

# Ph.D. Fellowship in Numerical Analysis of Electrochemical Systems



The Energy Systems Design Laboratory at the University of Alberta, Canada, is currently looking for motivated Ph.D. students to work on the development of our open-source polymer electrolyte fuel cell, electrolyzer and battery simulation framework. The finite-element based framework aims at modelling multi-scale, multi-phase mass and charge transport in electrochemical systems. Our research group has been developing the framework for over a decade (see [openfcst.mece.ualberta.ca](http://openfcst.mece.ualberta.ca)) and now we would like to extend our micro-scale and macro-scale fuel cell models to account for transient phenomena, such as start-up and degradation, to fluid flow in channels, as well as to continue extending the framework to other electrochemical systems, such as electrolyzers and batteries. You would be in charge of working in one of these areas in a team of at least four other developers. The Ph.D. students will have a fellowship for a minimum of four years with a basic stipend of \$25,000/yr to cover tuition and living expenses, which could be increased by securing a teaching assistantship position. Additional funding for conference travel and internships will also be provided. The starting date would be as early as January 2023, but it could be as late as September 2023.

The position is at the Energy Systems Design Laboratory in the Mechanical Engineering Department at the University of Alberta (one of the top five research intensive universities in Canada). For more information about the ESDLab please visit: <http://www.esdlab.mece.ualberta.ca>. Dr. Marc Secanell is the director of the laboratory and would be your primary supervisor. Dr. Secanell is 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 optimization. His laboratory has experimental equipment for validating all numerical models developed in OpenFCST. He has received over 3,500 citations, has an h-index of 34 (see <https://bit.ly/2NrH9zq>), has been invited to present at prestigious conferences such as the Electrochemical Society Meetings and the Gordon Research Conference in Fuel Cells, and is currently the co-chair of the 2022 Gordon Research Conference in Fuel Cells. ESDLab graduates and postdoctoral fellows who contributed to the OpenFCST framework were able to secure industry jobs at leading companies such as 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).

Applicants are expected to have the following qualifications:

## Basic qualifications

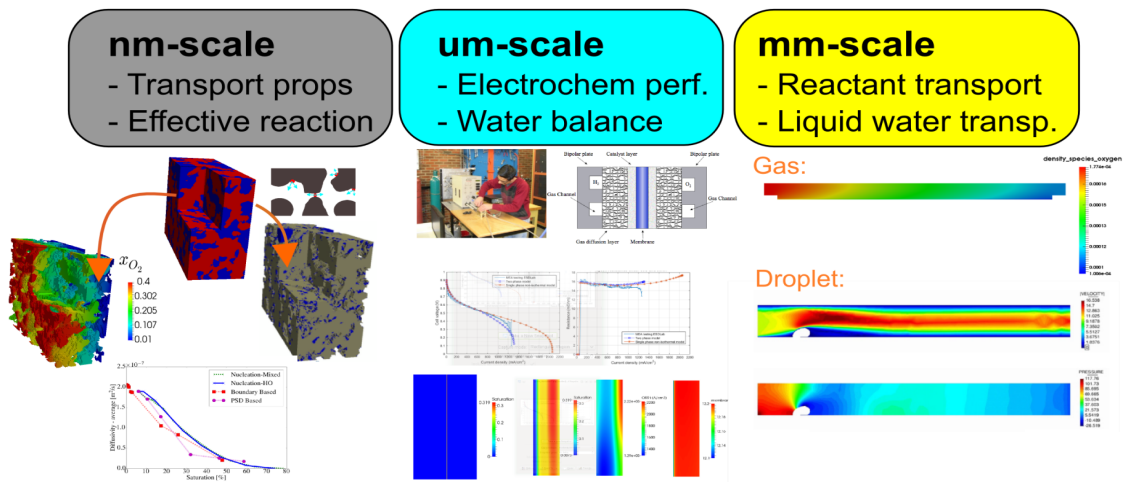
1. A B.Sc., M.Sc., or equivalent degree in Mechanical Engineering, Chemical Engineering, Applied Mathematics, or Applied Physics.
2. Programming experience in any language (C/C++, Python, Fortran, Matlab, or others).
3. Strong communication and teamwork skills.
4. Strong desire to learn mathematical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

## Preferred qualifications (these qualifications are a plus)

1. An M.Sc. degree or equivalent in the aforementioned fields.
2. Programming experience in an object-oriented language, preferably C++ and/or Python.
3. Experience in and understanding of numerical methods, in particular, the finite element method and its implementation in libraries such as [deal.ii](http://deal.ii.org).
4. Experience in and understanding of electrochemical systems.
5. At least one scientific journal or conference publication.

If you are interested, please email your detailed CV to [secanell@ualberta.ca](mailto:secanell@ualberta.ca) along with your most significant journal/conference publication if any. Qualified candidates will be contacted for an interview.

# OpenFCST: Fuel Cell Simulation Toolbox



## About the Energy Systems Design Laboratory

(<http://esdlab.mece.ualberta.ca>)

Founded in 2009, the ESDLab is a research team at the University of Alberta focused on the design of sustainable electrochemical energy systems. The laboratory has both a numerical and an experimental group. The numerical group is responsible for the development of OpenFCST, an open-source fuel cell, electrolyzer and battery simulation framework, and CoolIT, a wet cooling tower analysis software. The experimental group is responsible for the fabrication, characterization and testing of polymer electrolyte fuel cells and electrolyzers to provide validation data to the modeling team. Past ESDL graduates and trainees have secured highly competitive positions at Ballard Power Systems (Canada), Lawrence Berkeley National Laboratory (USA), Paul Scherrer Institute (Switzerland), General Motors (Canada), and Altair Engineering (Spain).

## About the University of Alberta

(<https://www.ualberta.ca/index.html> and <https://www.ualberta.ca/engineering/mechanical-engineering/index.html>)

Founded in 1908, University of Alberta is one of Canada's foremost research-intensive universities with an operating budget of over one billion dollars annually; external research funding is approximately \$500 million per year. The University has about 37,000 students at BSc, MSc, and PhD levels. The Faculty of Engineering is among the top 5% in size in North America with over 4,000 undergraduate and 1,500 graduate students. The Department of Mechanical Engineering has more than 750 undergraduate and over 250 graduate students. For more information see the Department of Mechanical Engineering website.

## About the City of Edmonton

(<https://www.edmonton.ca/>)

Edmonton's cost of living is favourable when compared with other major cities in Canada. The Edmonton River Valley is the largest urban park in Canada, with more than 160 kilometres of maintained pathways and 20 major parks. It is a paradise for running and cycling enthusiasts such as Dr. Secanell and many of his team members. The Greater Edmonton area has a population of over one million people and offers a diverse array of cultural and sporting activities year round, which has earned Edmonton the nickname of Festival City. Edmonton is an international city, as evident by over seventy cultures from all over the world that were represented in the recent annual Heritage Festival. Edmonton is only a few hours from the Rocky Mountains and Jasper and Banff National Parks, which offer some of the finest skiing, kayaking, cycling, hiking, and camping in the world. The University is located centrally on the banks of the North Saskatchewan River and a few minute walk away from River Valley and downtown Edmonton.