Bridging Models at Different Scales to Design New Generation Fuel Cells for Electrified Mobility (BLESSED)

HORIZON-MSCA-2021-DN-01-01 - MSCA Doctoral Networks 2021
Reduced-Order Modelling of combined chemical and mechanical PEMFC membrane degradation (BLESSED-DC7)

JOB INFORMATION
Organisation/Company: Scuola Internazionale Superiore di Studi Avanzati – SISSA / AVL LIST GMBH
Department: Mathematics Area, PhD course in Mathematical Analysis, Modelling, and Applications
Country: Italy / Austria
Application Deadline: November 16th 2023 – 13.00 hrs
Type of Contract: Temporary
Job duration: 36 months
Job Status: Full-time
Offer Starting Date: January 1st 2024
Is the job funded through the EU Research Framework Programme?
Marie Curie Grant Agreement Number: 101072578

OFFER DESCRIPTION

The Doctoral Candidate (DC7) will be hired for two consecutive 18-month periods as part of the “Bridging Models at Different Scales To Design New Generation Fuel Cells for Electrified Mobility (BLESSED)” project which is funded through the Horizon Europe Marie Skłodowska-Curie Actions (MSCA) Doctoral Networks 2021. The DC7 individual project will be realized:

a) at the Scuola Internazionale Superiore di Studi Avanzati - SISSA (Trieste, Italy), supervised by Prof. Gianluigi Rozza;
b) at AVL LIST GMBH (Graz, Austria), under the supervision of Dr. R. Pöschl. DC7 will be enrolled as a PhD student at SISSA, under the supervision of Prof. Gianluigi Rozza to develop a project on computational and model reduction strategies by automatic learning.

Hydrogen-powered Proton Exchange Membrane Fuel Cells (PEMFCs) are carbon-free power devices that meet these goals in both mobile and stationary applications. BLESSED aims at revolutionising the design process of next generation PEMFCs, to improve efficiency, durability and affordability for widespread use, with direct implications in clean energy and sustainable industry/mobility. PEMFC applications are exposed to interacting degradation mechanisms which deteriorate the polymer electrolyte assembly, especially the reinforced membrane.
Further information can be found at: https://cordis.europa.eu/project/id/101072578

DC7 will focus on the combination & modelling of the interaction mechanisms for chemical & mechanical membrane degradation. Reduced Order Methods (ROMs) and Machine Learning (ML) will be used to analyse the parametric response of the model by using only a reduced number of high-fidelity simulations and experimental data to identify the weight of governing stressors. The ROM will be based on hybrid (high fidelity numerical simulations & available experimental data) approaches combined with the domain knowledge in terms of governing equations. The aim is to compile an interacting mechanism for chemical & mechanical degradation and extrapolate degradation data to investigate the weight of governing stressors. Physics informed neural networks will be used if the amount of training data is small.

Expected Results of DC7 are: (i) A novel computationally efficient strategy for combined degradation models. (ii) A computational framework based on ROM & ML which resembles the effects of chemical & mechanical degradation, which will be suitable for concept design studies of FCs and serve as a basis for real-time models to be used in controls. (iii) Impact of PEMFC operation profile on membrane degradation.

During the project, the DC7 will spend two-month secondment at CNRS (Amiens, France) under the supervision of prof. A. Franco to harmonise on the applied chemical degradation approaches and two-month secondment at University of Ljubljana (Ljubljana, Slovenia) under the supervision of prof. T. Katrašnik to harmonise on the applied mechanical degradation approaches.

REQUIREMENTS

Main research fields  Renewable energy, electromagnetism and electronics, automotive engineering, computational science, fuel cells

Education Level  Master of Science degree or equivalent


ADDITIONAL INFORMATION

Working place, supervisor, and secondments
The project will be carried on under the supervision of Prof. Gianluigi Rozza, within the Mathematical Analysis, Modelling, and Applications group at SISSA - Scuola Internazionale Superiore di Studi Avanzati - Trieste, Italy. SISSA is a scientific center of excellence within the national and international academic scene, with focus on three main areas: Physics, Mathematics and Neuroscience. SISSA
features 100 professors and researchers, about 100 post-docs, 300 Ph.D. students and 115 technical administrative staff members. SISSA offers top facilities for research, such as High-Performance Computing. SISSA has leading roles in large international collaborations and, constitutes a research network with the other scientific institutions in the area; SISSA has also drawn up several collaboration agreements with the world's leading schools and research institutes. SISSA holds the top position among Italian scientific institutes in terms of research grants obtained in relation to the number of researchers and professors. The SISSA Valorisation Office will provide support for talent enhancement, career development, and offer training on best practices for dissemination and public outreach.

The Mathematical Analysis, Modelling, and Applications group has been one of the first to be established in SISSA and has awarded more than 220 Ph.D. titles in more than 40 years. The group comprises 15 staff members, 15 postdocs and 38 Ph.D. students.

The activity in mathematical analysis is mainly focused on Dynamical Systems and PDEs, on the Calculus of Variations, on Hyperbolic Conservation Laws and Transport Problems, on Geometric Analysis and on Geometry and Control theory. Connections of these topics with differential geometry and reduced order modelling are also developed.

The activity in mathematical modelling is oriented to subjects for which the main technical tools come from mathematical analysis. The present themes are multiscale analysis, mechanics of materials, micromagnetics, modelling of biological systems, computational fluid and solid dynamics, numerical analysis and scientific computing, and problems related to control theory.

The applications of mathematics developed in this course are related to the numerical analysis of partial differential equations and of control problems. This activity is developed in collaboration with MathLab group for the study of problems coming from the real world, industrial and medical applications, and complex systems.

The BLESSED project foresees that all DCs will spend at least 50% of their fellowship duration in one out of the eight non-academic beneficiaries of the project.

DC7 will spend the second 18 months at AVL which is one of the world's leading mobility technology companies for development, simulation, and testing in the automotive industry and, in other sectors. AVL will contribute to the fundamental courses on the principles of FCs and the physics behind. It will also deliver advanced training for automotive systems engineering, CFD analysis and optimization methods, applied for FCs components and systems. Finally, AVL will contribute to the transferable skills with emphasis on innovation management and mapping business and technology.

Gianluigi Rozza is professor in Numerical Analysis and Scientific computing at SISSA - Scuola Internazionale Superiore di Studi Avanzati, Trieste, Italy. Phd in Applied Mathematics at EPFL in 2005, MSc in Aerospace Engineering at
Politecnico di Milano in 2002, post-doc at MIT. At SISSA he is the coordinator of SISSA Mathematics Area, lecturer in the master in High Performance Computing, in the master degree in Mathematics with the University of Trieste, and in the master degree in data science and scientific computing. He is SISSA Director’s delegate for Valorisation, Innovation, Technology Transfer and Industrial Cooperation. His research is mostly focused in numerical analysis and scientific computing, developing reduced order methods. Author of more than 130 scientific publications (editor of six books and author of two books). Co-advisor of 30 master thesis, co-director/director of 20 PhD theses since 2009. Principal Investigator of the European Research Council Consolidator Grant (H2020) AROMA-CFD and PoC ARGOS (HE), as well as for the project FARE-AROMA-CFD funded by Italian Government. Within SISSA MathLab he is responsible of several industrial projects with companies such as Danieli, Electrolux, Wartsila and Fincantieri. He is member of the Applied Mathematics Committee of European Mathematical Society. More:http://people.sissa.it/grozza

Eligibility criteria
Applicants can be of any nationality and must hold a Master of Science degree (or equivalent) in a scientific subject, relevant to the aforementioned topics. They need to fully respect the following eligibility criteria:
(a) Must be doctoral candidates, i.e., not already in possession of a doctoral degree at the date of the recruitment.
(b) Must undertake transnational mobility. Researchers must not have resided or carried out their main activity (work, studies, etc.) in Italy for more than 12 months within the 36 months immediately before their date of recruitment. Compulsory national service, short stays such as holidays, and time spent as part of a procedure for obtaining refugee status under the Geneva Convention are not taken into account.

A good knowledge of spoken and written English is required and will be evaluated during the selection process.

How to apply

Candidates should apply through https://pica.cineca.it/sissa/ by 16th November 2023 – 13.00 hrs. CEST - and should provide:
- An application form duly completed.
- A Curriculum Vitae (CV) including previous technical and scientific experiences with a list of publications (if any) and/or participation to scientific meetings and research expertise.
- Motivation letter, including research interests and the reasons for applying for this programme;
- Undergraduate level certificates, including university grades and the detailed list of university courses with grades. Copies of any other scientific publication that the candidate believes significant are also welcome.
- The applicant must also provide two reference letters.

**Evaluation and interview**
The selection process will consist of two different selection phases and will be based on:

1. Academic qualifications
2. Interview

After the first selection phase, based on the CVs and qualifications, only candidates with a minimum mark of 21/30 will be contacted to attend the interview. Candidates will be interviewed by a committee that includes at least two BLESSED members. The interview, aiming to assess the skills, the motivation and the fluency in English, will take place in SISSA or in remote between 27th and 30th November. The interview minimum mark to be considered eligible will be 49/70.

The first candidate in the ranking list (Academic qualifications + Interview) will be offered the position. If, for any reason, the selected candidate should decline the offer or will fail to comply with the requirements for taking up the position, the next in the classification list will be offered the position.

At SISSA, we value diversity and equality. SISSA recognizes that employees may wish to have working patterns that fit with their caring responsibilities or work-life balance. Due consideration will also be given to applicants who have had career breaks for reasons including maternity, paternity or adoption leave, disability or illness.

**Rights and responsibilities of researchers participating in Marie Sklodowska-Curie Actions**
The European Charter for Researchers is a set of general principles and requirements which specify the roles, responsibilities and entitlements of both researchers and the employers and/or funders of researchers. The aim of the Charter is to ensure that the nature of the relationship between researchers and employers or funders is conducive to successful performance in generating, transferring, sharing and disseminating knowledge and technological development and to the career development of the researchers.

It is mandatory for applicants to read and understand the detailed information regarding the rights and responsibilities of researchers engaged in a Marie Sklodowska -Curie Innovative Training Network. The European Charter for researchers can be accessed at [https://euraxess.ec.europa.eu/jobs/charter/code](https://euraxess.ec.europa.eu/jobs/charter/code).

**Employment contract and remuneration**
The selected candidate will receive a salary in accordance with the MSCA regulations for DCs. The gross salary includes a living allowance (€3400 per month subject to MSCA Country Correction Coefficient, namely 97.4% for Italy and 106.3% for Austria), a mobility allowance (€600 per month) and a family allowance.
(€660 per month), if the researcher has family ('Family' means persons linked to the researcher by (i) marriage or (ii) a relationship with equivalent status to a marriage recognized by the legislation of the country where this relationship was formalized or (iii) dependent children who are actually being maintained by the researcher). The guaranteed (EC) funding is for 36 months.

**Personal Data**
Any personal data will be processed in accordance with the General Data Protection Regulation 679/2016 EU (GDPR) on the Protection of Individuals.

The Director  
(Prof. Andrea Romanino)  
(digitally signed)