PhD Advert Template

Project title: Fuel cells for life – Developing computational tools for assessing fuel cell degradation

Accept all year-round applications

Funding information: Self-funded students only

Project description:

Hydrogen fuel cell electric vehicles (FCEVs), such as vans and heavy-duty trucks, will play a critical role in the decarbonization of the transportation sector. However, in order for FCEVs to be deployed at a large scale, its cost and durability have to be substantially increased, as recently noted by the [U.S. Department of Energy](https://millionmilefuelcelltruck.org/). Prof. Secanell’s research team has been developing an open-source software to aid in the computer-aided design of polymer electrolyte fuels for over a decade. The finite-element based framework, which is [available online](http://www.openfcst.org), simulates the transient, multi-phase mass, heat and charge transport, as well as electrochemical reactions taking place inside a fuel cell with the aim of optimising the fuel cell geometry and composition. Thus far, the computational models have helped engineers optimise electrode composition at beginning of life; however, they have not accounted for fuel cell degradation during the lifetime of the device in decision making. The aim of this project is to extend the modelling capabilities to account for membrane and catalyst degradation, in order to include end of life performance as part of the design cycle. The PhD student involved in this project will working within a dynamic team of software developers to extend the capabilities of the software, in particular, by extending the software capabilities to predict hydrogen peroxide formation and membrane mechanical and chemical degradataion, and by including these phenomena in the fuel cell design cycle. Funding for conference travel and internships will be provided.

The PhD student would work under the supervision of Prof. Marc Secanell, a leading researcher in the field of mathematical modeling of electrochemical energy systems, fabrication and characterization of polymer electrolyte fuel cells and electrolyzers, and design and optimisation. His laboratory has experimental equipment for validating all numerical models developed. He has received over 5,000 citations, has an h-index of 41 (see <https://bit.ly/2NrH9zq>), has been invited to speak at prestigious conferences (e.g., the Electrochemical Society Meetings and the Gordon Research Conference in Fuel Cells), and was co-chair of the 2022 Gordon Research Conference in Fuel Cells. Graduates under his supervision have been able to secure industry jobs at leading companies such as Johnson Matthey (UK), Siemens (US), Ballard Power Systems (Canada), Altair Engineering (Spain/US), and Circle Cardiovascular Imaging Inc. (Canada); postdoctoral fellowships at Lawrence Berkeley National Laboratory (US) and Paul Scherrer Institute (Switzerland); and faculty positions at the Indian Institute of Technology (IIT) and University of Calgary (Canada).

Applicants are expected to have the following qualifications:

**Basic qualifications**

1. A B.Sc, M.Sc., or equivalent degree in Chemical Engineering, Mechanical Engineering, Applied Mathematics, or Applied Physics.
2. Programming experience in any language (C/C++, Python, Fortran, Matlab, or others).
3. Strong communication and teamwork skills.
4. Strong desire to learn mathematical modeling of electrochemical systems and numerical methods.

**Preferred qualifications (these qualifications are a plus)**

1. Programming experience in an object-oriented language, preferably C++ and/or Python.
2. Experience in and understanding of numerical methods, in particular, the finite element method and its implementation in libraries such as deal.ii.
3. Experience in and understanding of electrochemical systems.
4. At least one scientific journal or conference publication.

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Application enquires: Prof. Marc Secanell [marc.secanell@ncl.ac.uk](mailto:marc.secanell@ncl.ac.uk)

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public relations

publishing

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design

drama

fashion

film studies

fine art

graphic design

interior design

music

music technology

photography

theatre studies

other

Economics

econometrics

financial economics

macroeconomics

microeconomics

political economics

other

Education

further education

higher education

nursery education

primary education

secondary education

special needs education

other

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acoustics engineering

aerospace engineering

atomic engineering

automotive engineering

bioengineering

biomedical engineering

chemical engineering

civil engineering

communications engineering

control systems

cybernetics

dynamics

electrical engineering

electronic engineering

energy technologies

environmental engineering

fluid mechanics

gas engineering

geotechnical engineering

integrated engineering

manufacturing engineering

marine engineering

mechanical engineering

mechanics

mechatronics

nanotechnology

offshore engineering

petroleum engineering

robotics

solid mechanics

structural engineering

structural mechanics

systems engineering

thermodynamics

other

Environmental Sciences

climate science

hydrology

marine sciences

meteorology

pollution

soil science

other

Finance

actuarial science

banking

financial management

insurance

investment

taxation

other

Food Sciences

food hygiene

food production

other

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archaeological science

forensic science

other

Geography

agricultural geography

cultural geography

economic geography

environmental geography

geographical information systems gis

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human geography

marine geography

physical geography

political geography

remote sensing

social geography

transport geography

urban geography

other

Geology

applied geology

geochemistry

geophysics

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geotechnology

hydrogeology

marine geology

palaeontology

seismology

volcanology

other

History & Archaeology

african history

american history

ancient history

archaeology

asian history

australasian history

british and irish history

economic history

european history

heritage studies

history

history of art

history of religions

history of science

medieval history

military history

modern history

russian history

social history

world history

other

Information Services

information security

information systems

librarianship

other

Languages, Literature & Culture

african studies

american studies

asian studies

australasian studies

chinese

danish

dutch

english language

english literature

european studies

finnish

french

german

italian

japanese

middle eastern studies

norwegian

portuguese

russian

spanish

swedish

other

Law

criminal law

commercial law

contract law

property law

other

Linguistics & Classics

ancient greek

celtic studies

classics

latin

linguistics

other

Materials Science

ceramics

glass

metallurgy

polymers

textiles

other

Mathematics

applied mathematics

applied statistics

computational mathematics

data analysis

engineering mathematics

mathematical modelling

medical statistics

operational research

probability

pure mathematics

statistics

stochastic processes

other

Medicine

anatomy

audiology

biomechanics

cardiology

complementary medicine

dentistry

endocrinology

epidemiology

neural engineering

neurology

nutrition

ophthalmology

optometry

pathology

pharmacology

pharmacy

physiology

physiotherapy

podiatry

radiology

speech science

tissue engineering

toxicology

other

Nursing & Health

adult nursing

community nursing

counselling

dental nursing

environmental health

health informatics

medical nursing

mental health nursing

midwifery

occupational health

occupational therapy

paediatric nursing

paramedical science

surgical nursing

other

Philosophy

ethics

metaphysics

philosophy of science

other

Physics

acoustics

astronomy

astrophysics

chemical physics

computational physics

electromagnetism

environmental physics

experimental physics

medical physics

nuclear physics

optical physics

particle physics

quantum mechanics

solid state physics

space science

theoretical physics

other

Politics & Government

development studies

government

international relations

politics

public policy

other

Psychology

child psychology

clinical psychology

community psychology

counselling psychology

developmental psychology

educational psychology

forensic psychology

health psychology

neuropsychology

occupational psychology

organisational psychology

psychotherapy

sport psychology

other

Sociology

criminology

disability studies

gender studies

socio economics

social work

other

Sport & Exercise Science

sport coaching

sport development

sport performance

sport technology

sport therapy

other

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divinity

religious studies

theology

other

Veterinary Sciences

animal welfare

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veterinary nursing

veterinary nutrition

veterinary pathology

other