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UNIVERSITÀ DI TRENTO

Call for admission to the Doctoral positions with scholarships of the 38th cycle (a.y. 2022/23) according to the Directorial Decree no. 1031/2022, 1058/2022 e 119/2022, within the Italian National Recovery and Resilience Plan (NRRP), in the frame of Mission 4, component 2 "From Research to Business" in the context of the Doctorates of the 38th cycle (a.y. 2022/23)

A.Y.2022/2023 – Cycle 38

RESEARCH TOPIC DESCRIPTION

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Doctoral Programme in BIOMOLECULAR SCIENCES

Proposed research/Scholarship title	Standardization and validation of methods for iPSC generation, differentiation and cryopreservation for biobanking implementation.
Supervisor	Prof. Luciano Conti
Brief description of the proposed research	Human induced pluripotent stem cells (hiPSCs) have emerged as a unique tool for understanding disease mechanisms, creating cell models for drug development, and generating novel clinical therapies. Indeed, they provide a limitless and sustainable supply of accessible patient-derived cell types. This project aims (i) to set up standardized and validated procedures to generate a collection of hiPSC lines from patients affected by neuropsychiatric and neurodevelopmental disorders and (ii) to optimize their neural differentiation potential to robustly create in vitro disease-relevant functional 2D and 3D neuronal models. These cellular resources will be deeply investigated at morphological, molecular and functional levels to get novel insight to foster the understanding of the molecular and cellular mechanisms underlying the pathogenesis of these CNS disorders.

Doctoral Programme in BIOMOLECULAR SCIENCES

Proposed research/Scholarship title	Standardization and validation of methods for biofluid-derived EVs (Extracellular Vesicles) isolation, detection, storage and characterization for biobanking.
Supervisor	Prof.ssa Francesca Demichelis
Brief description of the proposed research	In the last few years extracellular vesicles (EVs) and their associated molecular cargos (including proteins, RNA, DNA, etc.) have emerged as compelling biomarkers for the diagnosis and the progression assessment of several diseases. In this context, this project aims to optimize and validate standardized procedures towards the establishment of an innovative biobank of EVs isolated from multiple biological samples using several technological approaches. Optimization and standardization will encompass several steps, including: i) definition of procedures for the optimal processing and storage of biofluids; ii) implementation of multiple methodological approaches for EV isolation; iii) EV quantification and EV-subpopulations profiling by imaging technologies (such as nanoparticle tracking analysis technology and/or imaging flowcytometry); iv) definition of ideal conditions for EV storage; v) optimization of protocols for extraction of EVs-associated molecular components. Overall, given the EV's clinical implications, this project will contribute to the generation of a valuable platform to support precision medicine implementation.

Doctoral Programme in BIOMOLECULAR SCIENCES

Proposed research/Scholarship title	Implementation of drug screening and drug design technologies.
Supervisor	Prof. Alberto Inga
Brief description of the proposed research	The project will capitalize on the strong expertise of various research groups in UNITN on the subjects of drug screening, also taking advantage of the High Throughput Screening and Validation and of the Cell Technology facilities. Main objective is the exploitation of forward and reverse chemogenomics approaches through the development of new disease-relevant in vitro models, in silico and HTS screening of novel and repurposed libraries, de novo drug design and deep biological characterization of the disease models and the drugs mechanism of action.

Doctoral Programme in INFORMATION ENGINEERING AND COMPUTER SCIENCE

Proposed research/Scholarship title	High Performance Artificial Intelligence for climate change research at extreme-scale
Supervisor	Tutor: dott. Flavio Vella Co-tutor: Prof. Andrea Passerini, Prof. Sandro Luigi Fiore
Brief description of the proposed research	Motivated by the problem of finding extreme weather patterns in climate data, the project focuses on the design of high-performance computing and deep learning techniques to design accurate climate prediction systems at a high-resolution scale. In particular, by following an interdisciplinary approach, we will investigate graph-based learning models (e.g., Graph Neural Networks) and their efficient implementation on exascale computing systems in the climate domain. Therefore, the research playground is a vibrant multidisciplinary area where big data, deep learning, HPC, and parallel computing converge to address the prediction of climate extreme events at scale. The activity will contribute to the software infrastructure of the next generation Earth system models (ESMs) workflows within the "Earth & Climate" Spoke of the recently established ICSC - Italian National Center for High-Performance Computing, Big Data, and Quantum Computing. Previous experience with graph learning-based algorithms or Multi-GPUs systems is a plus but is not a strict requirement.

Doctoral Programme in CIVIL, ENVIRONMENTAL AND MECHANICAL ENGINEERING

Proposed research/Scholarship title	Hydrological Extremes in Storm-Resolving Earth System Models: Spatio-temporal characteristics in present and future climates.
Supervisor	Prof.ssa Simona Bordoni
Brief description of the proposed research	The frequency, duration and intensity of hydrological extremes, such as droughts and extreme rainfall events, have been observed to increase in different regions of the world, albeit at different rates. Regional changes in extremes are potentially among the most impactful consequences of global warming, and yet they remain affected by significant uncertainty, primarily because state-of-the-art climate models that are currently used to project future changes cannot explicitly resolve essential processes and scales. In this project, we will explore hydrological extremes both globally and regionally in two global storm-resolving Earth System Models (ESMs) that are being developed as part of the EU funded H2020 NextGEMS project (https://nextgems-h2020.eu). Spatiotemporal characteristics of extremes in both the tropics and the extra-tropics (including the Mediterranean basin) will be carefully evaluated and compared to those assessed from observations, as well as coarse resolution ESMs within the CMIP6 archives. In particular, leveraging the unprecedented resolution of NextGEMS model outputs, we will explicitly consider extremes of different length and time scales, which, associated with different circulation regimes or weather systems, may respond differently to climate change. It is expected that this project will: 1) Improve our understanding of the thermodynamics and dynamics (including the connection with large-scale circulation patterns) of extreme events globally and regionally; 2) Highlight key processes that climate models need to resolve to faithfully reproduce extremes and, hence, inform future parameterisation and model development; 3) reduce the uncertainty of changes and hazards related to these high-impact events. Suggested skills - The PhD candidate is expected to have a background in physics, math, earth and environmental sciences or related disciplines, as well as experience in the analysis of observational data and/or numerical simulations, including machine learning techniques. Previous training in meteorology, atmospheric physics, oceanography and/or climate dynamics will be considered a plus.

Doctoral Programme in MATERIALS, MECHATRONICS AND SYSTEMS ENGINEERING

Proposed research/Scholarship title	Robotic devices for health
Scientific contact person	Prof. Mariolino De Cecco, Prof. Daniele Fontanelli, Prof. Andrea Del Prete, Prof. Giandomenico Nollo
Brief description of the proposed research	Devices for Health include innovative systems for advanced diagnosis, therapies, assistance, and healthy life. All of the above can be achieved with robotics. Imagine a robotic agent able to assist an impaired person in walking while measuring their behaviour and physiological parameters in a gamified software environment. Patient status evaluation could then be performed through their collaborative behaviour. Assistance, rehab and thus an appropriate therapy able to foster a healthy lifestyle would be achieved simply by using a device, which could be made more attractive through gamification factors, such as performance recording and proper presentation. Augmented Reality interfaces, social sharing and socially acceptable behaviours, human-robot interaction and shared autonomy will be the principal items touched by this PhD project. The PhD student shall develop knowledge on the current state of the art in the applicative field of human assistive devices for walking, propose novel solutions and algorithm to tackle the identified research gaps, focus on relevant technologies to develop and test the proposed solutions in relevant scenarios, such as the Interdepartmental Institute of Robotics of our University or the Ausilia facility at the Villa Rosa rehabilitation Hospital in Pergine. - On this ground, the research could focus on algorithms, techniques and technologies related to collaborative robotics. The developed robotic prototype could be equipped with shared autonomy capabilities and increased human-robot interaction, network physiology for patient feedback automatic estimation. Mixed Reality to increase human perception, human motion predictions in shared environments, socially aware motion planning and control for navigation in populated environments.