UNIVERSITÀ DEGLI STUDI DI BERGAMO | Scuola di alta formazione dottorale

CALL FOR PHD PROFGRAMMES ON "TECHNOLOGY FOR SMART CITIES AND DIGITALISATION AND "ADVANCED MATERIALS AND PROCESSES FOR INDUSTRY 4.0" IN COLLABORATION WITH ENEA

Within the scientific collaboration framework between the University of Bergamo and ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development – some PhD positions have been opened (XXXV Cycle).

The PhD students will be involved in the recently established **Joint Laboratories** in the field of **Technology for Smart Cities and Digitalisation** and of **Advanced Materials and Processes for Industry 4.0**, which will be established at the Kilometro Rosso Innovation District in Bergamo.

All the information pertaining to the public selection can be found on the website: https://www.unibg.it/bandi/bando-concorso-lammissione-corsi-dottorato-ricerca-xxxv-ciclo

The PhD School can provide additional support in all the matters regarding the selection procedure and scholarship grants (phd-school@unibg.it) while the Academic supervisor (mail listed below) are available for any issue concerning the scientific program content.

THE RESEARCH TOPICS

Development of sensor system architectures for the effective collection of measurement data (multisensor data fusion for anomaly detection and assisted living in a home environment)

The project plans to design and fabricate sensor platforms based on commercial devices, and to study their integration in a "smart building". The platform architecture will be optimized for different applications, from the detection of anomalies in the building systems to the detection of the energy consumption for each of the systems in the building. Also in the frame of a "smart building", the project plans to investigate the use of wearable sensors to monitor the activity and the physiological parameters of people inside the building itself, especially in view of enabling an assisted living infrastructure for the elderly and/or for people affected by diseases that require a continuous monitoring of the patients' conditions. A crucial issue of this research is the development of custom algorithms for these applications, for example to allow for the disentanglement of loads and the identification of the characteristic signatures of each household appliance by an analysis of the aggregate energy consumption of the building. To avoid bottlenecks in the transmission of data, the project will evaluate the implementation of these algorithms in the firmware of the microcontrollers integrated in the sensor platforms.

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Microservices for Big Data and their use for Smart Cities

Smart City technologies are associated with scenarios with distributed infrastructures, with the frequent need to manage large amounts of data. Computer science research has devoted much attention recently to the study of distributed architectures that operate according to the microservices paradigm, applying the principles of data decomposition on a large scale. Significant example of this decomposition-based approach is represented by MapReduce systems, which saw great initial success with the Hadoop system. Programming languages have been developed for these scenarios, dedicated to the representation of parallel and scalable solutions, such as Scala. A recent development in this domain is represented by the Apache Spark technology, which offers a solution for the distributed and parallel processing of data by adapting the principles that have guided the development of distributed databases and in which it is possible to obtain higher performances compared to Hadoop thanks to an execution strategy that tries to keep the data in memory and to minimize the costly write operations to mass memory. Thanks to these technologies it is possible to create systems capable of offering good performance and low response times on large volumes of data. The data analyzed can potentially be very recent. The use of a microservice architecture also makes the system easy to integrate with a wide range of application development technologies, both in traditional contexts and in contexts based on an extensive use of cloud technologies.

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Development of solutions for the collection and processing of environmental data in the Province of Bergamo

A scenario is considered where the development of advanced technologies and platforms is closely integrated with the needs of companies and institutions interested in managing environmental data. In this domain ENEA holds a leading role and the standards and IT platforms designed with ENEA's contribution in these areas constitute an important reference point. The activity associated with this theme has the ambition to establish a clear link between ENEA and the private and public actors of the Bergamo area, in order to disseminate the use of these data to those who can obtain a direct benefit from their production, management and analysis. A goal is also to develop a set of skills regarding the development of applications that make use of these tools. Developing an ecosystem of services based on environmental data requires that companies active in software design become familiar with these solutions and skills. The benefits of this initiative can extend over a very broad front. In addition to producing scientific publications, a significant economic and social impact is expected.

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Development of innovative textile architectures based on recycled carbon fibers for the composite materials sector.

Carbon fiber-based composite products are becoming more widespread and are increasingly finding application in multiple industrial sectors and in people's daily lives. To make them, raw materials with a high cost are used, whose processing waste must now be treated as special waste. Thanks to this new project, composite materials at the end of their life and processing waste will no longer be considered a waste to be sent to landfill or, at best, a poor quality raw material to be used for creating second-choice products or with low added value. On the contrary, they can be reintroduced into the production cycle as quality raw materials, and potentially reused countless times for the creation of ever new products. The main objective of the PhD project is to develop a system that allows the production of carbon product for different industrial applications obtained through the use of production waste and composite material come to the end of their life and therefore destined for disposal. In order to reach the ambitious goal of the project, research activities will have to focus on the development of actions aimed at recovering fibers from scraps or waste, through proper characterization, process development, experimental prototypes and circular economic models.

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