



PhD in SCIENZE E TECNOLOGIE ENERGETICHE E NUCLEARI / ENERGY AND NUCLEAR SCIENCE AND TECHNOLOGY - 38th cycle

PARTENARIATO PNRR Research Field: INTEGRATION OF ARTIFICIAL INTELLIGENCE IN THE PROBABILISTIC MODELLING OF POLLUTANT TRANSPORT FOR THE RISK ASSESSMENT OF AQUIFER CONTAMINATION FROM INDUSTRIAL ACTIVITIES

Monthly net income of PhDscholarship (max 36 months)

€ 1195.5

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

CUP D43C22003030002

Decreto di concessione D.D. 1552 del 11/10/2022

D.D. 341 del 15/03/2022 Avviso pubblico per la presentazione di Proposte di intervento per la creazione di “Partenariati estesi alle università, ai centri di ricerca, alle aziende per il finanziamento di progetti di ricerca di base” – nell’ambito del Piano Nazionale di Ripresa e Resilienza, Missione 4 “Istruzione e ricerca” – Componente 2 “Dalla ricerca all’impresa” – Investimento 1.3, finanziato dall’Unione europea – NextGenerationEU

Motivation and objectives of the research in this field

The objective is to address the problem of pollutant transport across heterogeneous aquifer systems within a probabilistic risk assessment framework coping with various sources of uncertainty (i.e., conceptual/model and parametric uncertainty, including uncertainties related to extreme climate events). The research is aimed at identifying time-dependent preferential pathways of pollutants across groundwater systems and leverage on a stochastic approach to model their transport across complex hydrogeological systems, when the a risk assessment of aquifer contamination from industrial activities must be conducted. A unique framework to assess and propagate uncertainty in a systematic and transparent way across heterogeneous aquifer systems



	<p>will be developed by (a) quantifying uncertainty through ensemble and information theory techniques, (b) assessing data-worth (including data-assimilation frameworks) via probabilistic inverse modeling, and (c) model reduction through physics-based artificial intelligence (Physics Based Neural Networks, PINN), and local and global sensitivity analysis. The research activity conducted within the RETURN - Partenariato Esteso Multi-Risk Science For Resilient Communities Under a Changing Climate (Piano Nazionale di Ripresa e Resilienza - PNRR), Spoke VS4: Environmental Degradation.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>The research activity aims at developing innovative artificial intelligence and sensitivity analysis methods for the probabilistic modelling of pollutant transport for the risk assessment of aquifer contamination from industrial activities. Methods and techniques to be considered for this (in an integrated manner) are: Physics Based Neural Networks, Deep Artificial Neural Networks, Convolutional Artificial Neural Networks, Generative Adversarial Networks, Reservoir Computing, Support Vector Machines, Grey-box models, Genetic Algorithms, Evolutionary Optimization, Kriging Metamodels, Bayesian Inverse Uncertainty Quantification Methods, local and global sensitivity analysis methods, variance-based and distribution-based methods, information theory techniques for sensitivity analysis. The PhD student will benefit from the international and interdisciplinary research teams involved in the RETURN - Partenariato Esteso Multi-Risk Science For Resilient Communities Under a Changing Climate (Piano Nazionale di Ripresa e Resilienza - PNRR), Spoke VS4: Environmental Degradation.</p>
<p>Educational objectives</p>	<p>To prepare a RAMS (Reliability, Availability, Maintainability and Safety), Risk and Resilience professional, expert and competent researcher with the technical skills, algorithmic knowledge and system analysis capabilities for evaluating and making decisions for preventing and managing the risk of industrial systems, with also specific domain expertise and</p>



	consideration of pollutant transport and aquifer modelling.
Job opportunities	RAMS, reliability, maintenance, safety, risk engineer and manager, data analyst in support of decision making for complex industrial systems (e.g., energy generation and distribution, nuclear, chemical, etc.) design, operation, management and regulation, researcher in national and international research centers and universities.
Composition of the research group	2 Full Professors 1 Associated Professors 1 Assistant Professors 12 PhD Students
Name of the research directors	Enrico Zio

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	598.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Educational activities: Financial aid per PhD student is available for purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences, instrumentations and computer, etc. The amount is equal to 10% of the annual gross amount, for 3 years.</p> <p>Teaching assistantship: Availability of funding in recognition of supporting teaching activities by the PhD student. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.</p> <p>Computer availability: individual use.</p> <p>Desk availability: individual use.</p>