

CERC PI Seminar

Brian Wetton

Mathematics Department
University of British Columbia
`wetton@math.ubc.ca`

Modelling and Simulation Expertise at UBC

Analytic and Computational Techniques:

- Faster and cheaper than experiments.
- More information than limited measurements.
- Allows exploration of design space (optimization).
- (A model can be inaccurate but still give insight).

Institute of Applied Mathematics:

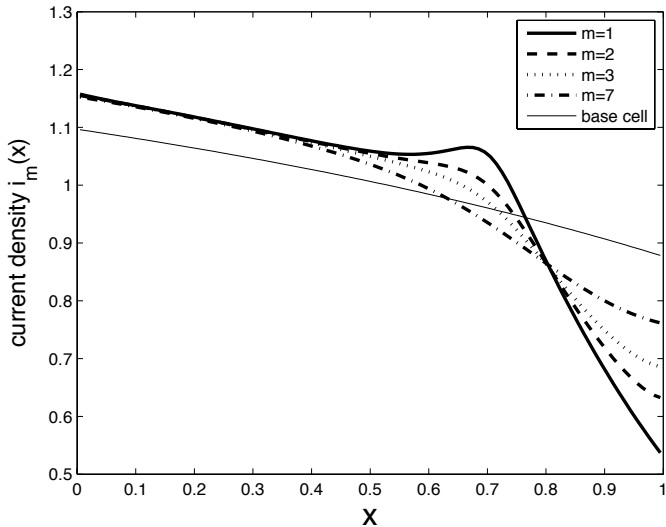
- Faculty participation from many departments.
- Interdisciplinary graduate program.

Fuel Cell Modelling with Ballard Power Systems

- MITACS project with Ballard Power Systems 1998-2010, developing computational simulation tools to aid design.
- Review articles:
 - “Reduced dimensional computational models of polymer electrolyte membrane fuel cell stacks,” JCP **223** (2007).
 - “PEM Fuel Cells: A Mathematical Overview,” SIAP **70** (2009).
- Our project involved multi-scale modelling of stack level fuel cell performance, based on experimentally-fit component models.

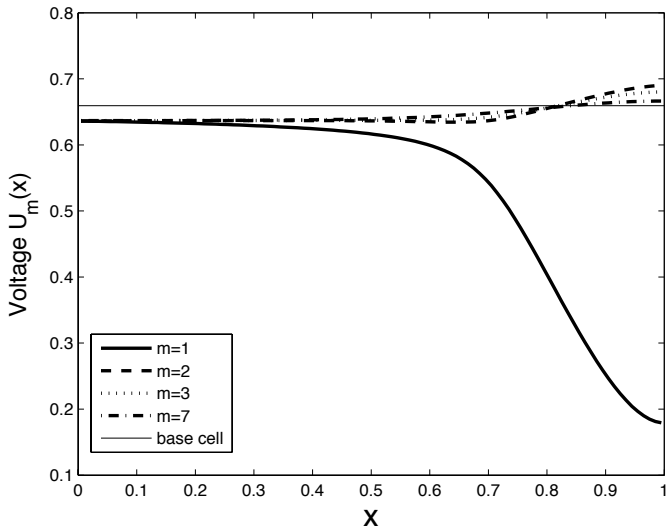
Stack Results I - current densities

Anomalous centre cell stack model

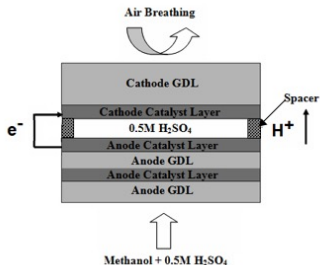


Stack Results II - voltages

Anomalous centre cell stack results



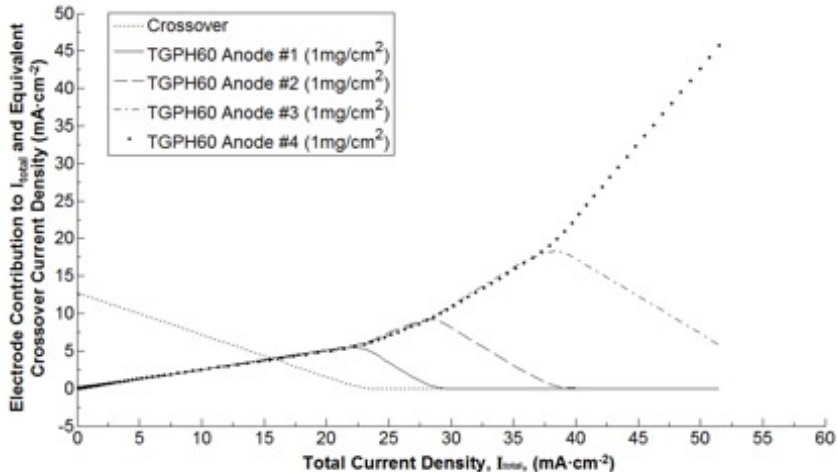
Direct Methanol Fuel Cell



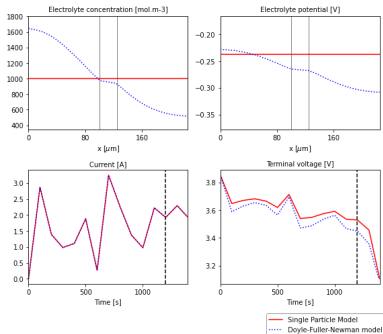
- Small, direct methanol test system.
- No membrane, multi-anode structure to reduce methanol crossover.
- Alfred Lam, BW, David Wilkinson, JES 158, B29-B35 (2011).

Direct Methanol Fuel Cell

Model results: four anodes



Machine Learning of Li-Ion Battery Models



- Electrochemical models needed for high C rate predictions.
- Too computationally intensive for real time BMS.
- Replace the PDE computation with a deep NN.
- Maricela Best-Mckay, Bhushan Gopaluni, BW, IFAC PapersOnLine 54-3 (2021) 97–102