i.e. universities, institutes and other companies (all national and international), ASML has initiated activities to enhance the understanding of the (plasma-) processes induced by the interaction of the EUV light with the gas inside their machines. These activities are both experimental and computational.</p>
<p>Research activities to be carried out during the period spent in the company</p>	<p>The Ph.D. candidate will design and develop state-of-the-art optical diagnostic techniques to diagnose a transient non-thermal plasma generated inside a lithographic device. The Ph.D. candidate will investigate the production of atomic species (H and N) and evaluate the influence of process parameters in producing stable products (NH₃, N₂H₄, etc.). He/she will investigate the main physical and chemical processes responsible for producing stable species in the plasma. He/she will propose strategies to limit the degradation of mirrors present in the vacuum chamber where the plasma is produced.</p>
<p>Period spent in the company</p>	<p>At least 12 months.</p>
<p>Research activities to be carried out abroad</p>	<p>The Ph.D. candidate will have the opportunity to carry out his/her research activity at the R&D department of ASML in Veldhoven, Netherlands.</p>
<p>Period spent abroad</p>	<p>At least 12 months.</p>
<p>Name of the host institution abroad</p>	<p>ASML Netherlands B.V. De Run 6501, 5504 DR Veldhoven, The Netherlands</p>



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Doctoral Programme in PHYSICS

Proposed research/Scholarship title	Gravitational reference sensors for LISA
Scientific contact person	Prof. William Joseph Weber ;prof. Rita Dolesi
Brief description of the proposed research	<p>The doctoral student will, in collaboration with the GRS team at UTN and in OHB, elaborate a comprehensive verification strategy for the charge management in the LISA GRS, to be implemented in the laboratories of OHB and UTN in the time frame of the GRS “engineering model” campaigns. Specific test campaigns will include the integrated GRS test mass and electrode housing, to be tested with torsion pendulum measurements at UTN. The research will also include development of the test techniques under OHB responsibility, including early testing of photoelectric emission at sample level and/or femtoAmpere electrometry tests to be performed in the final “end to end” GRS, experimenting with the parameters of the surface preparation and handling. The results will be integrated with the discharge models being developed for the LISA GRS, which will be also be used in the analysis of the results.</p>
Name of the company	OHB Italia S.p.A.
Brief presentation of the company	<p>OHB Italia S.p.A. is part of the European Space and Technology Group OHB SE (Orbitale Hochtechnologie Bremen), listed on the Frankfurt Stock Exchange.</p> <p>It is one of the three top space companies in Europe with 3.000 employees worldwide and total revenues for EUR 901 Mio. in 2020.</p> <p>OHB Italia S.p.A. was founded in 1981, nowadays In Italy it is one of the two major satellite system integrators with more than EUR 150 Mio backlog and EUR 104 Mio revenues in 2020. It is a recognized national leader in the fields of Satellite&Missions, Earth Observation, Space Situational Awareness, Electronics&Mechanisms, Scientific&Planetary Instruments, with headquarters and Clean Room facilities (730 sqm) in Milan and offices in Rome and Benevento. OHB Italia S.p.A. provides innovative solutions combined with development / integration of complex equipment and a strong focus on customer satisfaction. The company employs 210 people between staff and collaborators, with a high percentage of graduates (78,5%) whose degrees are mainly in Aerospace Engineering, Math, Physics, Electronic Engineering and IT.</p> <p>OHB Italia S.p.A. is Prime Contractor for important missions of Italian Space Agency (ASI) and European Space Agency (ESA), which are the main customers together with Research Institutes, Universities and all the industrial key players in the space market, with special attention to export domain.</p>



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Research activities to be carried out during the period spent in the company	The activity in OHB will be concentrated on preparing the sample and “end-to-end” discharge tests, as well as integrating the results Trento “engineering model” test campaign into the overall GRS discharge verification plan and reporting.
Period spent in the company	6 months (likely spread across 2-3 separate periods)
Research activities to be carried out abroad	The University of Florida group is part of the GRS hardware team, supplying, under NASA contract, the GRS “charge management device”, the avionics unit that supplied UV LED light for the photoelectric discharge of the LISA test masses. The doctoral student will collaborate with the Florida group on characterization of the CMD and training for its use in Italy (as part of the engineering model test campaign). Additionally, the student will collaborate on joint testing strategies, involving the UF torsion pendulum and prototype GRS hardware.
Period spent abroad	6 months (ideally between 2nd/3rd year of study)
Name of the host institution abroad	University of Florida (informal agreement)



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Doctoral Programme in CIVIL, ENVIRONMENTAL AND MECHANICAL ENGINEERING

Proposed research/Scholarship title	<p>Decision Support System based on data fusion of satellite and terrestrial monitoring data</p> <p>Sistema di Supporto alle Decisioni basato su data fusion di dati di monitoraggio satellitare e terrestre</p>
Scientific contact person	Prof. Daniele Zonta
Brief description of the proposed research	<ul style="list-style-type: none"> - Stato dell'arte dell'interferometria satellitare, delle reti Bayesiane, dei sistemi di supporto alle decisioni e di early warning. - Uso dell'interferometria satellitare DInSAR e dei dati COSMO-SkyMed, TerraSAR-X e Iceye per ottenere informazioni sul comportamento dei ponti. Data fusion con misure acquisite attraverso monitoraggio terrestre con sensori a contatto. - Sviluppo di una rete Bayesiana per estendere le informazioni acquisite da pochi ponti a un intero stock e valutarne il rischio. - Sviluppo di un sistema di supporto alle decisioni e di allerta precoce (early warning) che identifichi in tempo reale il comportamento anomalo dei ponti e ne definisca la gestione ottimale. - Validazione dei risultati mediante applicazione a casi di studio.
Name of the company	Nplus s.r.l.
Brief presentation of the company	<p>Nplus è una PMI innovativa con sede presso il Polo della Meccatronica di Rovereto (TN). L'azienda è specializzata nello sviluppo di tecnologie hardware e software per il monitoraggio strutturale permanente. In particolare, i progetti di R&D si concentrano nelle seguenti aree:</p> <ol style="list-style-type: none"> 1) nuovo hardware e sensori per sistemi di misura 2) strumenti di analisi dei dati e diagnostica strutturale 3) creazione di piattaforme di asset management che incrocino i dati derivanti dalle ispezioni strutturali, dai sistemi di monitoraggio permanente, da sistemi inSAR per analisi storiche e dei rischi idrogeologici. <p>L'azienda include competenze trasversali nelle seguenti discipline ingegneristiche: civile, elettronica, informatica, delle telecomunicazioni, meccatronica.</p> <p>Nplus è titolare di 2 brevetti e 1 modello d'uso per tecnologie per il monitoraggio strutturale dell'infrastruttura civile, che sono funzionali all'esecuzione del progetto.</p>
Research activities to be carried out during the period spent in the company	<ul style="list-style-type: none"> - Analisi dei requisiti industriali per lo sviluppo del Sistema di Supporto alle Decisioni per Manutenzioni, Riparazione e Sostituzione dei ponti. - Specifiche per l'integrazione con i dispositivi terrestri sviluppati da Nplus. - Sviluppo della metodologia generale <p>applicazione a casi studio di operatori di infrastruttura, indicativamente: Autovie Venete BMS; Comune di Verona BMS;</p> <ul style="list-style-type: none"> - Applicazione a casi studio, indicativamente: Viadotto Montevideo PAT; Ponte Casalmaggiore; Sovrappasso Autostradale di Dolo CAV. Per ciascuno, analisi dei requisiti, sviluppo degli algoritmi, per analisi dei data e decisione. - Sulla base delle applicazioni, definizione delle specifiche di un Sistema di Supporto alle Decisione generale.



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	- Sfruttamento delle Proprietà Intellettuale, disseminazione.
Period spent in the company	18 mesi
Research activities to be carried out abroad	<ul style="list-style-type: none">- Analisi dei requisiti in collaborazione con il Centre for Intelligent Infrastructure della University of Strathclyde, Glasgow (Prof. Edoardo Patelli, Prof. Enrico Tubaldi)- Applicazione a casi studio della Scozia del Sud-Ovest con particolare riferimento al problema della gestione dei ponti suscettibili a scalzamento attraverso l'uso congiunto dei dati satellitari e delle misure di monitoraggio in sito.- Analisi dei requisiti per lo sviluppo di un sistema di supporto alle decisioni basato sul monitoraggio in collaborazione con i principali operatori di infrastruttura di trasporto dello UK: Transport Scotland, Highway England, Network Rail.
Period spent abroad	6 mesi
Name of the host institution abroad	University of Strathclyde, Glasgow, UK



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Doctoral Programme in CIVIL, ENVIRONMENTAL AND MECHANICAL ENGINEERING

Proposed research/Scholarship title	Metamaterials for Seismic Isolation Metamateriali per ingegneria sismica
Scientific contact person	Prof. Nicola Pugno
Brief description of the proposed research	In particular, numerical simulations and modelling for the design of metamaterials will be performed. Metamaterials will also be realized, e.g. with 3D printing or other techniques, and characterized with dynamic experiments, e.g. laser vibrometer. The focus will be the scaling up of seismic shielding but also of other phenomena such as sound attenuation thanks to this emerging field of elastic metamaterials. The phd will be in synergy with the FET open project Boheme on Bioinspired hierarchical metamaterials that we are coordinating.
Name of the company	Phononic Vibes srl
Brief presentation of the company	www.phononicvibes.com Spinoff del Politecnico di Milano Attiva dal 2018 nella progettazione, brevettazione, produzione e commercializzazione dei metamateriali
Research activities to be carried out during the period spent in the company	Design e testing di metamateriali per ingegneria sismica
Period spent in the company	Minimo 6, massimo 18 mesi
Research activities to be carried out abroad	Quando previsto dal bando
Period spent abroad	Minimo 6, massimo 18 mesi
Name of the host institution abroad	Da definire



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Doctoral Programme in CIVIL, ENVIRONMENTAL AND MECHANICAL ENGINEERING

Proposed research/Scholarship title	Friction design through composite materials on rough surfaces
Scientific contact person	Prof. Nicola Pugno
Brief description of the proposed research	Design, characterization, and numerical modeling of friction properties of composite materials on rough surfaces. Numerical evaluation of ideal morphologies, laboratory preparation of model materials, micromechanical characterization (AFM tapping mode, etc ...), friction and rolling resistance tests.
Name of the company	Pirelli Tyre S.p.A.,
Brief presentation of the company	Pirelli Tyre S.p.A. is an international company, among the leaders of tyre manufacturing. Pirelli boasts over 2,100 people engaged in R&D, located at its Milan headquarters and 12 local technology centres, and a portfolio of more than 6,700 patents. Pirelli has also established a series of R&D collaborations and Joint Development Agreements with external players such as suppliers, universities and car manufacturers. It has 50 collaboration projects with Universities, more than 20 Joint Development Agreements and collaborations with suppliers and a huge number of R&D collaborations with Premium car manufacturers in innovative technologies.
Research activities to be carried out during the period spent in the company	Creation of model compounds, micromechanical characterization, friction and rolling resistance tests.
Period spent in the company	6 months
Research activities to be carried out abroad	Integration of recycled rubber in new tyre matrix by domain design (cryo-milled recycled rubber, with appropriate domains size, distribution and mechanical coupling)
Period spent abroad	6 months
Name of the host institution abroad	Fakultät Kunststofftechnik und Vermessung, Wuertzburg University



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Doctoral Programme in INFORMATION ENGINEERING AND COMPUTER SCIENCE

Proposed research/Scholarship title	Digital Twins for Sustainable and Smart Cities
Scientific contact person	Prof. Elisa Ricci
Brief description of the proposed research	<p>Main duties of the intended Ph.D. activity include (but are not limited to):</p> <ul style="list-style-type: none"> - maturing a comprehensive knowledge of currently existing state-of-the-art approaches adopted for implementing the different components of DT solutions, with particular focus to those targeting urban environments; - implementing novel approaches for photorealistic 3D reconstruction from multi-source data leveraging recent advances in the field; - developing VR/AR applications supporting an immersive and functional interaction with the modelled/physical environment and enabling a simple and fast exploitation of all information accessible from the UDT database; - developing effective solutions for querying the different information layers populating the UDT; - integrating different predictive models enabling the simulation of 'what-if' scenarios.
Name of the company	MindEarth Rue du Manège, 5 Biel/Bienne – 2502 Switzerland
Brief presentation of the company	<p>MindEarth is a consultancy and applied research company based in Switzerland operating in the fields of advanced spatial analytics merging remote sensing, high frequency mobility data analysis and spatial data gathered from crowd street view technology. It was founded in 2018 by a group of scientists with the mission of tackling contemporary societal problems through cutting-edge technological innovation. Currently, MindEarth's team includes experts in computer science, Earth observation, environmental and telecommunication engineering, robotics and urban planning. MindEarth collaborates with world-leading international institutions, such as the World Bank, the European Space Agency, the International Committee of the Red Cross, United Nations and the German Aerospace Center (DLR).</p>
Research activities to be carried out during the period spent in the company	<p>MindEarth is currently completing (in collaboration with DLR) a project funded by the European Space Agency (ESA) for the development of a Digital Twin Urban Pilot targeting an area of 83K ha in the region of the Roman Castles (Italy). In particular, for 2 specific study areas (enclosing the ESA-ESRIN establishment and the Frascati town centre), fully textured, explorable, georeferenced 3D models have been derived from in-situ UAV and street-view panoramic imagery. Here, a number of information layers have been generated to populate the DT including: Sentinel-based products (i.e., monthly median S3 day/night LST, S5P tropospheric NO2 concentration, S1-based subsidence deformation rates), census units, building footprints and height, road network, points of interest, built environment indicators, terrain topography, in situ weather and air quality measurements, hydrogeologic hazard maps, transportation indicators (+timetables), mobility indicators</p>



	<p>(generated out of High-Frequency Location-Based data for the year 2020) and real estate information. A modern and responsive web platform has been designed based on Cesium that enables fast, high quality and data efficient rendering of 3D content, as well as to gather and effectively display the information from all available layers. Concurrently, two mobile applications have been designed for Android platforms: i) a VR app, providing the very same structure and functionalities of the web platform, tailored to smartphones and tablets; ii) an AR app, providing to the final user an immersive interaction with the surrounding environment through the camera of the mobile display. MindEarth has large experience in designing and prototyping custom hardware for street-level photographic surveys. Indeed, it developed an in-house backpack powered by an SBC (a Raspberry Pi 4B) able to collect photospheres with 15MP resolution at 1 FPS frequency. The device is equipped with an LTE 4G modem and a dedicated, high-precision GPS unit. Also, it runs a fully customized GNU-Linux distribution mounted on an encrypted drive, where the collected data are securely transmitted via a Software Defined Network to the company's cloud infrastructure. The device also allows performing an advanced blurring of faces/plates as they are collected. Nine copies of the backpack have been deployed throughout the years, and they have been continuously improved from a software and a hardware point of view. At the time of writing, the backpacks collected more than 4TB of pictures in very different settings:</p> <ul style="list-style-type: none"> - In 2022, MindEarth launched an extensive street-view survey in the city centre of Milan. This survey covers more than 1200 km of streets to be performed in about two months; - In 2020, MindEarth collected street-view imagery in 9 Italian cities that fed the AI models of the Strolling Cities installation, shown at the Biennale di Venezia; - In 2019, MindEarth performed a detailed street-level photographic survey in Brazzaville and Pointe-Noire (Republic of Congo). The survey, commissioned by the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR), has been performed by a crowd of local workers that have been instructed and trained by the MindEarth personnel.
Period spent in the company	6 months
Research activities to be carried out abroad	As described earlier.
Period spent abroad	6 months
Name of the host institution abroad	<p>MindEarth is based in Biel/Bienne in the canton of Bern, Switzerland therefore the required period to be carried out abroad will correspond with the permanence of the doctoral student in the enterprise. For the duration of his/her stay at the company, the candidate will be hosted at our offices in Biel/Bienne to conduct his/her own research and support MindEarth's activities, in close contact with our team of data scientists and developers and having full access to MindEarth's equipment.</p>



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Doctoral Programme in INFORMATION ENGINEERING AND COMPUTER SCIENCE

Proposed research/Scholarship title	Computer Vision approaches targeting urban dynamical features under time-varying conditions
Scientific contact person	Prof. Nicu Sebe
Brief description of the proposed research	<p>Main duties of the intended Ph.D. activity include (but are not limited to):</p> <ul style="list-style-type: none"> - Gaining an extensive knowledge of novel research trends in the CV field to be potentially transferred to MindEarth's Research and Development team; - Developing a comprehensive understanding of the complete cycle of real-life CV problems, from original use-case technical formalisation through solution proposal recommendation, optimal dataset definition, time development management, continuous trade-offs comparison, and final quality assessment; - Developing incremental learning solutions to improve resource efficiency when addressing classification problems, which allow to avoid retraining from scratch when new data arrive and the need to consider the presence of new information classes; - Supporting the redesign of existing CV routines already created and in use by MindEarth for offline processing, in order to meet new real-time and on-the-edge usage requirements.
Name of the company	MindEarth Rue du Manège, 5 Biel/Bienne – 2502 Switzerland
Brief presentation of the company	<p>MindEarth is a consultancy and applied research company based in Switzerland operating in the fields of advanced spatial analytics merging remote sensing, high-frequency mobility data analysis and spatial data gathered from crowd street view technology. It was founded in 2018 by a group of scientists with the mission of tackling contemporary societal problems through cutting-edge technological innovation. Currently, MindEarth's team includes experts in computer science, Earth observation, environmental and telecommunication engineering, robotics and urban planning. MindEarth collaborates with world-leading international institutions, such as the World Bank, the European Space Agency, the International Committee of the Red Cross, the United Nations and the German Aerospace Center (DLR).</p>
Research activities to be carried out during the period spent in the company	<p>MindEarth is currently completing (in collaboration with DLR) a project funded by the European Space Agency (ESA) for the development of a Digital Twin Urban Pilot targeting an area of 83K ha in the region of the Roman Castles (Italy). In particular, for 2 specific study areas (enclosing the ESA-ESRIN establishment and the Frascati town centre), fully textured, explorable, georeferenced 3D models have been derived from in-situ UAV and street-view panoramic imagery. Here, a number of information layers have been generated to populate the DT including: Sentinel-based products (i.e., monthly median S3 day/night LST, S5P tropospheric NO2 concentration, S1-based subsidence deformation rates), census units, building footprints and height, road network, points of interest, built environment indicators, terrain topography, in situ weather and air quality measurements, hydrogeologic hazard</p>



	<p>maps, transportation indicators (+timetables), mobility indicators (generated out of High-Frequency Location-Based data for the year 2020) and real estate information. A modern and responsive web platform has been designed based on Cesium that enables fast, high quality and data efficient rendering of 3D content, as well as to gather and effectively display the information from all available layers. Concurrently, two mobile applications have been designed for Android platforms: i) a VR app, providing the very same structure and functionalities of the web platform, tailored to smartphones and tablets; ii) an AR app, providing to the final user an immersive interaction with the surrounding environment through the camera of the mobile display. MindEarth has large experience in designing and prototyping custom hardware for street-level photographic surveys. Indeed, it developed an in-house backpack powered by an SBC (a Raspberry Pi 4B) able to collect photospheres with 15MP resolution at 1 FPS frequency. The device is equipped with an LTE 4G modem and a dedicated, high-precision GPS unit. Also, it runs a fully customized GNU-Linux distribution mounted on an encrypted drive, where the collected data are securely transmitted via a Software Defined Network to the company's cloud infrastructure. The device also allows performing an advanced blurring of faces/plates as they are collected. Nine copies of the backpack have been deployed throughout the years, and they have been continuously improved from a software and a hardware point of view. At the time of writing, the backpacks collected more than 4TB of pictures in very different settings:</p> <ul style="list-style-type: none"> - In 2022, MindEarth launched an extensive street-view survey in the city centre of Milan. This survey covers more than 1200 km of streets to be performed in about two months; - In 2020, MindEarth collected street-view imagery in 9 Italian cities that fed the AI models of the Strolling Cities installation, shown at the Biennale di Venezia; - In 2019, MindEarth performed a detailed street-level photographic survey in Brazzaville and Pointe-Noire (Republic of Congo). The survey, commissioned by the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR), has been performed by a crowd of local workers that have been instructed and trained by the MindEarth personnel.
Period spent in the company	6 months
Research activities to be carried out abroad	As described above.
Period spent abroad	6 months
Name of the host institution abroad	<p>MindEarth is based in Biel/Bienne in the canton of Bern, Switzerland therefore the required period to be carried out abroad will correspond with the permanence of the doctoral student in the enterprise. For the duration of his/her stay at the company, the candidate will be hosted at our offices in Biel/Bienne to conduct his/her own research and support MindEarth's activities, in close contact with our team of data scientists and developers and having full access to MindEarth's equipment.</p>



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Doctoral Programme in INFORMATION ENGINEERING AND COMPUTER SCIENCE

Proposed research/Scholarship title	Interactive Neural Photomontage
Scientific contact person	Prof. Nicu Sebe
Brief description of the proposed research	<p>The objective of project is to research and develop an interactive neural photomontage solution. The project will start with dataset collection to solve the task and followed by research and development of a solution to generate an image from given image set and text description. Expected results is that user can select a set of images and give a text description and system should generate diverse collage outputs. If time permits, this system can be extended to videos.</p> <p>The project will involve in depth understanding of generation and manipulation using vision-text models, dataset collection, self supervised learning and image retrieval. In later stages the student would also learn to design an efficient system to make the solution real time and interactive</p>
Name of the company	Picsart Inc.
Brief presentation of the company	Picsart is a technology-driven company that develops online photo and video editing applications, with a social creative community. The company is currently carrying out research in many CV fields such as classification / detection / segmentation / generation / etc.
Research activities to be carried out during the period spent in the company	Picsart's major focus is machine learning based computer vision that towards practical photo and video editing solutions. Inclusive topics in CV such as classification / detection / segmentation / generation are in the scope of research.
Period spent in the company	6 months
Research activities to be carried out abroad	As described above.
Period spent abroad	6 months
Name of the host institution abroad	Picsart is a global company with many sites in US, Armenia, India, etc. The exact location within the company will be determined according to the interest of the candidate and the intermediate results obtained.



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Doctoral Programme in INFORMATION ENGINEERING AND COMPUTER SCIENCE

Proposed research/Scholarship title	Modifiable Neural Radiance Light Field
Scientific contact person	Prof. Nicu Sebe
Brief description of the proposed research	<p>Neural Radiance Field (NeRF) is a raising technique in 3D that incorporate deep implicit models with the ray aggregation algorithm. Yet the current NeRF technique largely promotes overfitting one model for one scene, which will be a waste of digital storage in applications. Thus modifiable NeRF serving general-purpose could with great value in both research and commercial. Exciting works dedicated to this direction developed morphable NeRF models for video objects, stylized scenes, etc. Our project tackles a more advanced 3D related topic: a modifiable NeRF simulating various lighting conditions in the scene. Our ultimate goal is to train a reuseable light field for all nature scenes and thus compress the storage needed by NeRF techniques in applications.</p> <p>The PhD student will need to comprehensively understand the related CV knowledge such as machine learning principles, deep learning techniques, 3D rendering algorithms, etc. The PhD student should also expand his/her ability in exploring new research ideas in this field as well as carried out individual studies throughoutly during his/her degree.</p>
Name of the company	Picsart Inc.
Brief presentation of the company	Picsart is a technology-driven company that develops online photo and video editing applications, with a social creative community. The company is currently carrying out research in many CV fields such as classification / detection / segmentation / generation / etc.
Research activities to be carried out during the period spent in the company	Picsart's major focus is machine learning based computer vision that towards practical photo and video editing solutions. Inclusive topics in CV such as classification / detection / segmentation / generation are in the scope of research.
Period spent in the company	6 months
Research activities to be carried out abroad	As described above.
Period spent abroad	6 months
Name of the host istitution abroad	Picsart is a global company with many sites in US, Armenia, India, etc. The exact location within the company will be determined according to the interest of the candidate and the intermediate results obtained.



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	AI and computer vision for improved laser-based manufacturing
Scientific contact person	Prof. Nicola Conci
Brief description of the proposed research	<p>The proposed research project aims at the development of new systems and new strategies that can be introduced in the field of laser-based manufacturing processes to guide the manufacturing process, to enhance its performance and to increase the current level of automation. Within the relatively wide range of laser-based manufacturing processes and industrial systems, the project focuses on systems for laser cutting and/or laser welding of both tubes and metal sheets.</p> <p>The Ph.D candidate will have the opportunity to get acquainted with the most recent technologies and algorithms in the state of the art, having access to relevant journals and conference proceedings. From a methodological viewpoint the research will focus on the study of machine/deep learning solutions with the target of ensuring, scalability, replicability, and customization properties. In addition, the study of tiny machine learning solutions will be envisaged, especially for anomaly detection, to be applied at different stage of the production pipeline.</p>
Name of the company	Adige S.P.A., BLMGROUP - Levico Terme (TN), Italy
Brief presentation of the company	<p>In the past years the company investigated similar research questions both with internal and external research projects.</p> <p>The main projects and partnerships are briefly listed below. Adige - BLMGroup is a member of the Cluster Fabbrica Intelligente, and won a grant of MIUR called "Sustainable Manufacturing" in 2012, in consortium with other 42 entities, including industries, universities and RTOs.</p> <p>Adige - BLMGroup is one of the founding Member of SMACT, National Competence Center for Industry 4.0. The machines of BLMGroup are the core assets of the Live Demo of SMACT in Rovereto, hosted at the Polo della Meccatronica.</p> <p>Adige applied to a national Grant for Innovation projects in manufacturing in 2019, the name of the project is EMMA.</p> <p>Adige is member of the European Factories of the Future Research Association, EFFRA, and Photonics21 (the european PPP in photonics)</p> <p>Adige regularly applies for public funding grants on a regional basis, under the framework called "D.LSG 06/99" Considering the patents inherent with the proposed project, Adige owns the patent family of US10994372B2 concerning an opto-mechanical system able to reconstruct the real shape of tubes based on computer vision technology. This technology is nowadays part of our machines and it represents one of the most important devices that allow us to increase the accuracy of the manufactured parts. This device is continuously improved via internal research projects.</p>



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Research activities to be carried out during the period spent in the company	The research activities developed during the stay of the doctoral candidate in the company will be focused in the integration of the prototypes with the machines. The systems may be integrated at different TRLs (technology readiness level) and in different automaton environments (Siemens/Beckhoff). Furthermore, the experimental part of the project concerning realistic tests and validations of the proposed solutions will be conducted in the company.
Period spent in the company	The candidate will stay in the company for about 12 months. This period can be discontinuous.
Research activities to be carried out abroad	The research period abroad and the associated activities will be evaluated as soon as a clear research direction will be defined. At the current stage of the proposal, among the potential destinations, several institutions in Germany (e.g. TUM) and Sweden (KTH) deal with similar topics, as well as many other universities across Europe.
Period spent abroad	6 months
Name of the host institution abroad	To be defined.



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Innovative laser and mechanical machining techniques for advanced structural applications
Scientific contact person	Prof. Oreste S. Bursi, Prof. Gabriele Zanon
Brief description of the proposed research	<p>The research focuses are both the study and the optimization of innovative laser cutting and mechanical machining techniques for structural and automotive application.</p> <p>The Phd student activity will focus on the study of the effects due to the innovative laser and mechanical machining techniques. In this context the main principles of investigated techniques together with the structural response, taking into account material metallurgical aspects, will be the core of the training activity. Experimental and numerical activities will be carried out, involving the application of the machine learning.</p>
Name of the company	Adige SYS S.P.A., BLMGROUP - Levico Terme (TN), Italy
Brief presentation of the company	<p>The research activity at the company will be mainly focused on the study of the innovative laser and mechanical machining techniques applied to structural application. This part will be carried out in parallel with an experimental part finalized to study the effects of these techniques on the structural response.</p> <p>In the past years the company investigated similar research issues both with internal and external research projects. The main projects and partnerships are briefly listed below.</p> <p>RFCS EU Projects (2016-2019) Project name: LASTEICON - "Laser Technology for innovative Constructions" Project number: 709807 (2016)</p> <p>Project description: LASTEICON project aims to eliminate the use of excessive amount of stiffener plates and welding in steel joints, using laser cutting technology (LCT). The project will notably enhance the economy and sustainability of the fabrication as well as the aesthetic of any type of steel joints. Major focus is given to I-beam-to-CHS-column connections to promote hollow sections, since their excellent structural properties combined with their aesthetic appeal will lead decision makers (architects, building owners) to use more steel products in the building construction sector. Extendibility of the solution to other construction applications will be investigated with reference to steel truss girders.</p> <p>RFCS EU Projects (2021-2024) Project name: LASTTS – "LASer cutting Technology for Tubular Structures" Project number: 101034038 (2021)</p> <p>Project description: The previous EU-RFCS LASTEICON 709807 project showed that joint configurations fabricated using laser cutting technology (LCT) were superior in terms of resistance and stiffness from the tubular joint options obtained by conventional manufacturing techniques (directly welded, through diaphragm, external diaphragm and open section). This superior performance</p>



	<p>also resulted in a major potential of lowering the fabrications costs and environmental impact in both low and high seismicity regions. In the conclusion of the previous LASTEICON project, it was mentioned that, to achieve an increased readiness levels for market penetration, some topics needed further studies such as experimental performance of the joints related to the low cycle fatigue, experimental fire performance, more challenging architectural geometries, rectangular hollow sections, vertical splicing of columns, capacity under compression, frame corner nodes, local behavior around the welded joints, further automatization and robotization as well as minimization of welding in the joints. In the LASTTS project, tubular structures are going to be designed using LCT joints with different configurations their key components will be tested, and parametric analyses will be performed at local and global levels. With this large database of research, design guidelines and worked examples will be produced and disseminated for a major market penetration of innovative steel tubular applications into the EU construction sector. The final impact will be to let engineers and architects to exploit the outstanding structural and architectural properties of steel hollow sections in the future building projects.</p> <p>BLMGroup is a member of the Cluster Fabbrica Intelligente, and won a grant of MIUR called “Sustainable Manufacturing” in 2012, in consortium with other 42 entities, including industries, universities and RTOs. BLMGroup is one of the founding Member of SMACT, National Competence Center for Industry 4.0. The machines of BLMGroup are the core assets of the Live Demo of SMACT in Rovereto, hosted at the Polo della Meccatronica.</p> <p>BLMGroup is member of the European Factories of the Future Research Association, EFFRA, and Photonics21 (the european PPP in photonics)</p>
<p>Research activities to be carried out during the period spent in the company</p>	<p>The research activities developed during the student's stay in the company represent an important part of the project. In fact, we want to give a very applicative aspect to the research. For this, a very substantial experimental phase on industrial machines is necessary.</p> <p>Furthermore, the experimental part of the project concerning realistic tests and validations of the proposed solutions will be conducted in the company.</p>
<p>Period spent in the company</p>	<p>18 months</p>
<p>Research activities to be carried out abroad</p>	<p>Part of the numerical activities, surrogate modelling and/or machine learning can be carried out in specialized centers agreed with BLM, e.g. ETH Zurich, etc.</p>
<p>Period spent abroad</p>	<p>6 months</p>
<p>Name of the host istitution abroad</p>	<p>ETH Zürich Department of Civil, Environmental. and Geomatic Engineering</p>



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	AI and automated techniques for security assessments, in the context of safety-critical systems
Scientific contact person	Prof. Fabio Massacci
Brief description of the proposed research	<p>Objective: Leverage the opportunity of existing system models and design/code artefacts to improve the level of automation in assessing systems risks and their impacts. Speedup dependencies and root-cause analysis, to identify the impacted parts of the design/code (if any) and support fixes. Explore applications of Artificial Intelligence / Automated Reasoning to continuously assess risks, support prioritization according to the impact, and provide explanations that can speedup human expert review. Facilitate link between high-level security and safety requirements, identified threats, and code – to reduce design/code patching time and reduce re-certification efforts</p> <p>The candidate will investigate novel techniques for safety and security risk assessment with support of advanced artificial intelligence algorithms.</p>
Name of the company	Advanced Laboratory on Embedded Systems S.r.l. (ALES) A part of Collins Aerospace - 00185 Rome, Italy
Brief presentation of the company	For almost a century, Collins Aerospace has operated in Italy, serving aerospace customers in-country and worldwide. Its broad range of capabilities includes design, development, manufacturing and aftermarket support. The company helps move the aerospace and defense industry forward with a strong commitment to advancing technologies and maintaining close, collaborative customer relationships.
Research activities to be carried out during the period spent in the company	<p>Safety (challenged by unintentional/non-malicious threats) and Security (challenged by intentional attackers) have been traditionally addressed by separate communities in both academia and industry. As a result, Safety and Security issues have been assessed and mitigated separately, with limited analysis of mutual constraints and potential benefits. Not only methodologies and standards are different, but mitigation measures may also be conflicting. In very recent years, we have seen a transformation in the Safety and Security communities starting to work together for a more efficient risk management (e.g. in the Automotive and Energy sectors). Even if established Safety or Security standards have been defined also in the Civil Aviation sector, a unified method for Safety and Security assessment still needs to be consolidated. In the civil aviation domain, safety is the most important aspect for airworthiness, but also cybersecurity is becoming extremely relevant.</p> <p>For example, DO-326A:2014 describes a process where functional, safety and security design processes are conducted in parallel, with mutual interaction, influenced by safety and security risk assessment methods. Moreover, DO-356A:2018 describes methods and considerations for DO-326A implementation. However, we are far from having an effective method that will allow</p>



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	<p>evaluating jointly safety and security effects on the overall aircraft behavior.</p> <p>The principal challenge to be addressed is to provide automated and AI-enabled advanced approaches for joint safety and cybersecurity risks evaluations that capture safety and cybersecurity aspects in a single reasoning framework which can be subject to (potentially automated or tool supported) evaluation. The second challenge is to define how to relate security incidents affecting safety and safety-effects affecting cybersecurity measures. The third challenge is to establish a risk metrics that can include safety and cybersecurity events into a unique system/aircraft-level risk evaluation.</p> <p>ALES / Collins ART Italy has a long-standing experience of safety-critical aerospace systems design also considering regulations and certification requirements. In the specific domain of cybersecurity risk assessments, ALES / Collins ART Italy has developed a DO-326 compliant cybersecurity risk evaluation approach and related toolchain for automating the analyses.</p>
Period spent in the company	12 months
Research activities to be carried out abroad	To be defined with the student and the reference professor
Period spent abroad	6 months
Name of the host institution abroad	Either in a Collins site in EU / US or in a third-party university – to be decided with the student and the reference professor



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Validation and Verification of Machine Learning Models
Scientific contact person	Prof. Andrea Passerini Prof. Marco Roveri Prof. Roberto Sebastiani
Brief description of the proposed research	<p>The goal of this research project is to define an analytical approach to demonstrate that an ML model whose inputs are specified according to some probability distribution complies with functional and non-functional specifications above a given probability threshold. This demonstration shall provide the means of compliance for critical learning assurance objectives defined by EASA (e.g., LM10-12). The desired outcome consists of an analysis method supported by a proof-of-concept toolchain whose applicability and scalability shall be demonstrated on an industrial avionics' use case.</p> <p>Recent advancements in the techniques based on weighted model integration represent an interesting framework for hybrid probabilistic inference enabling the opportunity of leveraging formal verification techniques for the assessment of compliance of ML models with functional and non-functional specifications and properties.</p> <p>The candidate will investigate the applicability of advanced hybrid probabilistic inference techniques to the problem of probabilistic formal verification of ML models. S/he will study how Weighted Model Integration strategies can be improved to deal with the task, particularly in terms of scalability and approximations with guarantees, and develop a prototypical probabilistic formal verification tool for a use case in industrial avionics.</p>
Name of the company	Advanced Laboratory on Embedded Systems S.r.l. (ALES) A part of Collins Aerospace - 00185 Rome, Italy
Brief presentation of the company	Advanced Laboratory on Embedded Systems (ALES) SRL is a company of Collins Aerospace (https://www.collinsaerospace.com/), specialized in model-based technologies and methodologies for the design and verification of distributed safety-critical embedded systems. ALES SRL has developed and matured several methods for validation and verification (V&V) of models leveraging both formal methods as well as simulation-based approaches both in the context of internally sponsored research and development projects as well as EU sponsored projects.



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<p>Research activities to be carried out during the period spent in the company</p>	<p>In the context of the FP7 program, specifically in the DANSE [1] and MBAT [2] EU projects, ALES SRL has matured the Formal Specs Verifier framework for the V&V of Simulink/Stateflow models capturing embedded avionics software control algorithms with respect to functional and non-functional specifications. In the context of CleanSky2 program, specifically in the MISSION EU project, ALES SRL has matured a methodology for V&V of models of communication and computational platforms with respect to functional, temporal, and performance specifications. Furthermore, in the MISSION EU project, ALES SRL has contributed to the development of methods for V&V of avionic system architecture models with respect to non-functional specifications.</p> <p>[1] Designing for Adaptability and evolution in System of systems Engineering (DANSE) - https://cordis.europa.eu/project/id/287716</p> <p>[2] Combined Model-based Analysis and Testing of Embedded Systems (MBAT) - https://cordis.europa.eu/project/id/269335</p> <p>[3] Modelling and Simulation Tools for Systems Integration on Aircraft (MISSION)</p>
<p>Period spent in the company</p>	<p>12 months</p>
<p>Research activities to be carried out abroad</p>	<p>Research activity on theoretical aspects of probabilistic formal verification of machine learning models and potential applications in the automotive industry, under the supervision of Prof. Manfred Jaeger and Prof. Kim Larsen.</p>
<p>Period spent abroad</p>	<p>6 months</p>
<p>Name of the host institution abroad</p>	<p>Aalborg University</p>



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Doctoral Programme in INDUSTRIAL INNOVATION

<p>Proposed research/Scholarship title</p>	<p>Innovative Artificial Intelligence / Machine Learning (AI/ML) solutions for smart harvesting of high value crops</p> <p>Metodi innovativi di AI / ML e infrastrutture di tracciabilità a supporto dello smart harvesting in colture ad alto reddito.</p>
<p>Scientific contact person</p>	<p>Prof. Farid Melgani Prof.ssa Ilaria Pertot</p>
<p>Brief description of the proposed research</p>	<p>Il progetto dottorale intende sviluppare nuove tecnologie di accelerazione dei processi digitali in agricoltura, per l'obiettivo industriale di riduzione dei costi di produzione e della garanzia di una filiera agrifood sostenibile. In particolare, verranno sviluppati algoritmi di deep learning per la identificazione della maturazione ottimale in colture ad alto reddito o in nuove situazioni produttive (es. coltura idroponica). Gli algoritmi verranno applicati nel contesto di una piattaforma di tracciabilità del prodotto, permettendo di guidare la selezione ottimale dei prodotti e la riduzione degli sprechi produttivi. Verranno inoltre esplorati gli aspetti di supporto agli Automated Cultivation Systems, combinando identificazione, stima fenologica e della qualità, e potenziali applicazioni a sistemi attuatori di taglio e raccolta ad alta efficacia. Saranno inoltre sviluppate le potenzialità della assimilazione diretta dei dati da AI/ML in piattaforme di tracciabilità.</p> <p>Sarà sviluppato un piano formativo transdisciplinare, con una solida base di informatica, competenze operative di ML/AI, capacità ricevere le specifiche di settore agro-alimentare nella coltivazione in serra di colture ad alto reddito, integrazione in sistemi di tracciabilità e trasparenza.</p>
<p>Name of the company</p>	<p>Antares Vision S.p.A. - 25039 Travagliato (BS)</p>
<p>Brief presentation of the company</p>	<p>Con quasi 300 dipendenti dedicati alla R&S, Antares Vision (AV) è il leader mondiale della trasparenza delle filiere e della transizione sostenibile, con un ecosistema completo di tecnologie per la qualità e la tracciabilità del prodotto lungo tutta la filiera e per la gestione integrata dei dati. Progettiamo, produciamo e installiamo soluzioni innovative con tre divisioni altamente specializzate:</p> <ul style="list-style-type: none"> - sistemi innovativi di ispezione e controllo qualità. - Tracciabilità a vita con tecnologie di Track and Trace, aggregazione e serializzazione. - Gestione intelligente dei dati, anche attraverso l'applicazione dell'intelligenza artificiale (AI).
<p>Research activities to be carried out during the period spent in the company</p>	<p>AVG collabora con numerose università e centri di ricerca; dispone di uno spazio di 150 mq all'interno del centro CSMT dell'Università di Brescia dedicato allo scouting di nuove tecnologie (7 ric. full time e attrezzature innovative); nonché un Innovation Lab (300mq) nella sede di Travagliato (BS), dedicato a svolgere prove e studi di fattibilità e sviluppo di prototipi. La R&D in AI/ML per healthcare e in agritech è inoltre il tema specifico di Orobix Life, azienda collegata di AV con esperienza internazionale in sistemi di Deep</p>



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	Learning per Imaging medico, modelli predittivi per stratificazione predittiva, e per la caratterizzazione tramite visione di difetti e fenologia in produzione vitivinicola. Sono stati completati o sono in corso due progetti MiSE di Innovazione e un progetto Horizon. Saranno rese disponibili le risorse della sede operativa di Rovereto e i laboratori tecnici del Dipartimento Innovazione AV di Travagliato.
Period spent in the company	18 mesi
Research activities to be carried out abroad	Sviluppo di soluzioni analitiche da includere in sistemi di tracciabilità e trasparenza
Period spent abroad	6 mesi, ovvero 2 periodi da 3 mesi
Name of the host institution abroad	Almeno uno dei periodi sarà svolta presso, una sede estera di Antares Vision o Antares Vision Group. Una parte della attività all'estero verrà svolta in un centro di ricerca estero identificato con docenti referenti scientifici del progetto in funzione dei risultati raggiunti.



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Doctoral Programme in INDUSTRIAL INNOVATION

<p>Proposed research/Scholarship title</p>	<p>Modeling Data Drift in Artificial Intelligence / Machine Learning (AI/ML) solutions for traceability and transparency of Digital Healthcare frameworks</p> <p>Metodi innovativi di Data e Model Drift in Intelligenza artificiale e machine learning (AI/ML) integrate in infrastrutture di tracciabilità per la salute.</p>
<p>Scientific contact person</p>	<p>Prof. Farid Melgani</p>
<p>Brief description of the proposed research</p>	<p>Lo scopo del progetto dottorale è sviluppare nuove tecnologie di accelerazione dei processi digitali in medicina, in particolare per la ricerca medica, sostenendo gli aspetti di riproducibilità e di gestione dei flussi di analisi sperimentale.</p> <p>Nel progetto, in considerazione delle problematiche di Data Drift in ambito sanitario, saranno studiati algoritmi di Data o Model Drift in generale e in riferimento a sistemi di deep learning per il migliore sfruttamento delle informazioni disponibili. Obiettivo specifico è ottenere e funzionalizzare una maggior robustezza dei sistemi che utilizzano AI/ML per automatizzare operazioni high-throughput o a supporto della valutazione clinica.</p> <p>Sarà sviluppato un piano formativo transdisciplinare, con una solida base di informatica, competenze operative di ML/AI, capacità di utilizzare ed espandere i sistemi di tracciabilità e trasparenza. Saranno inoltre sviluppate le competenze di collaborazione con ricercatori e clinici nei settori di applicazione (es. radiologia e dati di laboratorio).</p>
<p>Name of the company</p>	<p>Antares Vision S.p.A. - 25039 Travagliato (BS)</p>
<p>Brief presentation of the company</p>	<p>Con quasi 300 dipendenti dedicati alla R&S, Antares Vision (AV) è il leader mondiale della trasparenza delle filiere e della transizione sostenibile, con un ecosistema completo di tecnologie per la qualità e la tracciabilità del prodotto lungo tutta la filiera e per la gestione integrata dei dati. Progettiamo, produciamo e installiamo soluzioni innovative con tre divisioni altamente specializzate:</p> <ul style="list-style-type: none"> - sistemi innovativi di ispezione e controllo qualità. - Tracciabilità a vita con tecnologie di Track and Trace, aggregazione e serializzazione. - Gestione intelligente dei dati, anche attraverso l'applicazione dell'intelligenza artificiale (AI).
<p>Research activities to be carried out during the period spent in the company</p>	<p>AVG collabora con numerose università e centri di ricerca; dispone di uno spazio di 150 mq all'interno del centro CSMT dell'Università di Brescia dedicato allo scouting di nuove tecnologie (7 ric. full time e attrezzature innovative); nonché un Innovation Lab (300mq) nella sede di Travagliato (BS), dedicato a svolgere prove e studi di fattibilità e sviluppo di prototipi. La R&D in AI/ML per healthcare è inoltre il tema specifico di Orobix Life, azienda collegata di AV con esperienza internazionale in sistemi di Deep Learning per Imaging medico, modelli predittivi per stratificazione predittiva. In particolare, parte della attività verrà svolta in collaborazione con</p>



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	<p>Orobix Life, che ha in corso di sviluppo soluzioni basate su PyTorch e la libreria derivata TorchDrift per la identificazione di problemi di Drift da dati medici. Sono stati completati o sono in corso due progetti MiSE di Innovazione e un progetto Horizon.</p>
Period spent in the company	<p>Per permettere lo sfruttamento delle infrastrutture aziendali, il progetto prevede la permanenza del dottorando per 18 mesi presso la sede aziendale. Le tecniche di analisi sviluppate saranno testate in contesto realistico con il supporto del partner aziendale al fine di valutarne la possibile integrazione nell'ecosistema aziendale ed eventualmente estendendone l'uso anche in ambiti pertinenti, ad esempio per il supporto dei processi produttivi e di controllo qualità di dispositivi medici o farmacologici.</p>
Research activities to be carried out abroad	<p>Una parte del periodo all'estero (3 mesi dei 6 previsti) verrà svolto presso sedi estere dell'azienda al fine di permettere una migliore integrazione dell'attività di ricerca dello studente con quelle aziendali, ed una sperimentazione con sistemi reali. Inoltre, sarà esplorata la potenzialità di offrire una esperienza di internship con una azienda produttrice di farmaci interessata alla nuova metodologia sviluppata nel progetto. Una seconda parte verrà svolta presso un centro di ricerca leader mondiale nella ricerca preclinica e clinica in oncologia.</p>
Period spent abroad	<p>Almeno 6 mesi</p>
Name of the host institution abroad	<p>Wistar Institute Philadelphia</p>



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Feed conversion ratio tables modelling using deep learning and simulated data
Scientific contact person	Prof. Giovanni Iacca
Brief description of the proposed research	<p>The purpose of this research is to detect appropriate deep learning techniques to produce a predictive AI tensor-flow model over a data lake.</p> <p>Developed model must demonstrate a superior accuracy and precision compared to traditional regression analysis.</p> <p>This research refers to a digital method that can be used in freshwater and marine aquaculture for all breedable fish species.</p> <p>This research uses, as starting information, all that comes from a suitable data lake (a storage place intended for the analysis and correlation of structured and unstructured data, inserted in their original format) provided by aquacloud (that is, to date, a huge database over the last 30 years of Italian and Mediterranean farms) and provides as output a conversion table, for any specific breeding lot, refined in its conversion coefficients FCR.</p>
Name of the company	Aquacloud s.r.l. - Trento
Brief presentation of the company	Aquacloud s.r.l. is an Italian innovative startup incubated by Trentino Sviluppo. Born in May 2021, holds the industrial property right (including patent and intellectual rights) relating to Fishmakers, a software for the management of aquaculture companies.
Research activities to be carried out during the period spent in the company	Fase di test del sistema del modello di AI. Integrazione del modello all'interno della piattaforma Smart Fish.
Period spent in the company	18 mesi
Research activities to be carried out abroad	Fase di test del sistema sul campo, presso una azienda di acquacoltura estera.
Period spent abroad	6 mesi
Name of the host institution abroad	Pisciculture Marine De Malte Limited



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	3D Neural Rendering for indoor and outdoor environment reconstruction
Scientific contact person	Prof. Nicola Conci
Brief description of the proposed research	<p>The proposed research project aims to leverage the most recent developments in the area of 3D volume representation, to improve the workflow of Arcoda as far as the monitoring and maintenance of outdoor worksites is concerned. In particular, the company is interested in developing the recent neural rendering approaches, known in literature as NeRF (Neural Radiance Fields). Through NeRF models it is possible to re-create a full 3D model of a given scene starting from an arbitrary number of 2D pictures captured using off-the-shelf devices. Such representation has demonstrated to be a groundbreaking technology, as it exploits the capabilities of neural networks to embed the knowledge related to a given observed object through a set of network weights: the 3D model is no more represented as a collection of pictures or a 3D point cloud, which turn out to be demanding in terms of storage requirements as well as in terms of computational resources, in order to load and process the associated information content.</p> <p>In addition, the obtained neural model, besides being lightweight, it also allows the observation of the scene from arbitrary positions, also the ones that were not part of the training set.</p> <p>The Ph.D candidate will be required to look carefully into the state-of-the-art literature, sectioning the existing methods and evaluating the corresponding pros and cons, in order to fully understand the subject and its applicability to the context of outdoor areas. The initial results of the research, which are expected to be tangible after the end of the first year, will be submitted for publication, so as to contribute to the research community with novel methodologies, use cases, and datasets.</p>
Name of the company	Arcoda srl
Brief presentation of the company	<p>Arcoda realizza soluzioni geo-informatiche dedicate alla gestione delle operazioni sul campo, progettate per le specifiche esigenze di processo del settore delle utility. I nostri prodotti software sono pensati per essere utilizzati nella gestione di qualsiasi tipo di infrastruttura di rete (gas, elettrico, pubblica illuminazione, ciclo dell'acqua, teleriscaldamento, telecomunicazioni) e per essere facilmente integrati con i software già presenti in azienda</p>
Research activities to be carried out during the period spent in the company	<p>Arcoda is rather young company that has entered the world of research quite recently, and in particular thanks to two research projects co-funded by the Province of Trento in the framework of the LP6/99 funding mechanism. The projects, OFERA, and TRAMA, have experienced the collaboration with the University of Trento as the associated research partner, which contributed to the</p>



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	<p>study of innovative tools for the analysis and rendering of 3D data, using augmented-reality solutions</p> <p>While working in the company, the candidate will get acquainted with the workflow of Arcoda, the ongoing projects and collaborations, getting to know the customer base and its requirements, and practicing hands-on with the existing solutions, currently based on laser scanners, that Arcoda provides to the end-users for the acquisition and storage of 3D models of indoor areas. Being familiar with the applications and the associated technologies will drive the development of innovative algorithms to be integrated in future products.</p>
Period spent in the company	18 months
Research activities to be carried out abroad	<p>During the PhD program we expect that the student gets in touch with the most relevant players in the area of neural rendering. In particular, the most relevant research teams as far as this is concerned are located in the USA, Berkeley and Google in particular. The availability of these institutions in hosting the students will be evaluated.</p>
Period spent abroad	6 months
Name of the host institution abroad	Google, Berkeley.



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<p>Proposed research/Scholarship title</p>	<p>Design of a 5G network slice for Internet of Musical Things use</p> <p>Progettazione di una network slice 5G per uso in ambito Internet of Musical Things</p>
<p>Scientific contact person</p>	<p>Prof. Luca Turchet</p>
<p>Brief description of the proposed research</p>	<p>La ricerca proposta ha una natura fortemente innovativa e si prefigge di conseguire quattro obiettivi interdipendenti:</p> <ul style="list-style-type: none"> - Progettazione di una architettura di rete mobile a supporto dell'IoMusT che comprenda una 5G Music Slice; - Valutazione tecnica (quality of service, QoS) della network slice sviluppata; - Valutazione percettiva (quality of experience, QoE) della network slice sviluppata; - Valutazione costi/benefici della soluzione proposta, con particolare riferimento all'impatto in termini di riduzione dell'inquinamento atmosferico. <p>Anno 1, Semestre 1 (esame dello stato dell'arte e definizione dell'architettura):</p> <ul style="list-style-type: none"> - Studio sui requisiti percettivi dei musicisti al fine di individuare requisiti specifici per la progettazione dell'architettura di rete mobile; - Definizione dei requisiti tecnici per una IoMusT network slice; - Definizione dell'architettura di rete mobile per supportare casi d'uso di tipo IoMusT; - Valutazione di costi/benefici dell'architettura proposta. <p>Anno 1, Semestre 2 e Anno 2 (valutazione tecnica e prototipazione):</p> <ul style="list-style-type: none"> - Valutazione della 5G Music Slice progettata a livello tecnico tramite valutazioni numeriche/simulazioni; - Implementazione dell'architettura progettata su un testbed di ricerca 5G. <p>Anno 3 (valutazione percettiva):</p> <ul style="list-style-type: none"> - Integrazione del testbed di ricerca 5G con strumenti musicali abilitati all'IoMusT; - Valutazione della 5G Music Slice progettata a livello percettivo, tramite esperimenti con musicisti che suonano a distanza. <p>I risultati attesi dalla ricerca dovranno essere misurabili attraverso:</p> <ul style="list-style-type: none"> - verifica dell'istanziamento della network slice su infrastrutture virtualizzate di terze parti (standard/open-source); - raccolta di tracce di traffico scambiato tra terminali e applicazioni e viceversa attraverso la network slice sviluppata; - monitoraggio <u>prestazioni</u> a livello di rete e applicativo - conseguente verifica del soddisfacimento dei requisiti funzionali e di prestazione richiesti dal caso d'uso. - Pubblicazione di almeno 2 articoli su rivista e 2 a conferenza



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Name of the company	Athonet srl - 36050 Bolzano vicentino (VI)
Brief presentation of the company	Athonet è una PMI innovativa operante nel campo delle emergenti reti mobili private in 5G and beyond. Il dipartimento R&I affronta tematiche di ricerca industriale su diversi segmenti del mercato dove i prodotti trovano applicazione, tra cui il mercato plurivalente IoT. Si auspica la disseminazione e pubblicazione scientifica a valle dei risultati conseguiti.
Research activities to be carried out during the period spent in the company	Il dipartimento R&I affronta tematiche di ricerca industriale su diversi segmenti del mercato dove i prodotti trovano applicazione, tra cui il mercato plurivalente IoT
Period spent in the company	18 mesi
Research activities to be carried out abroad	Il candidato lavorerà sulla tematica di machine learning over wireless networks applicata ai segnali musicali, in collaborazione con un noto esperto di tale area di ricerca
Period spent abroad	6 mesi
Name of the host institution abroad	KTH Royal Institute of Technology



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Proposed research/Scholarship title	Optimal Integration of Microgrid-based EV-charging Infrastructures into Renewable Energy Communities
Scientific contact person	Prof. Vincenzo Trovato
Brief description of the proposed research	<p>The implementation of an efficient infrastructure for electrified transports and the boost to the renewable energy production are pivotal objectives of Italian and European plans to implement the energy transition. Recharging points for battery electric vehicles shall be installed on highways at least every 60 km. On the other hand, one of the measures to increment the share of renewable energy is the spreading of the Renewable Energy Communities (REC). These communities can promote distributed energy production and sustainable consumption practices. In their role of empowering consumers, RECs are expected to lead the social innovation.</p> <p>The proposed Ph.D. project acknowledges the interactions between the implementation of the EV-charging infrastructure and the deployment of the RECs. Its objective is to optimize the benefits of a REC which welcomes integrated EV-charging assets as members of the community itself, to increase projects' economic, social and environmental value. The most general version of an integrated EV-charging asset is the set of a renewable generation source (typically PV panels) and a battery storage assisting the EV charging infrastructure. The latter could be made of charging points with single- and/or bi-directional capability.</p> <p>During the Ph.D. program, the candidate will enhance his/her skills in the field of:</p> <ul style="list-style-type: none"> - multi-objective convex optimization, - mathematical-programming in Python, Julia - modelling and time-domain simulation of energy assets (e.g. in Matlab). - game-theory including mean-field games - machine learning algorithms <p>To this end, the training plan of the Ph.D. in Industrial Innovation will provide the right context and support to help the candidate develop the necessary skills. Moreover, the candidate will study different integrated EV-charging solutions and their connection to power-networks. Ultimately, he/she will gain experience</p>
Name of the company	Atlante S.r.l. - 20137 Milan, Italy
Brief presentation of the company	Born in 2005 as a technological spin-off of the Politecnico di Torino and Milano, today NHOA is a global player in Energy Storage, E-Mobility and EV Fast-charging Infrastructure. Currently, NHOA has offices in France, US and Australia, and maintains R&D in its global engineering center in Milano, production and manufacturing in its industrial plant in Valtellina.



	<p>With over 250 people from 24 nationalities and a unique team of engineers, NHOA has filed 130 patents around the world and over 1,200 industrial secrets.</p> <p>In July 2021, NHOA and Stellantis launched Atlante, the first EV Fast and Ultrafast Charging Network enabled by renewables, energy storage and 100% grid-integrated to be initially developed in Southern Europe.</p> <p>Atlante leverages on:</p> <ul style="list-style-type: none"> - specific technologies, know-how and industrial capabilities, - a full suite of e-mobility products, services and technologies, including electrified mobility service provider capabilities, and - microgrids, energy storage and grid interconnection technology, including electrical system integration, engineering, procurement, construction and project development capabilities. <p>The company has the R&D Department in its global engineering center in Milano. The R&D activities are, among others, in the field of energy management systems and grid integration of charging infrastructures integrated with battery energy storage systems and renewables in microgrid-based configurations.</p>
<p>Research activities to be carried out during the period spent in the company</p>	<p>During the placement at Atlante's Offices, the successful Ph.D. candidate will be able to leverage technical and economic data and expertise made available by Atlante.</p> <p>While carrying out the visiting experience, the candidate will be supported by technical and business resources in Atlante which will facilitate the completion of the pivotal activities described WP5. In addition, the candidate will spend valuable time at Atlante's Offices receiving techno-economic guidance especially in WP1 and WP3.</p> <p>During the six months' placement, the Ph.D. candidate is expected to attend those company's meetings which are assessed to be relevant to the Ph.D. project. He/she will also deliver presentations and organize workshops at Atlante to update on the progresses of work and receive feedback. Moreover, while at Atlante, the candidate will be able to gain technical competence by visiting the production and manufacturing industrial plants which are part of Atlante's network. In fact, an active contribution to both in academic research and to activities with the industrial partner is also a goal of this Ph.D. program. This will allow the successful Ph.D. candidate to establish a link between the academic research group and the company that will improve the knowledge transfer from the research to the industrial world.</p>
<p>Period spent in the company</p>	<p>6 months</p>
<p>Research activities to be carried out abroad</p>	<p>The candidate will refine her/his theoretical skills in convex optimization. Similarly, she/he will reach a high degree of proficiency in mathematical programming in the context of simultaneous optimization of multiple energy systems (e.g. renewable generators, flexible demand, EV-charging stations, battery storage, etc.). Depending on the actual laboratory facilities present at the hosting institution, the Ph.D. candidate will be able</p>



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	<p>to develop and test control algorithms and optimization software of prototype or off-the-shelf assets.</p> <p>As part of the experience at foreign universities or foreign research centres, the successful candidate will be able feed the developed models with data/scenarios/regulatory frameworks which are particularly relevant to the hosting Country. This is expected to broaden the scope and value of the research project, enhancing the future applicability of the developed research.</p> <p>Finally, the 6 months spent in a foreign Institution are expected to provide the successful Ph.D. candidate with an array of soft-skill such as an improved level of English, a multi-cultural approach, a reinforced team-working experience.</p>
Period spent abroad	6 months
Name of the host institution abroad	<p>Among the foreign Universities, in depth contacts have been carried out with Imperial College London (UK) and the NTNU - Norwegian University of Science and Technology (Norway). With respect to foreign Research Centers, the candidates are the EDF R&D Lab (France) and the SINTEF (Norway).</p>



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Proposed research/Scholarship title	Artificial Intelligence applied to the Smart Factory L'Intelligenza Artificiale applicata alla Fabbrica Intelligente
Scientific contact person	Prof. Giovanni Iacca
Brief description of the proposed research	<p>Il Dottorando avrà come tema principale lo studio della fabbrica intelligente del futuro che sarà caratterizzata dalla cooperazione tra macchine ed esseri umani. In questo contesto in particolare studierà nuovi algoritmi e metodi basati su Intelligenza Artificiale.</p> <p>Il Dottorando svolgerà una ricognizione critica sullo stato dell'arte delle tecnologie di IA sviluppate e di quelle effettivamente applicate nell'industria italiana.</p> <p>Durante l'attività sarà prevista la partecipazione a fiere ed eventi del settore e la possibilità di confrontarsi con altri ricercatori provenienti da altre università straniere.</p> <p>I risultati più interessanti dell'attività di ricerca saranno proposti per pubblicazioni su riviste scientifiche di settore</p>
Name of the company	BLUETENSOR SRL - 38123 TRENTO (TN)
Brief presentation of the company	<p>Bluetensor è una società specializzata in progetti di consulenza aventi lo scopo di ottimizzare i processi aziendali tramite tecnologie di intelligenza artificiale.</p> <p>Tre sono le tecnologie sviluppate da Bluetensor:</p> <ul style="list-style-type: none"> - sistemi di Computer Vision, per il riconoscimento di oggetti in immagini o video; - Natural Language Processing, ovvero estrazione di informazioni di valore da grossi quantitativi di testi scritti o parlati; - Analisi predittiva, estrazione di informazioni di valore da grosse quantità di numeri. <p>Bluetensor è composta da un team completo dedicato all'IA, che viene applicata in vari settori, tra cui: Industria, Logistica, Finanza e Assicurazioni.</p> <p>Bluetensor è sponsor del Dottorato in Innovazione Industriale presso l'Università di Trento (2019-2022). Tale Dottorando ha applicato l'Analisi Predittiva al tema della manutenzione di macchinari industriali (la cosiddetta "Manutenzione Predittiva").</p>
Research activities to be carried out during the period spent in the company	<p>Il Dottorando sarà inserito nel team di R&S di Bluetensor costituito da personale qualificato con il quale avrà la possibilità di un continuo confronto e creare sinergia per lo sviluppo della propria attività.</p> <p>Bluetensor inoltre metterà a disposizione uno o più casi d'uso concreti sui quali testare gli algoritmi studiati e valutarne efficacia ed applicabilità.</p>
Period spent in the company	18 mesi



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<p>Research activities to be carried out abroad</p>	<p>La tendenza nell'approccio all'approccio all'IA è sempre più Human Centric e ciò è stato ribadito anche dalla Strategia Nazionale italiana per l'A.</p> <p>Bluetensor ritiene di proporre al candidato un approfondimento della tematica dell'ottimizzazione industriale tramite IA tenendo in considerazione anche aspetti quali l'inclusione e la responsabilità.</p> <p>Attività di ricerca:</p> <ul style="list-style-type: none"> - approfondire il tema della relazione Uomo-Intelligenza Artificiale (tramite lo studio di interazioni multimodali, analisi di comportamenti, creazione di modelli User-Centric); - approfondire le problematiche connesse al knowledge engineering, tenuto conto che una delle difficoltà delle PMI è che il know-how è spesso intangibile, posseduto da pochi esperti "umani"; - approfondire il tema dei linked data. <p>Si prevede di delineare in modo più puntuale le attività di ricerca insieme al tutor accademico dell'ente straniero.</p>
<p>Period spent abroad</p>	<p>6 mesi</p>
<p>Name of the host institution abroad</p>	<p>ADAPT Centre https://www.adaptcentre.ie/ e/o Munster Technological University https://www.cit.ie/</p> <p>Bluetensor è già in contatto con tali istituti grazie a pregresse collaborazioni. Bluetensor si riserva di confermare l'istituto estero dopo l'avvio del Corso di Dottorato.</p>



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<p>Proposed research/Scholarship title</p>	<p>Advanced design and optimized production of innovative heat exchangers to reduce the environmental impact of industrial processes</p> <p>Progettazione avanzata e produzione ottimizzata di scambiatori di calore innovativi per ridurre l'impatto ambientale dei processi industriali</p>
<p>Scientific contact person</p>	<p>Prof. Paolo Bosetti</p>
<p>Brief description of the proposed research</p>	<p>L'obiettivo di questo progetto è, partendo dalla ricerca e sviluppo esistente in azienda, di usare i dati sperimentali e di simulazione termofluidodinamica computazionale (CFD), come input per la progettazione avanzata di scambiatori di calore. Si evince dalla letteratura che, a partire da un elevato numero di dati raccolti sperimentalmente e tramite simulazioni, è possibile sviluppare reti neurali e intelligenze artificiali che predicano il comportamento di scambiatori di calore innovativi. In altre parole, si ottengono modelli e software di progettazione avanzati, che permettano di ideare soluzioni di scambio termico dalle prestazioni, efficienza e costo altrimenti impensabili. Il progetto include la possibilità di ottimizzare la produzione di soluzioni selezionate, affinché essa sia efficiente nei costi e gli scambiatori innovativi abbiano diffusione sul mercato, per massimizzare il beneficio dell'investimento in ricerca per l'ambiente.</p> <p>Il progetto si articola nelle seguenti fasi:</p> <p>Anno 1°</p> <ul style="list-style-type: none"> - Studio e analisi delle geometrie innovative già presenti in azienda, come scambiatori Pillow Plate o da manifattura additiva. - Studio dei modelli termo-fluidodinamici presenti in azienda. Formazione e sviluppo sulla tematica CFD. - Studio dello stato dell'arte di metodi di ottimizzazione per scambiatori di calore. - Studio dello stato dell'arte dell'intelligenza artificiale (IA) applicata nella trasmissione di calore. <p>Anno 2°</p> <ul style="list-style-type: none"> - Analisi dei dati sperimentali già presenti. - Scelta di una tipologia di IA da sviluppare e in secondo luogo di metodi di ottimizzazione. Ideazione di campagne sperimentali e di simulazione per integrare quanto già presente secondo le necessità dell'IA da sviluppare. - Svolgimento degli esperimenti per geometrie di scambio termico selezionate, con auspicabile permanenza presso laboratori all'estero con cui l'azienda sta collaborando. <p>Anno 3°</p> <ul style="list-style-type: none"> - Test dei metodi di ottimizzazione in situazioni reali spinte dal mercato, tramite la creazione e messa in opera di prototipi. - Analisi dei risultati ottenuti e ulteriore sviluppo se necessario. <p>Il piano qui esposto, si svolgerà in concomitanza con un'altra borsa di Dottorato in Innovazione Industriale già avviata nel 2020 con l'Università di Trento, esposto nelle sezioni successive. È importante menzionare questa sinergia, dato che essi si completano a vicenda nel permettere all'Azienda di sviluppare scambiatori innovativi non solo per</p>



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	<p>il mercato ma anche per la ricerca scientifica stessa. Si ricava infatti dalla consultazione quotidiana della letteratura specializzata, che esiste una moltitudine di problematiche di efficientamento energetico che vanno risolte con soluzioni sempre più personalizzate e complesse. Questo progetto permetterà così di minimizzare gli sforzi necessari nello sviluppo di soluzioni ad hoc, che risultino in una notevole diminuzione dell'impatto ambientale di una moltitudine di processi industriali.</p>
Name of the company	Dav Coil S.r.l. - 37029, San Pietro in Cariano (VR), Italia
Brief presentation of the company	<p>La Società DAV COIL S.R.L., nata nel 1969 come Impresa Artigianale dall'intraprendenza del Rag. Zancanaro Giovanni, vanta 50 anni di attività che l'hanno portata a produrre scambiatori di calore di elevata qualità ed affidabilità. Un costante investimento in ricerca e l'impiego di tecnologie d'avanguardia hanno reso la DAV COIL, una Società leader nella produzione di: scambiatori di calore (a tubo alettato, a pacco lamellare), recuperatori di calore (economizzatori, condensatori, preriscaldatori, surriscaldatori), tubi alettati, scambiatori coassiali, scambiatori a piastre.</p> <p>La DAV COIL dispone di personale e procedure di saldatura TIG, MIG, MAG, Elettrodo e Ossiacetilenica, certificati in conformità alle UNI EN ISO 15613/15614-1 e EN ISO 9606-</p> <p>La Società inoltre è Certificata secondo la Norma UNI EN ISO 9001 e UNI EN 3834, concernenti la gestione aziendale e la produzione. I settori a cui la DAV COIL si rivolge sono: alimentare, petrolchimico, farmaceutico, tessile, cartario, conciario, recupero di calore, forni per essiccazione, refrigerazione, riscaldamento, condizionamento.</p>
Research activities to be carried out during the period spent in the company	<p>Dav Coil ha svolto sino dalla sua fondazione attività di ricerca, sviluppo e miglioramento interno. Questo le ha permesso di allargare la sua offerta dagli iniziali tubi alettati, a complessi sistemi di scambio termico con geometrie multiple e componenti elettroniche per la modulazione della loro potenza, il tutto rispettando le normative più stringenti per qualità costruttiva e saldatura. L'azienda ha anche sviluppato esperienza nel costruire e/o personalizzare i propri macchinari produttivi. Nel 2020 Dav Coil ha intensificato e formalizzato i propri sforzi di ricerca finanziando una borsa di dottorato su scambiatori di calore innovativi. Questo progetto ha come obiettivo lo sviluppo di metodi progettuali validati per due geometrie di scambiatori di calore innovativi, e si colloca pertanto come precursore di quanto viene ora proposto. La prima consiste nella geometria Pillow Plate (PPHE), la seconda consiste negli scambiatori di calore da manifattura additiva (AMHE). Gli scambiatori di calore innovativi citati costituiscono complessi sistemi termo-fluidodinamici, difficilmente comprensibili risolvendo problemi alle equazioni differenziali parziali in forma chiusa. Si rende necessaria la modellazione avanzata tramite la fluidodinamica computazionale (CFD) e in generale modelli numerici, oltre che un'estesa sperimentazione.</p>
Period spent in the company	18 mesi
Research activities to be carried out abroad	Studio di scambiatori innovativi, Pillow Plate o da Additive Manufacturing, e/o sperimentale e/o numerico con simulazioni CFD



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Period spent abroad	6-12 mesi, in base ai lavori sperimentali aperti.
Name of the host institution abroad	Si ipotizza University of Paderborn. Si è instaurato un collegamento con la cattedra di Fluid Process Engineering. La struttura svolge ricerca sugli stessi scambiatori da noi studiati e ha già dimostrato la volontà di ospitare un nostro ricercatore. La scelta finale dipenderà dall'effettivo combinarsi dei nostri vincoli temporali e di tematica ed i loro



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Proposed research/Scholarship title	Vision-based machine learning for quality control in the glass industry
Scientific contact person	Prof. Nicola Conci
Brief description of the proposed research	<p>The doctorate's work will concern the fields of machine learning and image processing for various application domains, among which the following stand out for importance:</p> <ul style="list-style-type: none"> - application of deep learning for detection and classification of glass defects on multichannel images; - detection of aesthetic defects of the print in distorted images due to scanning problems; - identification of glass fragmentation while testing the degree and quality of tempering; - anomaly detection algorithms for the identification of non-conformities in presence of sparse training data. <p>In the first place, the candidate will focus on the thorough analysis of the state of the art in the field. In particular, the most recent development in the field of anomaly detection via the use of neural networks will be investigated. Some particular learning paradigms will be the subject of the research, including few-shot learning and out-of-distribution learning. It is expected that the candidate will develop solutions that have a twofold objective. On the one hand they will contribute to the existing literature in terms from an algorithmic perspective. On the other hand they are required to have a direct impact on the production pipeline of the company.</p>
Name of the company	Deltamax Automazione Srl - 38121 Trento
Brief presentation of the company	<p>Born in 1989 as spin-off of the research centre Fondazione Bruno Kessler, Deltamax boasts wide experience in the development of artificial vision solutions for quality control in the industrial sector. Since 2010 the company has devoted to float glass quality control developing cutting-edge solutions thanks to continuous investment in Research&Development.</p>
Research activities to be carried out during the period spent in the company	<p>In the last 10 years, Deltamax has carried out two LP6/99 research projects co-funded by the Autonomous Province of Trento: RISOLVI, 2011 - 2015, and CLEVER, 2017-2021. Both projects concerned industrial research topics related to the development of vision systems for the quality control of flat glass. The vision systems, produced by Deltamax, are installed directly on the production lines and must therefore comply with stringent requirements dictated by the operating conditions of the line (speed, cycle time, space, to name a few). The research topics of the two projects, concerned the analysis of both the software and hardware components, and the achieved results allowed a rapid integration with the product line of the company.</p> <p>Among the various research topics dealt within the two projects, we report for convenience only the contributions that are better</p>



	<p>aligned with the research proposal for the industrial doctorate. In particular:</p> <ul style="list-style-type: none"> - Tests of application of deep learning to the problem of detection and classification of glass defects using state-of-the-art network architectures such as MaskRCNN and YOLO. The results of the research have been presented with a paper accepted for publication at the industrial workshop of ICPR-2020 (https://sites.google.com/view/iml2020). - Analysis of the taxonomy of defects, creation of a large dataset and implementation of an MLP neural network (SVM as alternative) for the classification of defects with features as input; - Specific algorithms for glass defects detection and features extraction for the MLP network. - Implementation of a highly innovative acquisition apparatus capable of acquiring from the same camera two twin images of the same scene, coming from two different inspection channels. This solution, called Q PLUS, was released in 2019 and is now installed in more than 20 factories around the world. This allows us to have a wide choice of installations from which to take sample images. - Algorithms for the quality control of the printed text and graphical elements on the glass from different point of view: geometric (size and position of the elements) and aesthetic (readability and completeness). - Development of a system, called FROG, for the automatic counting of glass fragments, to verify the degree of tempering. - Design and development in C++ of a modular and highly parameterized software architecture that are the basis of the control applications of Deltamax vision systems. - Development of an application, called ProductionAnalyzer, to view control results and their statistics taking data from databases. The application is also used for training and testing of neural networks and for labeling of images in the dataset. - Design and development of a highly innovative vision system called OPT, protected by a national patent and with an international patent pending license. Thanks to a dual-channel lighting system, one of which comes from illumination with laser light, the system can detect and measure internal glass defects in case of uncleaned sheet.
Period spent in the company	18 months
Research activities to be carried out abroad	The period abroad can be spent in different institutions all across Europe, as the topic is highly transversal. Based on the specific topic and the challenges that will be identified throughout the program, the most suitable institution will be identified.
Period spent abroad	6 months
Name of the host institution abroad	To be defined.



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Digital twins for real estate and energy efficiency
Scientific contact person	Fabio Remondino
Brief description of the proposed research	<p>L'obiettivo del progetto di dottorato è quello di creare una metodologia operativa, affidabile e replicabile per la realizzazione di modelli 3D rappresentazione virtuale (digital twins/gemelli digitali) accurate e dettagliati di un edificio e dei suoi impianti di produzione e conversione di energia. Questi modelli permetterebbero, in un'ottica BIM (Building Information Modeling), una migliore gestione dei flussi energetici, soddisfacendo le esigenze che possono essere di risparmio energetico, gestione del profilo di carico, riduzione dei picchi di assorbimento, ottimizzazione economica dei flussi di energia prodotti e utilizzati.</p> <p>Le attività di ricerca prevedono:</p> <ul style="list-style-type: none"> - Lo sviluppo di una metodologia per creare modelli 3D di edifici con alto livello di dettaglio (LOD4), e dei suoi impianti, a partire da dati rilevati o informazioni catastali; - la creazione di uno strumento di simulazione dinamica integrata che includa il modello 3D dell'involucro, degli impianti di climatizzazione, dei sistemi di produzione energetica da fonte rinnovabile e dei sistemi di accumulo energetico. - La definizione delle logiche di controllo dei sistemi energetici, per il soddisfacimento degli obiettivi prefissati, in relazione alle disponibilità delle reti di approvvigionamento elettrico/termico.
Name of the company	Edilvi SpA - Villorba (TV)
Brief presentation of the company	<p>Edilvi SpA è un'impresa di costruzioni attiva a Treviso dal 1984 e una Energy Service Company (ESCO) presente in Veneto dal 2011. Attraverso il marchio Casa Smart Plus si occupa di:</p> <ul style="list-style-type: none"> - Costruzione di case ecosostenibili nZEB (edifici a energia quasi zero); - ampliamenti di case esistenti; - ristrutturazione di case esistenti e interventi di manutenzione ordinaria e straordinaria.
Research activities to be carried out during the period spent in the company	<p>Casa Smart Plus: Il brevetto Casa Smart Plus, progettato specificamente per la costruzione di edifici NZEB, è un metodo costruttivo composto da tecnologie ad alte prestazioni che garantiscono l'efficienza energetica, il comfort e la sicurezza antisismica dell'abitazione.</p> <p>Si tratta di un sistema che combina involucro ad alte prestazioni e sistemi efficienti di ultima generazione.</p>
Period spent in the company	18 mesi
Research activities to be carried out abroad	Generalizzazione della metodologia a contesti e normative EU



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Period spent abroad	6 mesi
Name of the host institution abroad	Da definire.



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Automated design algorithms for soft robotic structures
Scientific contact person	Prof. Giovanni Iacca
Brief description of the proposed research	<p>The PhD research project in soft robotics could provide significant value to both the company and the research community. The candidate will:</p> <ul style="list-style-type: none"> - conduct a thorough literature review on soft robotics and tools for designing soft structures (M1-6) - develop an AI-based design methodology to integrate, in a seamless way, soft and rigid structures to maximize the advantages of both rigid robotics and soft robotics (M7-18) - evaluate the proposed method with a physics-based simulator, and test it in benchmark robotic tasks (M19-M30) - analyze the reality gap for some selected configurations (M24-M32) - collect the results in the final PhD thesis (M32-M36) <p>The main results of this PhD project will be a set of optimization techniques specifically designed for the optimal design of soft-rigid robotic structures.</p>
Name of the company	Enchanted Tools - 75002 Paris (France)
Brief presentation of the company	<p>Enchanted Tools was founded by Jérôme Monceaux, a leading expert in robotics and serial entrepreneur. Building on his extensive experience as former Executive VP of Aldebaran/Softbank Robotics and lead designer of Nao and Pepper, he has assembled in the last 12 months a diverse and highly skilled team of 40 roboticists, with a strong focus on innovation and R&D. This high profile team is currently building a new "More Than Useful" species of interactive service robots, with an ambition to bring modern logistics to social spaces such as hospitals (nursing units, ER, surgical wards etc.). The first prototype to be revealed at the end of 2022.</p>
Research activities to be carried out during the period spent in the company	<p>As Enchanted Tools focuses on providing robotic solutions for social environments, operational safety is a key driver of its research activities. It is a very multi-factorial topic, as guaranteeing safety requires multiple layers of converging mechanisms: besides soft robotics, Enchanted Tools therefore also explores compliance-first design and human predictive control, in an iterative field-testing and validation approach. Three important national research collaborations have been setup to implement this research strategy:</p> <ul style="list-style-type: none"> - Compliance-first design: design and control of a highly compliant mobile base, which will guarantee that E.T.'s robots can be moved around easily and safely by hand. This is necessary to operate in critical environments such as hospitals, as care personnel must for example be able to easily push the robot out of the way if they are passing with a



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	<p>stretcher or a wheelchair. This work is done in collaboration with Sorbonne University in Paris (ISIR).</p> <ul style="list-style-type: none"> - Human predictive control: safe operation of robotic arms in social environments requires continuous prediction of human movement through visual sensors and continuous adaptation of the control trajectories to avoid collisions and minimize impact force if collision does occur. This work is done in collaboration with INRIA and University of Grenoble (LIG). - Iterative field testing and validation: safe operation can only be guaranteed if it is properly assessed in a real-world environment. Enchanted Tools has set up a long-term collaboration with the Broca Living Lab research team (Assistance Publique-Hôpitaux de Paris) to iteratively test and assess its design in the real-world environment of Broca Hospital (Paris). <p>The research project on soft robotics for safety will have strong impact on and interdependence with the three projects described above: tight collaboration will be key to design robotics platforms that properly combine and validate the various safety mechanisms that emerge from these multi-disciplinary research efforts.</p> <p>The PhD candidate will be working in a highly multidisciplinary team of experts in robotics, engineering and AI, working mainly under the supervision of Dr. Davide Zappetti. Dr. Zappetti obtained a PhD on soft robot design from the EPFL in 2021, and he is currently working as Robotic Specialist at Enchanted Tools.</p>
Period spent in the company	6 months minimum
Research activities to be carried out abroad	Testing in hardware the simulation results obtained.
Period spent abroad	6 months minimum
Name of the host institution abroad	Enchanted Tools



Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Data models and data integration for renewable power generation
Scientific contact person	Prof. Marco Calautti
Brief description of the proposed research	<p>L'obiettivo generale del progetto è quindi la realizzazione di modelli di dati formali e metodologie per l'accesso efficace ed automatizzato a dati non strutturati generati nel contesto della produzione di energie rinnovabili.</p> <ul style="list-style-type: none"> - Studio dello stato dell'arte su criteri di modellazione dati nell'ambito della produzione di energia rinnovabile. - Formazione sui principali linguaggi per la realizzazione di modelli dati ontologici. - Partecipazione a scuole e seminari formativi. - Realizzazione di uno schema ontologico formale che implementi gli standard di riferimento sull'organizzazione di dati nel contesto della produzione di energia rinnovabile. - Ricerca di metodologie di integrazione dati non-strutturati all'interno di schemi ontologici. - Realizzazione di metodologie di interrogazione dati su schemi ontologici.
Name of the company	Enyr Srl - 38068 Rovereto (TN)
Brief presentation of the company	<p>Enyr è una startup che opera nel settore del data modeling per l'energia rinnovabile ed è specializzata nello sviluppo di strumenti SW per la progettazione top-down di artefatti sulla base di modelli dati per l'energia.</p> <p>Enyr è stata fondata da un team di persone con competenze multidisciplinari: protocolli IEC 61850 e IEC ISO 81346, automazione di processo in ambito produzione di energia da fonti rinnovabili, sviluppo di software open source e utilizzo di protocolli standard e interoperabili, web semantico, ontologie, big data, soluzioni cloud e industrial internet of things (IIoT).</p> <p>Strumenti, tool e prodotti per l'automazione dell'energia basati su standard internazionali.</p> <ul style="list-style-type: none"> - Servizi personalizzati per il mercato della generazione di energia da fonti rinnovabili. - Applicazioni e servizi Cloud-native e web-based - Soluzioni di edge computing per il condition monitoring di macchine e impianti.
Research activities to be carried out during the period spent in the company	<p>Verifica del modello ontologico per la modellazione dei dati.</p> <ul style="list-style-type: none"> - Benchmarking delle tecniche di Information Extraction per l'estrazione e conversione dei dati di origine e delle tecniche di Machine Learning per le fasi di estrazione di tipo semantico con la definizione di obiettivi minimi di accettazione dei risultati ottenuti.



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	- Test su dati reali delle tecniche di estrazione e conversione di dati non strutturati con specifici linguaggi di interrogazione per basi di conoscenza.
Period spent in the company	18 mesi
Research activities to be carried out abroad	Collaborazione con i ricercatori di Sintef che si stanno occupando di tematiche simili.
Period spent abroad	6 mesi
Name of the host institution abroad	Sintef - Trondheim (Norvegia)



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Doctoral Programme in INDUSTRIAL INNOVATION

<p>Proposed research/Scholarship title</p>	<p>Development of innovative machine learning and natural language processing techniques for the automatic assessment of the Company's Environmental, Social, and Governance (ESG) requirements.</p> <p>Sviluppo di tecniche innovative di machine learning e natural language processing per la valutazione automatica dei requisiti Environmental, Social, and Governance (ESG) delle Società.</p>
<p>Scientific contact person</p>	<p>Prof. Andrea Passerini</p>
<p>Brief description of the proposed research</p>	<p>Environmental, Sustainability and Governance (ESG) metrics have been recently introduced to allow investors to assess the several factors affecting sustainable development. Under the current de facto procedure, the collection of quantitative ESG data is delegated to the companies, which "translate" them in form of answers to the ESG questionnaires administered and collected by the rating agencies. Finally, the latter compute and publish a score for each of the three (E, S, and G) dimensions. The scores are then used to control access to 'sustainable' funding streams.</p> <p>AI and, in particular Natural Language Processing (NLP) and Machine Learning (ML) technologies, are expected to play a forefront role in the context of sustainability and its assessments. First, with the introduction of large pretrained language models (LLMs), recent breakthroughs in NLP nowadays allow to assess, at scale and in real time, the consistency of a company's sustainability claims as compared to the underlying data. Conversely, autoregressive language models such as GPT-3, trained with decoder-only architectures and left-to-right objectives, have shown promising few-shot generalization capabilities, and are thus potential candidates to obtain textual descriptions from tabular data. For these use cases, the AI is seen as a tool to expedite and facilitate the auditing of a company.</p> <p>Furthermore, while AI can be used to "audit" the sustainability practices of a company, as seen above, we posit that the ethical and regulatory questions arising from the very application of the above-mentioned NLP models will in the near future be themselves part of sustainability audits. Indeed, pre-production verification of the expected behaviour of a transformer-based model is currently hindered by the limited knowledge on its inner workings. The emerging research field dealing with the harmonization of machine behavior and algorithmic outcomes with human values is commonly referred to as "AI Alignment".</p> <p>The selected PhD candidate is therefore expected, on the one hand, to work on the adaptation of NLP models to the novel ESG domain, and on the other hand to gain the necessary knowledge and skills required to advance the state of the art in the context of AI alignment.</p> <p>The educational and research activities of the Ph.D. student will have a major focus on Natural Language Processing and Machine Learning. In particular, the student will be trained and will do research on large pretrained language models and on</p>



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	autoregressive language models (i.e., GPT-3) as well as on algorithmic fairness, accountability and transparency.
Name of the company	Ipazia S.p.A. - 20123 Milano (Italy)
Brief presentation of the company	The focus of Ipazia S.p.A. is the production and commercialization of high value AI-driven products based on the latest advances in AI scientific research. Ipazia S.p.A. operates in selected market segments, among which are financial services, energy management, and human resources. Furthermore Ipazia S.p.A. develops tools to facilitate companies' ESG requirements so as to enable them efficient and effective compliance to achieve the best possible rating while having real ESG impact. The main AI technologies of Ipazia S.p.A. include Machine Learning, Natural Language Processing, Computer Vision, and Computational Social Science.
Research activities to be carried out during the period spent in the company	<p>The Ph.D. student will gradually be introduced to ESG reporting practices and to the current technologies used – including those available on the market and those in development. Starting from a pre-existing set of core ESG indicators (e.g., wastewater management, ecological impacts, business ethics) the Ph.D. student will design and benchmark, using state-of-the-art methodologies and tools,</p> <p>AI models able to detect passages relevant to ESG indicators, along with their tone and valence. Further, s/he will extend her/his research to more experimental scenarios such as the detection of significant changes in ESG textual reporting both longitudinally and across companies. Such models should ideally be robust to changes in the set of ESG indicators, which can be updated on a yearly basis. Furthermore, the modeling activities will evolve in light of the operationalization of ESG indicators developed at Ipazia S.p.A. and progressively include tabular data along with natural language, enabling research on controlled text generation and factual assessment. After a successful benchmarking stage, the Ph.D. student will be involved in adapting the models to production requirements: s/he will collaborate with the engineering team in order to deploy at scale the proposed models.</p>
Period spent in the company	12 months
Research activities to be carried out abroad	A possible concrete visiting period is at MIT Connection Science (https://connection.mit.edu/) working with Alex “Sandy” Pentland and/or with Roberto Rigobon. In particular, the student may collaborate with the Aggregate Confusion Project (https://mitsloan.mit.edu/sustainability-initiative/aggregate-confusion-project) that aims at making less noisy the ESG rating improving the collection of data relevant for the metrics. To this end, the development of NLP and ML techniques may help the improvement of the quality of the ESG measurement.
Period spent abroad	6-8 months
Name of the host institution abroad	MIT



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Networked music performance system for high numbers of musicians
Scientific contact person	Prof. Luca Turchet
Brief description of the proposed research	<p>Il risultato che si intende conseguire è quello della realizzazione di un segnale audio e video che sia la risultante della fusione sincrona dei segnali inviati da una grande moltitudine di musicisti attraverso la Rete e gestiti da una regia audio e video in modo tale da poter essere fruita.</p> <ul style="list-style-type: none"> - Ricerca e sviluppo, creazione e realizzazione software - Allestimento server, configurazione e gestione delle Reti - Messa in prova del Sistema attraverso step successivi programmati - Controllo e supporto gestionale delle Reti - Implementazione grafica del Sistema e realizzazione delle relative interfacce - Gestione dei diversi segnali - Coordinamento tecnico/artistico del suono finale - Controllo e gestione segnali video - Regia generale video - Controllo e gestione sincronizzazione finale audio/video
Name of the company	M.A. di Cottone Maurizio e C. s.n.c. - 48015 Cervia, Ravenna
Brief presentation of the company	<p>La società proponente "M.A. di Cottone Maurizio e C. s.n.c.", che vede soci Maurizio Cottone e Francesco Penolazzi, opera da più di 40 anni nel campo dell'allestimento tecnico dei grandi eventi, oltre che della gestione della parte audio delle più importanti produzioni televisive come, ad es., il Festival di Sanremo, più volte nel corso degli anni, oltre che nella progettazione, sviluppo, consulenza e realizzazione tecnica nel settore audio professionale.</p> <p>Ha fornito un contributo fondamentale nella creazione e nella gestione della parte tecnica audio degli eventi denominati "Rockin'1000" (www.rockin1000.com), definita da molti "la più grande Rockband del mondo", in cui più di mille musicisti si riuniscono nei più grandi stadi (Stadio "Artemio Franchi" di Firenze, "Stade de France" di Parigi, "Commerzbank-Arena" di Francoforte, ecc.) per realizzare tutti insieme concerti che sono rimasti impressi nella memoria di chiunque abbia avuto la fortuna di assistervi.</p>
Research activities to be carried out during the period spent in the company	<ul style="list-style-type: none"> - - Analisi dei requisiti - - Progettazione - - Valutazione
Period spent in the company	6 mesi
Research activities to be carried out abroad	Il candidato lavorerà sulla tematica della spazializzazione acustica dei molteplici musicisti
Period spent abroad	6 mesi
Name of the host institution abroad	Edinburgh Napier University



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Hardware and software solutions for crowd-based street-view surveys
Scientific contact person	Prof. Roberto Passerone
Brief description of the proposed research	<p>Main duties of the intended Ph.D. activity include (but are not limited to):</p> <ul style="list-style-type: none"> - To identify the best combination of SBC and Machine-Learning enabled computing units for providing improved, on-site anonymization and pre-processing of street-level imagery; To develop an ad-hoc, modular connection system to allow the on-demand installations of different sensors on the survey units; - To develop the stack of drivers and software to link the sensors to the surveying unit and up to the cloud backend. <p>Furthermore, additional activities may encompass the designing of custom sensing devices to be added to the surveying unit, advanced hardware prototyping, and software development.</p> <p>Besides the Ph.D. courses offered by the University of Trento, MindEarth will grant the candidate the possibility to interact with its wide network of contacts. This includes top-level experts in hardware and software design for IoT devices and photographic-enabled surveying devices.</p>
Name of the company	MindEarth Biel/Bienne – 2502 Switzerland
Brief presentation of the company	<p>MindEarth is a consultancy and applied research company based in Switzerland operating in the fields of advanced spatial analytics merging remote sensing, high frequency mobility data analysis and spatial data gathered from crowd street view technology. It was founded in 2018 by a group of scientists with the mission of tackling contemporary societal problems through cutting-edge technological innovation. Currently, MindEarth's team includes experts in computer science, Earth observation, environmental and telecommunication engineering, robotics and urban planning. MindEarth collaborates with world-leading international institutions, such as the World Bank, the European Space Agency, the International Committee of the Red Cross, United Nations and the German Aerospace Center (DLR).</p>
Research activities to be carried out during the period spent in the company	<p>MindEarth has large experience in designing and prototyping custom hardware for street-level photographic surveys. Indeed, it developed an in-house backpack powered by an SBC (a Raspberry Pi 4B) able to collect photospheres with 15MP resolution at 1 FPS frequency. The backpack is equipped with an LTE 4G modem and a dedicated, high-precision GPS unit. Also, the backpack runs a fully customized GNU-Linux distribution running on an encrypted drive, where the collected data are securely transmitted via a Software Defined Network to the company's cloud infrastructure. The device also allows performing</p>



	<p>an advanced blurring of the pictures as they are collected, thus providing a state-of-the-art privacy level.</p> <p>Nine copies of the backpack have been deployed throughout the years, and they have been continuously improved from a software and a hardware point of view. At the time of writing, the backpacks collected more than 4TB of pictures in very different settings, such as:</p> <ul style="list-style-type: none"> - In 2022, MindEarth launched an extensive street-view survey in the city center of Milan. This survey covers more than 1200 km of streets divided into more than 900 single tasks to be performed in about two months. - In 2020, MindEarth collected the street-view images in nine different Italian cities that fed the AI models of the Strolling Cities installation shown at the Biennale di Venezia. - In 2019, MindEarth performed a detailed street-level photographic survey in Brazzaville and Pointe-Noire (Republic of Congo). The survey, commissioned by the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR), has been performed by a crowd of local workers that have been instructed and trained by the MindEarth personnel.
Period spent in the company	6 months
Research activities to be carried out abroad	As described earlier.
Period spent abroad	6 months
Name of the host institution abroad	<p>MindEarth is based in Biel/Bienne in the canton of Bern, Switzerland therefore the required period to be carried out abroad will correspond with the permanence of the Ph.D. candidate at its premises.</p> <p>For the duration of his/her stay, the candidate will be hosted at MindEarth's offices in Biel/Bienne to conduct his/her own research and support the company activities, in close contact with its team of data scientists and developers, while having full access to MindEarth's equipment.</p>



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Multi-source Spatial Inference in Support to Sustainable Development
Scientific contact person	Dr. Bruno Lepri; Dr.ssa Francesca Bovolo
Brief description of the proposed research	<p>Main duties of the intended Ph.D. activity include (but are not limited to):</p> <ul style="list-style-type: none"> - maturing a comprehensive knowledge of currently existing state-of-the-art approaches targeting spatial inference (especially in the presence of reduced training information) and identifying main pros and cons; - gaining solid experience in handling high-resolution and very-high resolution satellite imagery, HFLB data, as well as street-view imagery; - leveraging recent ML/DL advances for developing novel approaches to target spatial inference by jointly combining mobility and/or street-level data to satellite imagery specifically tailored to applications generally characterized by the limited amount of reference training data; - supporting the identification of applications that would most benefit from the employment of the implemented solutions. <p>Furthermore, besides the Ph.D. courses offered by the University of Trento, MindEarth will grant the candidate the possibility to interact with its wide network of contacts.</p>
Name of the company	MindEarth - Biel/Bienne 2502 Switzerland
Brief presentation of the company	<p>MindEarth is a consultancy and applied research company based in Switzerland operating in the fields of advanced spatial analytics merging remote sensing, high frequency mobility data analysis and spatial data gathered from crowd street view technology. It was founded in 2018 by a group of scientists with the mission of tackling contemporary societal problems through cutting-edge technological innovation. Currently, MindEarth's team includes experts in computer science, Earth observation, environmental and telecommunication engineering, robotics and urban planning. MindEarth collaborates with world-leading international institutions, such as the World Bank, the European Space Agency, the International Committee of the Red Cross, United Nations and the German Aerospace Center (DLR).</p>
Research activities to be carried out during the period spent in the company	<p>MindEarth was granted by the European Space Agency (ESA) the EO4Poverty project, whose goal was to implement a novel system based on advanced DL to generate accurate spatial wealth maps at the country scale by exploiting freely available EO data in combination with sparse information extracted from local household surveys. In particular, this improved existing approaches and provided an easily transferable service for creating maps which can be employed as ready-to-use tools for policy makers. Among others, the main innovations of EO4Poverty with respect to the existing state-of-the-art approaches included: i) the use of open and free high-resolution ESA Sentinel-2 imagery; ii) the design of an end-to-end DL system which directly estimates the local wealth; iii) the production of wealth spatial distribution maps at unprecedented 100m spatial resolution. Extensive experimental analyses</p>



	<p>have been carried out for 8 countries, namely Haiti, Malawi, Nepal, Nigeria, Rwanda, South Africa, Tanzania and Uganda.</p> <p>MindEarth has large experience in designing and prototyping custom hardware for street-level photographic surveys. Indeed, it developed an in-house backpack powered by an SBC (a Raspberry Pi 4B) able to collect photospheres with 15MP resolution at 1 FPS frequency. The device is equipped with an LTE 4G modem and a dedicated, high-precision GPS unit. Also, it runs a fully customized GNU-Linux distribution mounted on an encrypted drive, where the collected data are securely transmitted via a Software Defined Network to the company's cloud infrastructure. The device also allows performing an advanced blurring of faces/plates as they are collected. Nine copies of the backpack have been deployed throughout the years, and they have been continuously improved from a software and a hardware point of view. At the time of writing, the backpacks collected more than 4TB of pictures in very different settings:</p> <ul style="list-style-type: none"> - In 2022, MindEarth launched an extensive street-view survey in the city center of Milan¹. This survey covers more than 1200 km of streets to be performed in about two months; - In 2020, MindEarth collected street-view imagery in 9 Italian cities that fed the AI models of the Strolling Cities installation,² shown at the Biennale di Venezia; - In 2019, MindEarth performed a detailed street-level photographic survey in Brazzaville and Pointe-Noire³ (Republic of Congo). The survey, commissioned by the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR), has been performed by a crowd of local workers that have been instructed and trained by the MindEarth personnel. <p>MindEarth has performed different activities making use of HFLB data. In this framework, it strongly contributed (in collaboration with the World Bank's Urban Disaster Risk Management Unit, the World Bank's Global Facility for Disaster Reduction and Recovery and Purdue University) to the development of the Mobilkit Python library. In particular, Mobilkit aims at providing innovative data-analysis pipelines for HFLB data to measure the response of large populations to natural disasters and infrastructural changes. As an example, it has been recently used for supporting the World Bank in analyzing the displacement of people after the 2017 Puebla earthquake in the area of Mexico City.</p>
Period spent in the company	6 months
Research activities to be carried out abroad	As described earlier.
Period spent abroad	6 months
Name of the host institution abroad	MindEarth is based in Biel/Bienne in the canton of Bern, Switzerland therefore the required period to be carried out abroad will correspond with the permanence of the Ph.D. candidate at its premises.



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Advanced Solutions for managing of Crowd-based Street-level Surveys
Scientific contact person	Dr. Maurizio Napolitano
Brief description of the proposed research	<p>Main duties of the intended Ph.D. activity include (but are not limited to):</p> <ul style="list-style-type: none"> - To optimize task allocation problem under very complex spatio-temporal constraints, combining linear programming and Machine-Learning tools; - To develop efficient API endpoints to set-up the communication between the surveying unit and the backend; - To develop web and mobile applications to design, allocate and monitor the surveying tasks. <p>Besides the Ph.D. courses offered by the University of Trento, MindEarth will grant the candidate the possibility to interact with its wide network of contacts. This includes top-level experts in software design for remote management of IoT devices and researchers addressing the analysis of street networks and urban spaces.</p>
Name of the company	MindEarth - Biel/Bienne 2502 Switzerland
Brief presentation of the company	<p>MindEarth is a consultancy and applied research company based in Switzerland operating in the fields of advanced spatial analytics merging remote sensing, high frequency mobility data analysis and spatial data gathered from crowd street view technology. It was founded in 2018 by a group of scientists with the mission of tackling contemporary societal problems through cutting-edge technological innovation. Currently, MindEarth's team includes experts in computer science, Earth observation, environmental and telecommunication engineering, robotics and urban planning. MindEarth collaborates with world-leading international institutions, such as the World Bank, the European Space Agency, the International Committee of the Red Cross, United Nations and the German Aerospace Center (DLR).</p>
Research activities to be carried out during the period spent in the company	<p>MindEarth has large experience in designing and carrying out street-level photographic surveys. Indeed, it developed an in-house backpack, equipped with an LTE 4G modem, a dedicated, high-precision GPS unit and powered by an SBC able to collect photospheres with 15MP resolution at 1 FPS frequency. Nine copies of the backpack have been deployed throughout the years, and they have been continuously improved both in the software and hardware components.</p> <p>To control and monitor the data-collection activities, MindEarth developed a pipeline to generate survey tasks covering a given targeted study area and taking into consideration the corresponding street network and the presence of sidewalks, as well as the availability of workers. Also, a pipeline has been designed which allows to monitor the activities of the crowd, assign the tasks based on the position and availability of each specific</p>



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	<p>mapper, manage the logistics of the limited surveying resources, monitor the completion of the tasks and compute the rewards for the workers based on their efforts.</p> <p>At the time of writing, the backpacks collected more than 4TB of pictures in very different settings, such as:</p> <ul style="list-style-type: none"> - In 2022, MindEarth launched an extensive street-view survey in the city center of Milan. This survey covers more than 1200 km of streets divided into more than 900 single tasks to be performed in about two months; - In 2020, MindEarth collected the street-view images in nine different Italian cities that fed the AI models of the Strolling Cities installation shown at the Biennale di Venezia; - In 2019, MindEarth performed a detailed street-level photographic survey in Brazzaville and Pointe-Noire (Republic of Congo). The survey, commissioned by the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR), has been performed by a crowd of local workers that have been instructed and trained by the MindEarth personnel.
Period spent in the company	6 months
Research activities to be carried out abroad	As described earlier.
Period spent abroad	6 months
Name of the host institution abroad	<p>MindEarth is based in Biel/Bienne in the canton of Bern, Switzerland therefore the required period to be carried out abroad will correspond with the permanence of the doctoral student in the enterprise.</p> <p>For the duration of his/her stay at the company, the candidate will be hosted at our offices in Biel/Bienne to conduct his/her own research and support MindEarth's activities, in close contact with our team of data scientists and developers and having full access to MindEarth's equipment.</p>



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Powder metallurgy process modeling for Net Shape applications Modellazione di processo di metallurgia delle polveri per applicazioni Net Shape
Scientific contact person	Prof. Alberto Molinari
Brief description of the proposed research	<p>L'obiettivo del Progetto di ricerca è l'implementazione di metodi di simulazione numerica agli elementi finiti per processi di consolidamento di polveri metalliche tramite pressatura isostatica a caldo. L'ambito di applicazione riguarda principalmente approcci di progettazione "Net shape" del processo industriale per componenti con geometrie complesse. La modellazione del consolidamento di un manufatto richiede la definizione e l'applicazione di modelli fisici costitutivi in grado di riprodurre la concorrente azione di processi plastici e diffusivi attivati termicamente, in materiali con densità e proprietà meccaniche che variano considerevolmente nel corso dei cicli termici adottati. L'implementazione di modelli fisici richiede la creazione di database di dati sperimentali delle proprietà dei materiali coinvolti e la validazione sperimentale dell'accuratezza e precisione della modellazione. Aspetto di particolare criticità è la notevole variazione di volume e le deformazioni a cui sono soggetti i manufatti in metallurgia delle polveri durante le fasi di consolidamento.</p> <p>Nel Corso del Progetto, il candidato si dedicherà all'analisi delle fasi di progettazione del processo industriale di metallurgia delle polveri tramite pressatura isostatica a caldo, allo sviluppo di modelli di simulazione numerica del processo, con particolare attenzione alla fase di consolidamento, e alla validazione sperimentale del modello con il supporto delle risorse e competenze in materia dell'azienda. Il candidato predisporrà inoltre piani sperimentali per la creazione di database di dati materiale necessari per svolgere le simulazioni numeriche.</p>
Name of the company	Nuovo Pignone Tecnologie srl - 50127 Firenze (Italia)
Brief presentation of the company	Nuovo Pignone Tecnologie, parte del Gruppo Baker Hughes, è un'azienda di ingegneria che sviluppa prodotti e processi per vari mercati e in particolare energia, industriale e oil&gas.
Research activities to be carried out during the period spent in the company	<p>Nuovo Pignone Tecnologie è impegnata da anni nello sviluppo di materiali e processi innovativi di produzione di componenti industriali, tra cui tecnologie di manifattura additiva e di metallurgia delle polveri per applicazioni cosiddette "Net Shape". L'azienda dispone di laboratori dedicati per lo sviluppo del processo innovativi, sia a livello di simulazione che di realizzazione sperimentale, di caratterizzazione di prototipi, nonché la messa a punto del processo industriale.</p> <p>Progetto rilevante è quello sviluppato all'interno dell'Accordo di Programma denominato Galileo – SMATEC, finanziato dal MISE e</p>



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	dalla Regione Toscana, e relativo allo sviluppo di materiali e processi a supporto di turbomacchine per la transizione energetica.
Period spent in the company	6 mesi
Research activities to be carried out abroad	L'attività di ricerca prevede l'analisi e lo sviluppo di modelli fisici semi-empirici del processo di consolidamento di polveri in condizioni di sinterizzazione assistita da pressione, le metodologie di simulazione numerica agli elementi finiti, di ottimizzazione e di validazione sperimentale.
Period spent abroad	6 mesi
Name of the host institution abroad	CEIT (ES)



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	An Imaging-Based Bimolecular Fluorescence Complementation Assay to Screen for Unconjugated Protein Degraders
Scientific contact person	Prof. Emiliano Biasini
Brief description of the proposed research	<p>In this project, the Ph.D. candidate will capitalize on the versatility and scalability of the GFP1-10/GFP11 system to develop a screening platform allowing the search for small organic compounds capable of selectively promoting the degradation of target proteins. The student will collaborate with researchers at Sibylla Biotech to plan, design and execute the different activities. The company will also indicate the pharmacological target to pursue. From an experimental standpoint, the activities will include:</p> <ul style="list-style-type: none"> - Selection of protein target, GFP11 tagging design, preparation, and characterization of Tet-on inducible vector plasmids. - Preparation of lentiviral vectors encoding the GFP1-10 reporter tagged for specific intracellular expression (e.g., ER-directed GFP1-10 to monitor the expression of proteins transiting through the endoplasmic reticulum) - Cell transfection and transduction, clone selection, and characterization of expression by western blotting and confocal microscopy - Assay validation and scale up by using an automated imaging system (e.g., Operetta, Perkin Elmer) - Screening of a pilot library of compounds, validation of hit compounds by western blotting, and additional secondary assays (depending on the target proteins) <p>From an educational standpoint, the Doctorate in Biomolecular Sciences at the Department CIBIO, University of Trento, provides a unique opportunity for the student's scientific growth. In addition to the classical courses offered by the program, the student will have the chance to attend national and international meetings (at least twice a year) and learn directly from researchers working in academic institutions and pharmaceutical companies. This curriculum will perfectly fit the doctoral project. It will help the student develop skills in pharmaceutical technologies and drug discovery, areas of primary interest in strategic sectors for the development of the regional and national territory.</p>
Name of the company	Sibylla Biotech SRL
Brief presentation of the company	<p>Sibylla Biotech SRL (www.sibyllabiotech.it) is a research startup of the University of Trento, the University of Perugia and the National Institute for Nuclear Physics (INFN). The Company is the exclusive licensee of PPI-FIT, an innovative drug discovery technology developed in Trento. This approach is based on identifying small molecules that can selectively hinder the folding of target proteins. This is done using proprietary advanced molecular simulation algorithms, which are continuously developed and enable the in silico reconstruction of the protein folding process, with atomic resolution. Sibylla has established collaborations with leading players in Pharma industries, generating over 1 million revenues.</p>



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	In 2021, Sibylla has been selected by Nature among the top 8 biotech startups world-wide.
Research activities to be carried out during the period spent in the company	The activity, in this case, will be focused on acquiring expertise in the area of computational chemistry, a vital aspect of Sibylla's research, which will help the student pursue the goal of developing protein degraders.
Period spent in the company	During the second year of the doctoral course, the student will carry out a period of study and research at the company lasting 6 months.
Research activities to be carried out abroad	The period abroad will be focused on acquiring expertise in biophysics and protein technologies, further contributing to the student's expertise in the area of drug discovery.
Period spent abroad	During the third year of the doctoral course, the student will carry out a period of study and research abroad lasting six months.
Name of the host institution abroad	CIMUS, University of Santiago de Compostela, Spain



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Identification of transient druggable pockets in intrinsically disordered proteins by integrating AI-driven molecular simulations and quantum computing
Scientific contact person	Prof. Piero Faccioli
Brief description of the proposed research	<p>Training: The student will first acquire competences in computational biophysics, advanced statistical mechanics, quantum computing and protein biochemistry, by attending courses offered in the Physics Department and in the Department CIBIO. The student will also spend a training period of 6-8 months at the Frankfurt Institute for Advanced Studies, under the supervision of Prof. R. Covino, to learn about applications of state-of-the-art Machine Learning techniques for molecular simulations. Research: in the first part of the project, the student in collaboration with the scientists of Sibylla Biotech will implement a state-of-the-art AI-based technique for learning reaction coordinates of complex systems and use this information to navigate the configuration space of a IDP. Then, in collaboration with scientists at the Physics Department of U. Trento and Sybilla Biotech, he or she will design, develop, and test digital and analog quantum computing algorithms to solve a variational problem that enables the extraction of the equilibrium distribution from the molecular dataset previously generated using AI-driven methods. In the last part of the thesis (to be performed at Sibylla Biotech), the student will learn to use medicinal chemistry software for druggable pocket detection and apply it to the configurations generated for a specific intrinsically disordered protein</p>
Name of the company	Sibylla Biotech SRL
Brief presentation of the company	<p>Sibylla Biotech SRL (www.sibyllabiotech.it) is a research startup of U. of Trento, U. of Perugia and INFN. The Company is the exclusive licensee of PPI-FIT, an innovative drug discovery technology developed in Trento. This approach is based on identifying small molecules that can selectively hinder the folding of target proteins. This is done using proprietary advanced molecular simulation algorithms, which are continuously developed and enable the in silico reconstruction of the protein folding process, with atomic resolution. Sibylla has established collaborations with leading players in Pharma industries, generating over 1 million revenues. In 2021, Sibylla has been selected by Nature among the top 8 biotech startups world-wide.</p>
Research activities to be carried out during the period spent in the company	<p>Scientific Background: the computational team of Sibylla Biotech has been continuously involved in the development of its advanced algorithms for molecular simulations, both by improving the computational efficiency —e.g. migrating the software to GPU architectures— and by enhancing the accuracy of the physico-chemical models — e.g. by including in the simulation the interaction of the chain with the ribosome—. Sibylla is also involved in developing state-of-the-art machine learning driven algorithms for computational medicinal chemistry (in silico virtual</p>



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	screening) and molecular simulations. Finally, the company is conducting a number of biophysical and biochemical experiments aiming at further validating the PPI-FIT technology. Specific contribution to the proposed project: Sibylla computational scientists will contribute by supervising the student in the implementation of state-of-the-art AI-driven schemes for molecular simulations and data analysis algorithms. They will also train the student in the application of software for detecting druggable pockets on the IDP's structures generated with the new scheme to be developed.
Period spent in the company	6-8 months
Research activities to be carried out abroad	Training of state-of-the-art AI driven methods for uncharted exploration of energy landscapes
Period spent abroad	6-8 months
Name of the host institution abroad	Frankfurt Institute for Advanced Studies



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Doctoral Programme in INDUSTRIAL INNOVATION

Proposed research/Scholarship title	Advanced techniques for anomaly detection and threat prevention in heterogenous networks.
Scientific contact person	Prof. Fabrizio Granelli
Brief description of the proposed research	<p>Trentino Digitale S.p.A., inhouse providing company of the Provincia Autonoma di Trento and all the local Authorities, owns and manages important telecommunications infrastructures (optical fiber and radio) that provides connectivity and essential digital services for the Public Administrations of the province of Trento (Italy). Cybersecurity threats are growing constantly and it is important to enforce the company capacity to effectively prevent or respond to them.</p> <p>The proposal aims to identify advanced techniques, to be experimented on the provincial networks, in order to detect threat and prevent attacks and risks for the digital services provided by the company.</p> <p>Approfondimento delle reti e delle relative evoluzioni e individuazione, e sperimentazione, di tecniche avanzate di rilevamento di anomalie sulle reti eterogenee di Trentino Digitale anche al fine di prevenire minacce di cybersecurity.</p>
Name of the company	Trentino Digitale S.p.A. - 38121 Trento
Brief presentation of the company	Trentino Digitale S.p.A., Società ICT in house, è il braccio operativo della Provincia autonoma di Trento e degli Enti locali del territorio per la trasformazione digitale del sistema Trentino. La Società gestisce le reti di telecomunicazione provinciali in fibra ottica e radio, comprese le reti per l'emergenza, i data center e l'evoluzione verso il cloud, oltre a realizzare e gestire software e applicazioni, anche innovativi, per la digitalizzazione del territorio trentino. Le attività di Trentino Digitale includono anche la sicurezza informatica e il supporto alle strategie della Provincia autonoma di Trento per la diffusione della banda ultra larga nel Trentino.
Research activities to be carried out during the period spent in the company	<p>Trentino Digitale is not involved currently in research activities yet.</p> <p>Trentino Digitale has signed:</p> <ul style="list-style-type: none"> - at the beginning of 2022, a collaboration agreement with the University of Trento that includes research activities and knowledge transfer - at the end of 2021 a collaboration agreement with the Bruno Kessler Foundation that includes the topics of cybersecurity and anomaly detection.
Period spent in the company	18 months
Research activities to be carried out abroad	The Phd student will visit the Security Research Labs for a period of 6 months to study the treats and analyze security of next generation networks, including 5G/6G and Software Defined Networks. During his stay he will learn how to simulate attacks and



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	check security in real scenarios (e.g. MEC, core network, data centers).
Period spent abroad	6 months
Name of the host institution abroad	Security Research Labs, Berlin, Germany (https://www.srlabs.de/)



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Doctoral Programme in MATERIALS, MECHATRONICS AND SYSTEMS ENGINEERING

<p>Proposed research/Scholarship title</p>	<p>Advanced mechatronic systems for scientific space applications and innovative technological developments</p> <p>Sistemi meccatronici avanzati per applicazioni spaziali scientifiche e sviluppi tecnologici innovativi</p>
<p>Scientific contact person</p>	<p>Prof. Daniele Bortoluzzi</p>
<p>Brief description of the proposed research</p>	<p>L'obiettivo del progetto di Dottorato è quello di sviluppare tecnologie abilitanti per sistemi meccatronici in ambito spaziale. L'attività formativa prevede la frequenza di corsi di dottorato specifici sulle tecnologie più avanzate relative alla modellazione, stima e controllo di sistemi meccatronici, tecnologie di lavorazione non convenzionali, trasduttori ed attuatori innovativi. Le attività di natura applicativa prevedono la partecipazione a progetti di sviluppo di prototipi, qualificazione e testing di sistemi meccatronici spaziali, affiancamento ad attività di progetto svolte sia presso il laboratorio Space Applications del Dipartimento di Ingegneria Industriale che presso le strutture del partner OHB Italia. I risultati attesi sono la produzione di nuove conoscenze, opportunamente documentate su pubblicazioni scientifiche, partecipazione a congressi internazionali ed il contributo alla realizzazione di milestones di progetto di ricerca e sviluppo di sistemi meccatronici innovativi.</p> <p>L'attività formativa sarà svolta in conformità all'offerta della Scuola di Dottorato e prevede la frequenza di Corsi di natura teorica ed applicativa-laboratoriale coerenti con la tematica di ricerca. La ricerca verterà sulle tecniche di modellazione, validazione, analisi e stima dello stato di sistemi meccatronici per applicazioni spaziali (sensori avanzati per l'esplorazione gravimetrica/radiometrica della Terra, meccanismi di rilascio, ecc.), includendo le tecnologie innovative (ad esempio additive) per la loro realizzazione e/o per lo sfruttamento di risorse in situ per l'esplorazione di ambienti extraterrestri. L'approfondimento e lo sviluppo di queste tecniche saranno utilizzati come strumento progettuale per nuovi dispositivi meccatronici finalizzati ad applicazioni scientifiche e di esplorazione.</p>
<p>Name of the company</p>	<p>OHB Italia S.p.A. - 20151 Milan (MI), ITALY</p>
<p>Brief presentation of the company</p>	<p>OHB Italia ha esperienza nell'ambito della meccatronica per lo spazio da più di 20 anni. Il primo progetto del genere è stato EDEN / VVIS Body Rotating Device che volò sullo Spacelab.</p> <p>Da allora ha sviluppato diversi sistemi per ESA ed ASI sia come contraente principale sia come fornitore. Dal 2015 è stata istituita un'unità dedicata allo sviluppo di meccanismi per lo spazio.</p> <p>I prodotti principali sono meccanismi di ritenzione e rilascio in orbita, sistemi di attuazione, posizionamento e movimentazione in orbita e sistemi di manipolazione.</p> <p>Le attività di ricerca in corso si svolgono nei seguenti ambiti:</p> <ul style="list-style-type: none"> - Sensori gravitazionali orbitali



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	<ul style="list-style-type: none"> - Strumenti per osservazione della terra - Impianti ISRU (In Situ Resources Utilization) lunari - Pannelli solari dispiegabili flessibili di grandi dimensioni - Sistemi di supporto meccatronici per osservatori di terra (nell'ambito del monitoraggio di oggetti pericolosi e dell'osservazione astronomica)
Research activities to be carried out during the period spent in the company	<p>L'attività si svolgerà seguendo il flusso completo dello sviluppo e, quindi, passando attraverso:</p> <ul style="list-style-type: none"> - identificazione e consolidamento dei requisiti di sistema e generazione delle specifiche di sottosistema / equipaggiamento; - definizione delle soluzioni tecniche da implementare nel sistema meccatronico (meccaniche, termiche, attuazione e controllo) dal progetto preliminare a quello di dettaglio da portare avanti in collaborazione con un gruppo di specialisti - integrazione e test del sistema (prove funzionali ed ambientali)
Period spent in the company	8 mesi
Research activities to be carried out abroad	Collaborazione ad attività di progetto relative ad aspetti meccatronici in missioni spaziali ESA
Period spent abroad	6 mesi
Name of the host institution abroad	ESA Noordwijk, Olanda



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Doctoral Programme in MATERIALS, MECHATRONICS AND SYSTEMS ENGINEERING

Proposed research/Scholarship title	Q-PILOT
Scientific contact person	Dott. Davide Brunelli
Brief description of the proposed research	<p>Il progetto si pone l'obiettivo di implementare una soluzione software che, basando le proprie logiche su degli algoritmi di Machine Learning ed integrandosi in una soluzione preesistente, sia in grado di impartire ai motori installati nell'impianto di riferimento i comandi necessari per aumentare l'efficienza dell'intero impianto.</p> <p>L'attività prevede una preliminare fase di studio del funzionamento degli impianti di frantumazione per il mondo degli inerti e degli impianti di riciclaggio, una seconda fase di studio/identificazione dell'algoritmo di machine-learning più idoneo, una terza fase di implementazione dell'algoritmo stesso ed una quarta fase di test ed ottimizzazione dell'algoritmo stesso.</p> <p>Dalle analisi preliminari l'algoritmo sarà in grado di apportare fin dalle prime versioni un'efficienza all'attuale sistema di controllo di circa il 15%. L'efficienza dell'algoritmo potrà essere verificata sul campo o tramite simulazioni.</p> <p>Il candidato dovrà formarsi su tecniche di ottimizzazione dei processi industriali, e su tecniche di Machine Learning ed ottimizzazione.</p> <ul style="list-style-type: none"> - La lista dei corsi offerti dalla scuola di dottorato MMSE (e da scuole affini) sono adeguate per introdurre il candidato nella prima parte del percorso di dottorato (M0-M6) ed modellare il problema da affrontare su casi analoghi nello stato dell'arte. - Il periodo successivo sarà caratterizzato dall'acquisizione dei dati e dallo studio del modello da ottimizzare. L'attività sarà svolta prevalentemente in azienda (M6-M12) - Il periodo M12- M24 è pensato per ottimizzare i modelli sviluppare metodi di ottimizzazione dei processi. (anche questa parte sarà svolta in azienda) - Infine, il periodo (M24-M36) sarà speso per consolidare i risultati ottenuti, grazie ad un periodo di verifica validazione dei modelli, svolto anche con partner accademici ed aziendali all'estero. Infine, la preparazione della tesi e della difesa della tesi, si concentrerà sull'ultimo periodo.
Name of the company	Ma-Estro s.r.l.
Brief presentation of the company	<p>Nel 2006 viene costituita la Ma-Estro con l'obiettivo di automatizzare gli impianti dei settori minerario e del riciclaggio. Ad oggi Ma-Estro è presente in più di 500 siti produttivi, prevalentemente sul territorio italiano. I prodotti e servizi proposti sono incentrati sull'ottimizzazione del processo produttivo. Ogni automazione ha come focus principale quella di portare efficienza ed include quindi: PLC per il controllo dell'impianto e per l'intelligenza dello stesso, sensori per la raccolta dei dati dal campo nonché una soluzione cloud per lo storage e la gestione operativa dell'impianto (offriamo un sistema di gestione fabbrica per la</p>



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	gestione delle commesse, delle manutenzioni e per la supervisione della produzione). Sono attualmente in corso delle valutazioni per brevettare l'idea di progetto.
Research activities to be carried out during the period spent in the company	Le principali attività di ricerca saranno concentrate sulla definizione di un unico algoritmo di Machine Learning che, sulla base delle caratteristiche del materiale oggetto di lavorazione, del lay-out dell'impianto e delle altre peculiarità anche temporanee dell'impianto stesso (es. potenza macchinari ed usura dei vari componenti) sia in grado di effettuare le regolazioni più idonee al mantenimento dei KPI preimpostati dall'operatore responsabile del corretto funzionamento dell'impianto stesso.
Period spent in the company	Si prevedono di utilizzare tutti i 18 mesi concessi dal DM352 per la permanenza in azienda. Il numero effettivo potrebbe essere ridotto qualora le altre attività necessarie e previste dalla scuola di dottorato (ad es. l'acquisizione di crediti formativi, o la comprensione delle tecniche di Machine Learning necessarie, rendano necessario una presenza più intensa in Università.
Research activities to be carried out abroad	Sviluppo e verifica dei modelli predittivi e decisionali sviluppati
Period spent abroad	6 mesi
Name of the host institution abroad	Al momento non c'è un unico interlocutore internazionale interessato all'iniziativa. Le istituzioni estere che potrebbero consolidare un interesse di collaborazione, oltre a quelli già stabiliti con l'università di Trento sono: ETHz (CH), University of Newcastle (UK), TU Delft (NL) con cui UniTrento ed il gruppo di ricerca al DII, con il quale l'azienda ed il dottorando si relazionano, hanno già in corso.



Doctoral Programme in BIOMOLECULAR SCIENCES

<p>Proposed research/Scholarship title</p>	<p>Optimization of extracellular vesicles, and their production process, for the delivery of CRISPR-Cas.</p> <p>Ottimizzazione di vescicole extracellulari e del loro processo di produzione, per il delivery di CRISPR-Cas</p>
<p>Scientific contact person</p>	<p>Prof. Anna Cereseto</p>
<p>Brief description of the proposed research</p>	<p>Il progetto proposto ha come scopo generale l'ottimizzazione di VesiCas, sistema di delivery per CRISPR-Cas sviluppato nel laboratorio della prof. Cereseto e di proprietà di Alia. Il progetto si declina in due obiettivi realizzativi principali: i) ottimizzare la linea cellulare utilizzata per produrre VesiCas con lo scopo di aumentarne la produttività e la qualità delle vescicole prodotte in termini di attività specifica; ii) ingegnerizzare le vescicole in modo da ottenere un tropismo cellulare o tissutale specifico attraverso l'utilizzo di proteine virali o altri recettori di membrana capaci di indirizzare le vescicole verso un tipo cellulare definito. In particolare, per il primo obiettivo si procederà inizialmente a comprendere e valutare i processi metabolici e cellulari che possano interferire nel processo di produzione delle vescicole, anche attraverso approcci di whole genome CRISPR screen. Successivamente si passerà a creare linee cellulari opportunamente ingegnerizzate per validare i risultati del primo step. Infine, verranno generate le relative banche cellulari e le condizioni di coltura e di produzione delle vescicole verranno verificate e se necessario ottimizzate per la linea cellulare selezionata. Il secondo obiettivo verrà svolto in parallelo andando inizialmente a sviluppare un saggio high throughput che permetta di individuare in modo rapido e funzionale diverse molecole per il pseudotyping delle vescicole. L'obiettivo è quello di selezionare un set di proteine di membrana che permettano un targeting specifico delle vescicole ai neuroni e ai muscoli. I candidati verranno poi confermati in vitro e infine validati in modelli murini reporter. Il nuovo design delle vescicole verrà poi valutato in produzione e se necessario, il processo verrà ottimizzato per massimizzarne la resa oltre che la purezza finale. I risultati attesi si possono riassumere in: ottimizzazione del processo di produzione di VesiCas con un aumento della produttività della linea cellulare e creazione della relativa banca cellulare secondo standard che ne permettano un trasferimento in GMP; generazione di nuove versioni di VesiCas per il delivery tessuto specifico nel il sistema nervoso centrale o nel muscolo.</p> <p>In aggiunta alla frequenza ai corsi di formazione obbligatori proposti dalla Scuola di Dottorato, il dottorando verrà affiancato da ricercatori esperti nello svolgimento delle sue attività in modo da permettere una formazione continua relativamente alle tecniche di laboratorio e strumentazioni impiegate. Il dottorando verrà inoltre indirizzato nello studio della letteratura scientifica rilevante agli scopi del progetto. L'attività di ricerca si focalizzerà principalmente sull'identificazione e validazione in vitro di nuovi recettori da incorporare nel sistema VesiCas per garantire una veicolazione tessuto-specifica del sistema CRISPR.</p>



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Name of the company	Alia Therapeutics srl
Brief presentation of the company	Alia Therapeutics è nata nel 2018 come spin-off dell'Università di Trento e la sua missione è creare una nuova generazione di strumenti per la terapia genica caratterizzati da alta efficacia e un ottimo profilo di sicurezza, così da renderli particolarmente adatti alle applicazioni cliniche. Nello specifico ci avvaliamo del sistema CRISPR/Cas per correggere mutazioni in geni target legati allo sviluppo di malattie ereditarie rare e attualmente incurabili. Un settore di forte interesse nel campo della terapia genica è lo sviluppo di sistemi per veicolare la nucleasi fino alla cellula bersaglio. In questo ambito stiamo sviluppando un sistema innovativo basato su vescicole extracellulari prodotte da cellule ingegnerizzate che permettono l'ingresso della nucleasi nelle cellule bersaglio come proteina, con grandi vantaggi sul profilo della sicurezza. Tale sistema è stato protetto da brevetto (in capo ad Alia Therapeutics) ed è stato originariamente descritto nell'articolo scientifico Montagna et al., MTNA 2018.
Research activities to be carried out during the period spent in the company	Durante la permanenza in impresa il dottorando si occuperà di ottimizzare il processo di produzione di VesiCas ingegnerizzando una linea produttrice, oltre alle condizioni di coltura, trasfezione e produzione, in modo da garantire alte rese di vescicole con alta attività di genome editing. Questo richiederà lo svolgimento di diverse analisi high-throughput e di sequenziamenti di tipo NGS.
Period spent in the company	18 mesi
Research activities to be carried out abroad	Ottimizzazione dei processi di produzione e purificazione su larga scala di VesiCas, in collaborazione con selezionati partner industriali
Period spent abroad	6 mesi
Name of the host institution abroad	Tra le possibilità vi sono EVerZom, Testa Center, Hansa Biomed